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THE TRENDS OF AGRICULTURAL PRODUCTION AND OF POPULATION, WITH SPECIAL REFERENCE TO THE UNITED STATES

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NORTHWESTERN Europe, the United States and Canada appear to be approaching an era in the relationship of economic development to the progress of population for which there is no precedent. For the purpose of this discussion the history of these northern European peoples, both in their old and in their new homes, may be divided into two eras: (1) the era of tradition, when the knowledge of the arts was passed on from father to son with little change, and population fluctuated with wars, epidemics of disease and famines, but during which the trend was more or less stationary, except as it was altered by migration, and (2) the era of scientific progress, which in relation to agriculture did not begin much before the 18th century, and during which advances in the knowledge of nature and in the arts of utilizing natural resources have permitted a rapid increase in population as well as improvements in general welfare.

This era seems now to be drawing to a close, and there looms ahead a new era, in which science and the arts of exploiting the world's resources appear likely to continue to advance, while population in the occident becomes stationary, or indeed, unless the present trends in birth rates change, passes into a condition of decline.

At first blush such a prospect seems alluring, for increasing production and decreasing population clearly suggest increasing per capita consumption, that is, a higher standard of living per person. But further thought prompts one to ponder on this strange situation impending, so different from that existing during the past two hundred years, and consider some of its implications. It is of especial interest to us to examine these implications with reference to agriculture, but before doing so it will be helpful to notice the rapidity of population increase during the past two centuries and some of the causes of the even more rapid increase in agricultural production.

THE PROGRESS OF POPULATION SINCE 1700

The 18th and 19th centuries are unique in human history. During these two centuries the population of the world increased from about five hundred millions to about sixteen hundred millions, a gain twice greater than that in all the centuries since man appeared on the earth (figure 1). In Europe alone population

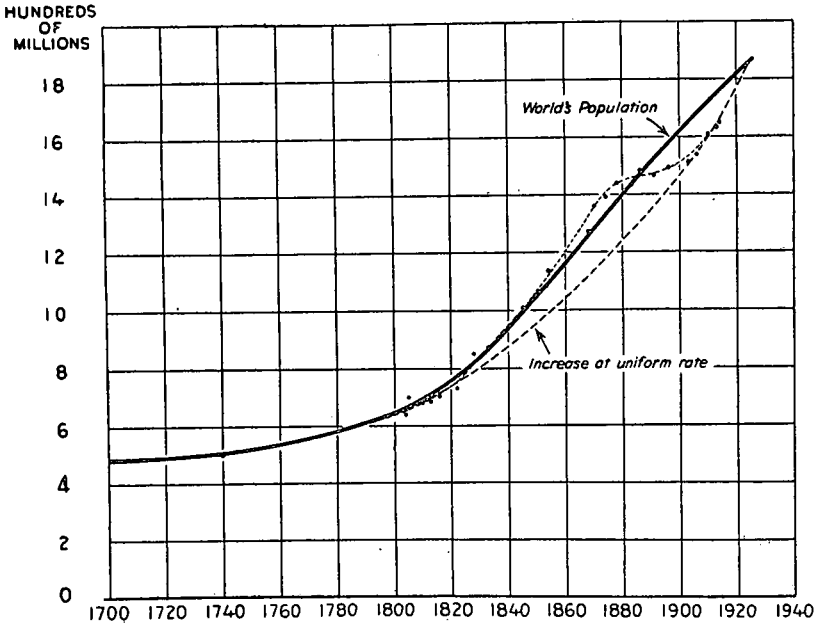

FIGURE 1. THE WORLD'S POPULATION, 1700-1924

The increase in the population of the world has been twice as great during the last centuries as in all the ages since man appeared on the earth. This increase has been made possible by the progress of science, which has enabled agriculture to expand onto the grass lands of the world, and has led to great increases in production per acre. The graph is based on G. H. Knibbs' "The Mathematical Theory of Population," in Report on Australian Census of 1911, Vol. 1, Appendix A, Bureau of Census and Statistics, Melbourne, 1916.

increased from approximately 100 millions to 400 millions; in the United States from five millions to over seventy-five millions, and in Canada from about 400 thousand to over five millions. Since 1900 the population of Europe, despite the devastations of fratricidal war, has increased to 500 millions, or 25 per cent, and the population of the United States and Canada from about 82 millions to approximately 132 millions, or 60 per cent.

THE PROGRESS OF AGRICULTURAL PRODUCTION

This increase in the populations of Europe and North America has been made possible largely by the expansion of agriculture onto the grasslands of the world, and by improvements in agricultural technique. The industrial revolution in western Europe and eastern North America was accompanied by an agricultural revolution in eastern Europe and western North America, which transformed the grasslands into grainlands and provided bread and meat for the people in the rapidly growing industrial areas bordering the Atlantic.

When Malthus wrote his famous essay a century and a quarter ago predicting that in the occidental world, as in the oriental, population would soon press upon the food supply and that it would be limited by war, famine and pestilence, only a small part of the vast steppes of southern Russia had been broken for wheat, the Hungarian plain was still mostly a verdant pasture, divided into the estates of nobles and cattle kings, the prairies and plains of central and western North America had not yet been crossed by white men, except by a few fur traders, the pampas of Argentina were an unexplored wilderness, and only a fringe of land along the coast of Australia had been explored. The lack of wood and water, apparently, had prevented the utilization of these lands for agriculture. But during the 19th century the invention of well drilling appliances gave water to the almost streamless plains, grain harvesting machinery enabled one man to do the work of five, releasing the other four for labor in urban industries, while the railroads brought wood and coal to the settlers and provided cheap and rapid transportation to market for their grain and other products. During the 19th century the arable area in Europe probably doubled, and in North America increased fully twenty-fold.

Likewise great increases took place in production per acre. During the Middle Ages, and probably as late as the 16th century, wheat yields per acre in England and much of the Continent probably did not exceed ten bushels. With the introduction of root crops in the place of the fallow in the three-field system, not only was the productive area increased by 30 or 40 per cent, but also feed was provided for more livestock, and these produced more manure. About the same time, or a little later, the use of clover increased greatly and this crop added both humus and nitrogen to the soil.

By the year 1800 the yield of wheat in England had increased to twenty bushels per acre according to Arthur Young—probably a slight overstatement—and about 1880, the average yield reached twenty bushels per acre in Germany. Meanwhile the science of chemistry developed, and Liebig in Germany, and Lawes and Gilbert in England demonstrated the great value of mineral fertilizers. By 1880 wheat yields reached 30 bushels per acre in England, but not until after 1900 did they reach this figure in Germany. During the thirty years preceding the World War wheat yields per acre in the United States increased over twenty-five per cent, corn yields nearly ten per cent, oat yields over twenty per cent and potato yields over thirty per cent. The productivity of farm animals was also greatly improved, both in Europe and North America, resulting not only in a larger product per unit of feed consumed, but also in a better quality of product. The yearly production of milk per cow in the United States has increased from probably 2,000 pounds a year, 100 years ago, to 5,000 pounds a year, at the present time, and it is doubtful if the consumption of feed per cow has doubled.

Not only did these factors of the expansion of agriculture onto the grasslands of the world, and of increasing production per acre and per animal on the formerly forested lands of Europe and North America, permit the population of Europe to double in the 19th century, and the population of North America—excluding Mexico—to increase over sixteen-fold, but they also permitted the diet to become more varied and expensive. The available figures indicate that the consumption of meat per capita in France nearly doubled during the latter half of the 19th century, and that this is probably also true of England. In Germany, the per capita consumption of meat apparently increased fully three-fold during the 19th century. Meat, both in price and in area of land required in production, is the most expensive of all the major foodstuffs.

The expansion of agriculture onto the grasslands of the temperate zones is now approaching the close, except in the U.S.S.R. (Russia) and China, but the increasing production per acre and per unit of feed consumed by farm animals is continuing, and appears to possess great opportunities for further increase in most parts of the world. The question is as to whether advances in agricultural technique will continue adequate to main-

tain, if not improve, the present standards of consumption of food and fibres in Europe and North America, and if so as to whether or not the present agricultural surplus is likely to persist. We have only just started to study the question in the United States, and I hesitate to present to you the preliminary result for one country only, but as Great Britain, and to a less extent Germany and Scandinavia, are partially dependent upon the United States for food and fibres, and as the trend of production in the United States is probably different from that in most European countries only in degree, it has occurred to me that it may be helpful to our European friends in appraising the problem of probable trends of agricultural development in their respective countries, to learn a little of the trends in the United States. These trends are also true of Canada in a general way.

THE TREND OF AGRICULTURAL PRODUCTION AND CONSUMPTION SINCE 1900

The decade since the war has been the most extraordinary period in American agricultural history. To understand the remarkable changes that have occurred, it is necessary to go back and study the changes since 1900, at least. During the past two years our Division of Land Economics has been compiling estimates of production and consumption of agricultural products, dividing each crop into the portion, if any, used for human food, that used for livestock feed, and that used for other purposes—principally industrial —such as cotton lint and flaxseed oil. The portion of the crop used for human food, plus the portion used for industrial purposes, plus animal products, constitutes the index of agricultural production, the various commodities being combined on the basis of the average farm price during the decade 1917-1926. Production during the five-year period 1897-1901 is considered the base, represented by 100 per cent. This permits bringing the several curves to a common denominator for comparison. May I note that this base period was a period of low prices and large production—not only the largest total production up to that time, almost certainly, but probably also the largest per capita production. May I note also that the figures are preliminary and have not yet had the benefit of criticisms by other divisions of the Bureau. They are therefore as yet unofficial.

Comparing total agricultural production with population, it will be found that production per capita was fairly well maintained until 1906. In 1907 a drop occurred, with only a slight recovery in 1908, and with a further drop in 1909 (figure 2). In this year production per person was over ten per cent below that at the beginning of the century, and it remained below by about this per-

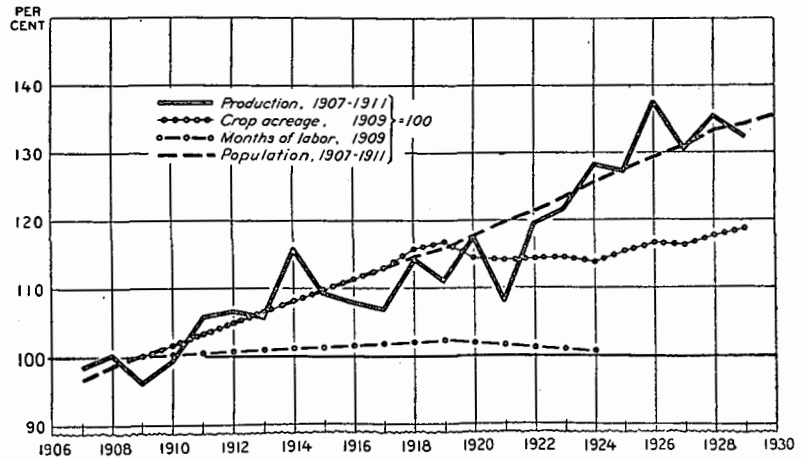

FIGURE 2. PERCENTAGE CHANGE IN POPULATION, AGRICULTURAL PRODUCTION, CROP LAND, AND FARM LABOR, 1907-1929

The estimated amount of labor employed for agricultural production in the United States has increased much less rapidly than has the quantity of products, and since 1919 the acreage of crop land has increased less rapidly than production. There was a decline in the ratio of production to population from 1907 to 1909 which was not regained until after the war. Although production kept pace with population from 1910 to 1920, it was at a much lower level. In 1926 the per capita production again reached the level at the beginning of the century, but since that time there has been a slight decline. (From "Land Utilization and the Farm Problem")

centage in most years until 1922. Only in 1914 did production per capita, for one year, rise to the 1897-1901 level. The years 1909-1913 were characterized by complaint of the high cost of living, and in several years of this period the value of imports of agricultural commodities almost equalled the value of exports.

It should be noted that production during the period 1911 to 1914 owed its increase principally to large cotton crops, and in 1912 and 1914 to large wheat crops also, but that animal products, which constitute probably two-thirds of the sales of all food products in the United States, remained steady from 1909 to 1920

at about 10 per cent below the per capita production at the beginning of the century. In other words, the decline in the ratio of production to population which occurred from 1907 to 1909 was not regained until long after the war. Although production kept pace with population growth from 1910 to 1920, it was at a lower level than in the previous decade.

The crops of 1921 were extraordinarily poor, particularly the cotton crop, and prices of agricultural products were extraordinarily low compared with prices of other commodities. In certain Corn Belt States the farmer's net income in that year, according to the estimates of Dr. King of the National Bureau of Economic Research, was only 15 to 25 per cent of the income in 1919.

Then came the most extraordinary period in American history from the standpoint of agricultural production. Every year from 1922 to 1926 production increased over the preceding year, and in 1926 per capita production again reached the level at the beginning of the century. Comparing the average of the five-year period 1922-1926 with that of the period 1917-1921, agricultural production increased, apparently, about 14 per cent, whereas the population of the nation increased only about 8 per cent. More remarkable, was the fact that this rapid increase in production—greater than at any time since 1900, and probably since 1890 when the exploitation of the prairies drew to a close—took place despite a slight decrease in crop acreage harvested, a practically stationary acreage of pasture, a notable decline in the number of livestock, and a six per cent decline in farm population.

Before analyzing this increase more closely, and considering some of the means by which it was obtained, let us note that agricultural production in 1927 declined slightly, owing principally to a much reduced cotton crop, in turn largely ascribable to the Mississippi floods. In 1928 production recovered but was slightly lower than in 1926, owing again, largely to a small cotton crop. In 1929 production has again been low, owing to unusually widespread adversity of weather conditions. There is, therefore, a suggestion that this period of rapid increase in agricultural production is drawing to a close, but as the depressed production during these two years is owing principally to accidents of nature, it is impossible to say, without further data, whether this tapering off of the rapid increase of production is transitory or permanent.

CHANGES IN PRODUCTION AND CONSUMPTION OF AGRICULTURAL PRODUCTS

It may throw some light on this question of the permanency of the upward trend of production to consider the changes during the past 30 years in the production and consumption of the major agricultural commodities.

PLANT FOODSTUFFS

The consumption of corn for human food has probably fallen to about 60 per cent of the level at the beginning of the century. Since population has increased 60 per cent since 1900, it appears that the per capita consumption of corn for human food has fallen to about 40 per cent of that at the beginning of the century. Nearly half of this decline took place at the close of the war when the restriction on consumption of wheat flour was rescinded, and the improved economic condition of both negroes and poor whites in the South, as well as of many people in the North, permitted them to use wheat flour more extensively than before.

The production of rye increased greatly during the war, and even yet compares fairly well with the increase of population. However, the exports have increased more rapidly than the production, so that the per capita consumption has fallen almost as greatly as that of corn, standing now at about 45 per cent of the level of thirty years ago.

Buckwheat, oats and barley are of so little importance in the American diet that they are grouped together. The joint production for food increased until 1914, then declined until 1923, and is now about what it was thirty years ago, but per capita consumption is only about one-third of what it was at the beginning of the century. Owing to the prohibition movement, the per capita consumption of barley for human food is only one-fourth as great as thirty years ago, or even fifteen years ago.

Much more important in the diet than any of these crops is wheat flour. Production remained more or less steady until the war years, but for the last decade has averaged nearly twenty per cent above the level at the beginning of the century. Meanwhile population has increased sixty per cent, and exports average as great as thirty years ago. Per capita consumption, therefore, is only about three-fourths as great. Most of this decline occurred between 1917 and 1921 (figure 3).

It is clear, therefore, that a great decrease in the per capita consumption of the cereals has occurred, especially since the war. Since the cereals at the close of the war contributed over 40 per cent of the calories in the American diet, the question arises as to what has taken their place.

The production of sugar has increased over threefold in the past thirty years and consumption per capita has increased between 60

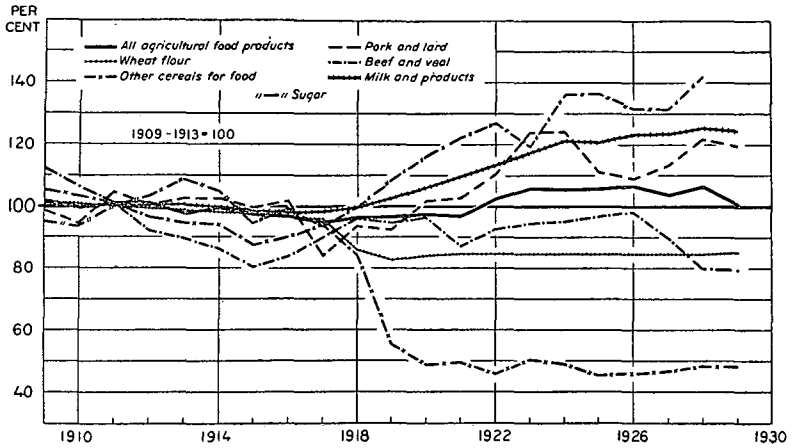

FIGURE 3. CHANGES IN THE TOTAL CONSUMPTION OF FOOD PRODUCTS PER PERSON IN THE UNITED STATES, AND CHANGES IN THE CONSUMPTION PER PERSON, OF SIX PRINCIPAL PRODUCTS, 1909-1929.

There has been a decline since the war years of about 100 pounds per person in the consumption of cereal foods, and an increase of about 27 pounds per person in the consumption of sugar, and almost as great an increase proportionately in the consumption of milk and its products. The per capita consumption of pork has also increased, while the per capita consumption of beef has declined. The period used as a base for this graph is 1909-1913 instead of 1898-1902 referred to in the text. (From "Land Utilization and the Farm Problem")

and 70 per cent. However, since the continental United States now produces only about one-fifth of the sugar it consumes, it is clear that imports have also increased rapidly. Comparing the five-year period 1923-1927 with the base period 1898-1902, the per capita consumption of the cereal foodstuffs decreased from about 370 pounds to 230 pounds, or 140 pounds, while the consumption of sugar increased from about 68 pounds to 109 pounds, or about 40 pounds. There remains, therefore, about 100 pounds of cereals to account for, if no change has occurred in the number of calories in the diet.

Potatoes, other vegetables, and fruits are minor foodstuffs in the

American diet, measured in calories, contributing only about eight per cent of the total. The changes that have occurred in the per capita consumption of these foods, notably the increase in the use of vegetables, are wholly inadequate to balance the decline in the consumption of cereals.

It is significant to note in passing that the greatest decrease has occurred in the consumption of the cheapest cereals, notably of corn, that the decrease in consumption of wheat has been much less, and that the more expensive plant foodstuffs—the fruits and vegetables—have maintained their place in the diet. Indeed the consumption of the citrus fruits, grapes, and of several vegetables, has increased notably. Sugar, however, is a cheap food—it is much the same price as flour and cheaper than bread. Americans like sugar; the per capita consumption has increased tenfold during the last century.

ANIMAL FOODSTUFFS

The animal foodstuffs are the most expensive major constituents in the American diet. Normally, the most expensive of the animal foodstuffs are beef and veal. The total production of beef and veal, after allowance is made for the well-defined cycle, is about the same as at the beginning of the century. Although population has increased 60 per cent meanwhile, consumption per capita averaged almost as high during the years 1922-1926 as it had thirty years before. The explanation lies in a great depletion of the breeding stock, and it is clear that the rapid decline in per capita consumption during the past two years will continue for several years more. It seems doubtful, moreover, since the population of the nation will doubtless increase for a couple of decades, that the post-war consumption per capita will ever be regained. Nothing to balance the decline in cereal foods can be found in the trend of consumption of beef and veal.

The changes in consumption of mutton and lamb are even less able to balance the decline in cereal foodstuffs. Although production is now about 50 per cent higher than thirty years ago, the increase in population has been even greater. Likewise, with chickens and eggs, production has increased greatly, but population even more. However, the increase in both the production and consumption of mutton and lamb and of poultry and eggs since 1920 has been greater than the increase of population, and these products

are now rapidly approaching the per capita production and consumption of thirty years ago.

The production of pork and lard did not fall so far behind the increase of population as did the production of the animal products just mentioned. However, the index of production from 1908 to 1917 was continuously below the index of population, and not until 1922 and 1923 did the index of production rise well above the index of population. After a fall in 1924 and 1925, the per capita production of pork and lard—1926 and 1927—was practically at the level of thirty years ago, but because of decreased exports of pork the per capita consumption was over ten per cent greater.

An even more significant increase has taken place in the production and consumption of milk. It has been difficult to construct an index of milk production, but it is our belief that these estimates, compiled by the Dairy and Poultry Division of the Bureau, and based largely on the Census of Manufactures, reports on farm consumption from crop reporters of the Bureau of Agricultural Economics, and reports from boards of health in 250 to 300 cities, are reasonably comparable through the series of years. These indicate that from 1900 to 1915 the production of milk failed to keep pace with the progress of population. The upward trend started in 1915, and was under full swing by 1918. In 1920 the per capita consumption of milk and dairy products (reduced to a milk basis) equalled that at the beginning of the century, and by 1928 was apparently 17 per cent greater than 30 years ago, and 23 per cent greater than in the period of 1910-1915. Part of this increase in milk consumption may be due to the health campaigns, part to the extension of prohibition, which became nation-wide in 1918, and part to the better quality of the milk, but whatever the cause it has resulted in a very significant change in the American diet, and has probably been the principal reason why many parts of the hay and dairying regions have scarcely felt the agricultural depression. In the thirteen years between 1915 and 1928 the total production of milk in the United States apparently increased 50 per cent. The production of no other major commodity has increased at such a rate, nor has the increase of any other commodity been so steady.

The increased per capita consumption of milk and dairy products and of pork and lard are not quite sufficient—after allowance is

made for the lesser consumption, as compared with 30 years ago, of beef and veal and of mutton and lamb—to balance in calories the decreased consumption of cereal foods. There has been a notable increase in the consumption of vegetable oils, and, as previously noted, some increase in the consumption of vegetables, but it is very doubtful if after these changes are taken into consideration the American diet contains as many calories as it did at the beginning of the century. Our index of production and consumption is not completed, and we have not made the conversion as yet into calories, but apparently the conclusion of the Food Research Institute at Stanford University that there has been a reduction in the calories of food consumed by the average American is correct. This is to be expected in view of the extensive substitution which has occurred of mechanical for human power.

However, the present diet is more expensive in terms of land required than the diet of thirty years ago. It requires about seven pounds of corn (maize) to produce a pound of dressed pork, and 12 to 16 pounds of grain to produce a pound of dressed beef, and although the pound of pork contains more, the pound of beef contains fewer calories, than a pound of corn. The great economy of a vegetarian diet with reference to land required is illustrated by the fact that two acres of crops are required to feed the average American, besides many acres of pasture, but only one acre of crops is required to feed the average German, one-half acre to feed a Chinese, and one-fourth acre to feed a Japanese. This is owing largely to the difference in diet, except that the difference between China and Japan is owing to much higher crop yields in Japan.

The decrease in the United States since the war years in the consumption of cereal food per person—principally wheat flour and cornmeal—has reduced the area of these crops needed to feed a person by about one-twelfth of an acre, while the increase in consumption of milk, vegetables, fruits, and of meat has increased the area needed per person to produce these products by a quarter of an acre. Nearly all the increase in sugar consumption has come from Cuba, Porto Rico, Hawaii, and the Philippines, so it has not been included in the estimate. The net result, therefore, of this change in diet should be an increase in cropland needed to feed each person of about one-sixth of an acre, which for 120,000,000 people amounts to 20,000,000 acres. Meanwhile, the population

of the United States has increased from 100 million to over 120 million, which, after allowing for the change in diet, indicates that about 46 million acres more cropland would have been needed to feed our people than before the war, provided no changes occurred in production per acre. But the fact is that there are only about six million more acres of crops used to produce the nation's food than were used during the war. Indeed, after the war the acreage of crops actually declined until 1924, and is now only about as large as it was in 1919. In 1924, about 25,000,000 acres of plow land lay idle.

The increasing importance of animal products in the American diet, especially since the war, made possible by the greatly increased income of the urban population, has tended to alleviate the agricultural depression. Without this change in diet the surplus would have been much greater. But the declining per capita production and consumption of beef during the past few years, and the possibility that the domestic per capita consumption of pork and lard, as well as the exports, can be maintained only with difficulty, suggest that the future trends in diet may not be so favorable to agriculture as in the past. However, the per capita consumption of sugar, most of which is imported from Cuba and the Insular Possessions, appears to have reached a maximum.

A diminution in the prosperity of people in the commercial and industrial occupations, which would be likely to cause a decreased consumption of animal and an increased consumption of vegetable foodstuffs, might have a serious effect upon the agricultural situation. It is possible that increasing efficiency in manufacturing may have a similar effect. Not only the number of farmers, but also the number of persons engaged in manufacturing in the United States is decreasing. These two groups include a large proportion of the population, and it is difficult for the other occupations to absorb the surplus. If this labor surplus should increase materially, it would have an effect upon the agricultural situation. The prospect for an increase in the per capita consumption of farm products which require a large area of land for their production is none too promising.

It appears desirable, therefore, to examine the factors which have effected the increase of production in the past, particularly from the viewpoint of the probable duration of their influence in the future.

MAJOR CAUSES OF THE RECENT INCREASE IN PRODUCTION

Prior to the World War the two principal means of increasing agricultural production were, as already noted, by increasing the area in crops and by increasing the crop yield per acre. These might be called the horizontal and the perpendicular methods, and they were of such major importance that other means of increasing production were commonly unrecognized. But during and since the war a new factor, the gas motor, has developed into a dominant influence and several formerly minor factors have become of major importance.

1. The automobile and tractor have caused a reduction of 7,000,000 in the number of horses and mules in the United States, and thereby released from 20,000,000 to 25,000,000 acres of cropland, which has been used mostly to feed meat and milk animals. This is eight to ten per cent of the total crop acreage, excluding that used to feed horses and mules. In addition, the tractor and automobile have exerted very important indirect effects.

The cropland released has been almost wholly in the North and West, and the resulting increase in cheap feed has made competition in meat production in the South, where feed is more expensive, increasingly difficult. There has been a decrease of 40 per cent in the number of hogs in the South since the World War and a decrease of 25 per cent in the number of beef cattle. Meat animals in the South are, in general, of poorer quality than in the North and less efficient in transforming crop feed into human food. As a consequence of this geographic shift in the production of pork and beef there has been an additional increase in meat production per acre of farm land which is indirectly attributable to the tractor and automobile.

The mechanization of agriculture has also promoted an expansion of grain production onto the semi-arid portion of the Great Plains, because, in general, the more acres a farmer can handle the drier the land he can use profitably for crops. The tendency, therefore, has been to maintain the war surplus of wheat and other grains that must find an export market.

2. There has been a great improvement in the amount of meat and milk produced per unit of feed consumed, entirely aside from that caused by the shift in production from the South to the North and West. For instance, the average yearly production of milk per cow has increased by about 1,000 pounds since the war, in the

North and West. This represents an increase of approximately 25 per cent in production, according to the Census, whereas it appears that the amount of feed consumed per cow has not increased by much over 15 per cent (figure 4). There has been a similar increase in the production of pork and lard per unit of feed consumed (figure 5). This increasing efficiency of farm animals in the use of feed has probably increased net production almost as much as the use of the tractor and automobile.

3. Agricultural production has been increased by shifts from the less productive classes of animals per unit of feed consumed to the more productive classes—notably from beef cattle to dairy cattle and hogs (figures 4 and 5). One acre of crops used to feed dairy cows or hogs yields as much human food, measured in calories, as four or five acres used to feed beef cattle.

4. There has been a shift from the less productive crops per acre toward the more productive, notably from corn toward cotton in the South, from wheat toward corn in the Central States, especially in the years immediately following the war, and from grain and hay crops toward fruits and vegetables, particularly in California. The average acre of cotton is worth a half more than an acre of corn, and an acre of corn about one-seventh more than an acre of wheat, while an acre of fruit or truck is normally worth many times as much as an acre of grain or hay.

5. There has been a little increase in the yield per acre of many of the crops. Since the war this has been a less important factor in increasing production than previously, doubtless because the low prices of farm products have not justified heavy expenditures for fertilizer.

6. There has been an increase in crop acreage in parts of the Great Plains region, but this has been more than balanced by the decline in crop acreage in the originally forested lands of the eastern United States.

The prospect is that at least three of these six factors which have contributed to the recent rapid increase in agricultural production will continue to be effective for several decades. As there are less than half enough colts on farms to replace the horses and mules that die annually, it is certain that the substitution of tractors for horses and mules must continue for several years, and it may continue into the period when the decline in the rate of population increase will be appreciable. Likewise, improvement in the pro-

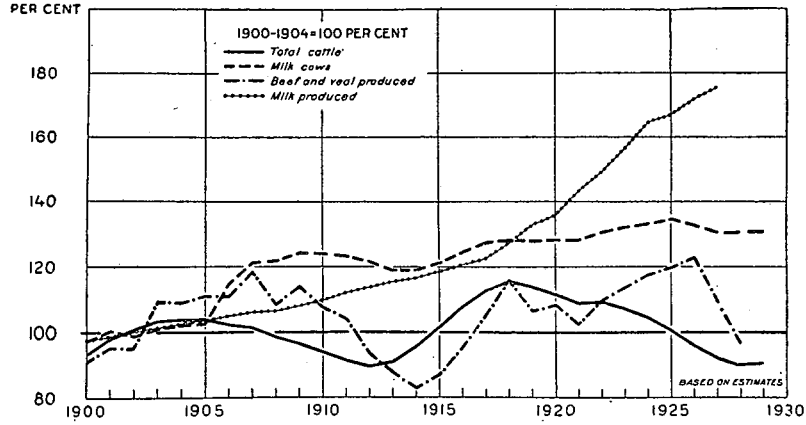

FIGURE 4. CATTLE AND MILK COWS ON FARMS JANUARY 1, COMPARED WITH PRODUCTION OF BEEF AND VEAL, AND OF MILK, 1900-1929

Two cycles in number of cattle and in production of beef are incompletely shown. The first cycle in number of animals began probably about 1896 and ended in 1912; the second cycle probably is just over. The first cycle of beef production began about 1898 and ended in 1914; the second cycle probably has a year yet to run. In milk production, there is no cycle, but, instead, a constantly rising production, which since 1918 has been increasing much more rapidly than milk cows.

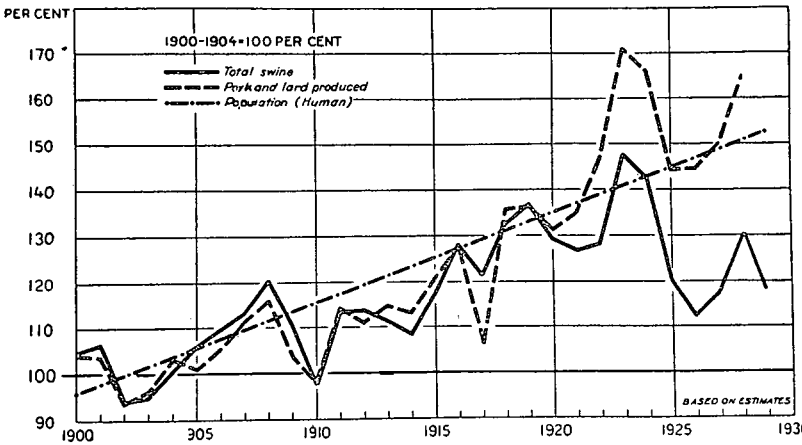

FIGURE 5. SWINE ON FARMS JANUARY 1, COMPARED WITH PORK AND LARD PRODUCED, AND POPULATION, 1900-1929

The production of pork and lard shows no deviation in trend from the number of hogs on farms from 1900 to 1920, that is, production per head on farms January 1 remained practically constant. Then the two lines began to diverge, and by 1923 production of pork and lard per hog on farms was 18 per cent greater than in 1920, and by 1926 it was 28 per cent greater. The production of pork and lard per person during the past decade averaged more than it did 25 years ago.

duction of milk and meat per unit of feed consumed probably will continue for many years, while it seems likely that the use of fertilizer will increase with any rise in the prices of farm products. Indeed, it is profitable to use more fertilizer even at present prices of products. Crop yields, therefore, are likely to increase, but only slowly, in the next few years.

Moreover, it is probable that new factors tending to increase agricultural production will rise to importance in the future as they have in the past. Every discovery in agricultural chemistry or biology, every invention in the field of agricultural machinery or the utilization of waste products, every improvement in agricultural practice tends to increase production; and the prospect is that with the Federal Department of Agriculture and 48 state experiment stations, and in addition all the private industries serving the farmers of the United States, constantly pursuing research for the promotion of agriculture, that production will increase as rapidly in the near future as in the past. The point of diminishing returns is not fixed, but recedes with every improvement in agricultural technique.

Under these conditions, and after a decade of over-production of most agricultural commodities, the nation enters an era of diminishing increase of population, with the prospect of a stationary, possibly declining, population a few decades hence.

THE POPULATION PROSPECT

The birth rate in the United States is decreasing so rapidly that despite the increasing population the total number of children born annually is now declining, according to the Census. Although the rural birth rate is higher than the urban, the decline is occurring at about the same rate in rural as in urban territory (figure 6). This decreasing number of children is reflected in the enrollment in the primary grades of the public schools. The number of children in the first grade has been decreasing since 1918, except for a stationary condition from 1922 to 1924 and a rise in 1927 which reflected the transitory increase of births in 1921. This decrease in children in the first grade may be owing in part to greater effort to prevent stagnation in this grade. However, the number of children in the second grade of the public schools has been declining since 1922, and in the third grade since 1924. The

more rapid decrease in the birth rate since 1924 is not yet reflected in the school enrollment figures.

It is clear that a decreasing number of children will mean a decreasing population a generation hence, unless the decrease be balanced by immigration, or the duration of life increases. The net immigration at present averages about 250,000 a year, whereas the decrease in number of births averages about 50,000 a year.

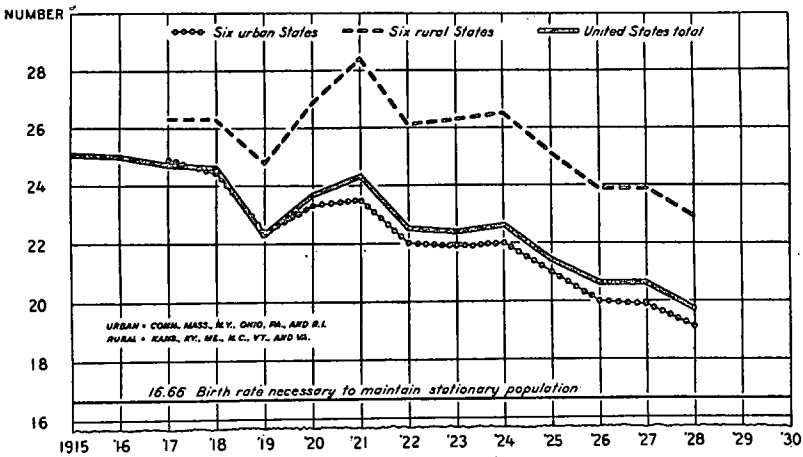

FIGURE 6. BIRTH RATE PER 1,000 POPULATION, REGISTRATION AREA OF UNITED STATES, 1915-1928, AND SIX URBAN AND SIX RURAL STATES, 1917-1928

The birth rate in the United States has decreased rapidly since 1921. (The drop in 1919 was owing largely to the influenza epidemic in 1918 and war-time conditions.) If the decline from 1921 to 1928 should continue for another seven years, it would fall below that necessary to maintain a stationary population, even with the present immigration. Note that although the birth rate in the rural states is higher than in the urban states, it is declining at about the same rate.

Five years hence, therefore, if the present downward trend in births continues, and the immigration laws are not altered, the flow of people, so to speak, into the nation, including immigrants, will be no larger than the number of births today. The number of births today is only sufficient to maintain a stationary population of about 140,000,000, having the present average age at death of 59 years. Although this average age at death may increase slightly, it appears unlikely that the United States will ever have over 160,000,000 people, unless the number of births or of immigrants increases. This is a third greater than the population at present.

The slackening in population growth will occur very slowly. The 1930 census will reveal, probably, a population of about 122,000,000, which would give an increase of over 15,000,000 since 1920. This will be a larger increase than has occurred during any decade in the past, except 1900-1910. In the decade 1930-1940 the increase in population may be not much over 11,000,000, and from 1940 to 1950 it will still be less. It is unlikely that the stationary condition will be reached before 1960, and whether population will afterward decline is dependent not only on the birth rate but also on immigration policy.

THE AGRICULTURAL SIGNIFICANCE OF THE POPULATION PROSPECT

A stationary population in the United States would have serious consequences for the American farmer, whose production has increased fully fifty per cent in the last thirty years and over twenty per cent in the last ten years, and which probably would double if prices of farm products should rise to and remain at the war-time peak. A declining population would be a calamity, if present conditions of production persisted and larger markets were not found abroad. Farm land values probably would decrease almost everywhere, farms would be abandoned more extensively than at present, taxes on the remaining land in the less fertile farming areas would rise and force the abandonment of still more farms, the maintenance of schools and roads would become increasingly difficult in these localities, the young people would flock from the farms to the cities even more rapidly than they are doing today, and forest or bush would creep down the mountains and slowly occupy many of the valleys—in brief, the present tendency to concentrate production on the more fertile or favorably located land would be accentuated.

Moreover, the rapid movement of many young people from the farms to the cities would tend to aggravate the population trend, because urban birth rates are, and doubtless will remain, lower than rural birth rates. One of the causes of the rapid decline in the birth rate since the war has been the greater movement of young people from farm to city than ever before. The farm population of the United States has decreased about ten per cent in the last ten years, and the loss has been principally of young and middle aged people.

THE NEED FOR A NATIONAL AGRICULTURAL POLICY

Population during the last ten years has increased about 1.4 per cent a year but the rate of increase is diminishing; agricultural production during the last decade has increased, on the average, over 2 per cent a year. Faced with this prospect of continued pressure of production on population, there appear to be five things which might be done to improve the agricultural outlook.

1. An educational campaign might be inaugurated for the purpose of increasing the birth rate. But as it costs at least an eighth of the average man's salary to care for and educate a child, it is obvious that to have three children, which is the average number per fertile family required to maintain even a stationary population, would mean a lower standard of living than if only one or two children were born. A lower standard of living is one of the things which people are most reluctant to accept.

A man's earning power does not increase in proportion to the number of his children, indeed, if there be no children it is often possible for the wife to work and augment the income. Our system of urban economic individualism is approaching a crucial test, and it appears probable that owing to increasing knowledge of birth control and decreasing respect for religious beliefs some modification of the present system will soon be indicated. Whether government aid in the care of children, such as has already been extended in provision for free education, will be effective, only the future can reveal.

2. The immigration quota might be increased. Although such an increase probably would result in increased immigration from most countries, owing to the higher wages in the United States than elsewhere, it might not obtain sufficient immigration twenty or thirty years hence from northern Europe to balance the upward tendency in agricultural production in the United States, because by that time population in northern Europe is likely to be stationary or declining.[1] Should it become necessary to depend in part on southern Europe or Asia for immigration, a modification of the immigration law very likely would meet not only with opposition from organized labor but also from many people interested in maintaining a Teutonic majority in the United States.

[1] Kuczinski, Robt. R. "The Balance of Births and Deaths, Vol. 1, Northern and Western Europe." The Brookings Institution Investigations, published by Macmillan Company, 1929.

3. If no way of increasing population should prove feasible, it might be possible to increase consumption of agricultural products per person. This object could be achieved by inducing the people to eat less cereal foods and more meat, especially beef. But such a shift has already taken place, as already noted, and may have progressed as far as is desirable from the standpoint of health, in view of the increasing proportion of the population engaged in sedentary occupations, while from the economic standpoint the prospect is none too promising. The productive powers of agriculture in the United States are beyond the consumptive powers of the people, and appear likely to remain so. Let us consider, therefore the fourth way of meeting the situation, namely, by a policy that will increase exports.

4. The trend of agricultural exports from the United States has remained approximately constant, with reference to the acreage of land required to produce them, during the last thirty years. The exports of wheat and cotton are as large or larger than twenty-five to thirty years ago, but the exports of animal products, except lard, have tended downward since the war, and the imports of beef and of dairy products now slightly exceed the exports (figure 7). There is a tendency, moreover, for the exports to Asia to increase, and for exports to Europe to remain constant. This tendency seems likely to persist, because the birth rate in all the countries of northwestern Europe has declined so rapidly since the war that it is scarcely sufficient to maintain a stationary population a generation hence. In England, Germany and Sweden not enough daughters are being born to replace the mothers of the present day.

On the other hand, agricultural production in northwestern Europe, as in the United States, is increasing, apparently, more rapidly than population. Russian grain also promises to come back into the world picture. A letter recently received from a friend who spent last season in the U.S.S.R. expresses the opinion that in three or four years Russia will be exporting 150,000,000 to 200,000,000 bushels of wheat. In view of these trends of population and agricultural production it appears unlikely that any great increase in demand for American agricultural products by northwestern Europe, where most of our agricultural exports have gone heretofore, can be expected—unless a notable shift in diet from cereals to meat and other more expensive foods should occur. In southern Europe the birth rate is still high and the people might

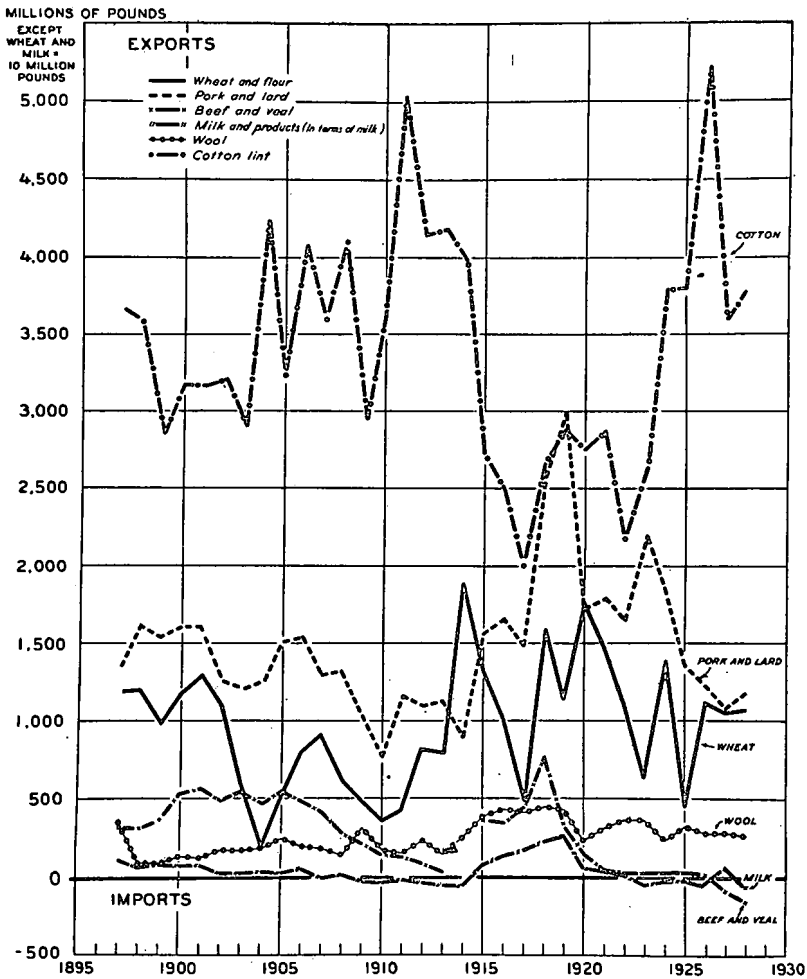

FIGURE 7. NET EXPORTS OR IMPORTS OF SIX MAJOR AGRICULTURAL PRODUCTS, 1897-1928

The area of crops required to produce the agricultural exports of the United States has remained almost constant for a quarter century. The exports of cotton are greater than at the beginning of the twentieth century, and the exports of pork products and of wheat were greater until recently. On the other hand, the exports of beef and of dairy products are now smaller than the imports. The curve representing wool should be below the 100 per cent line, as imports throughout the period have exceeded exports.

well use more agricultural products, but owing to limited natural resources it will be difficult for these nations to develop the necessary purchasing power. However, if American tourists and American capital continue to flow to Europe in increasing numbers and quantities it may enable even southern Europe to purchase enough farm products to materially improve our agricultural situation.

Although the immediate prospect for a notable increase of agricultural exports to Europe is rather gray, if we turn and look to the Orient, there can be seen in the dim distance rays of sunshine breaking through the clouds. In Asia there are twice as many people as in Europe. The birth rate is high and the few available statistics indicate no tendency toward decline, except a suggestion of such in the last three or four years in Japan. For fifty years, despite the progress of industrialization, the birth rate in Japan has been increasing until recently; and in the few Chinese families that have been studied, an improvement in economic welfare appears to result in a larger family rather than a smaller. These tendencies are the opposite of those in Europe and North America, and both religion and family sentiment in the Orient are so strong that it will be many decades, doubtless, before birth-control methods bring the birth rates down to the level of those in North America and northwestern Europe.

If China follows in the footsteps of Japan, and develops industrially, as China has already started to do, there is a prospect not only of a notable increase in population, but also of an even greater increase in purchasing power. Japan's population has doubled in the past sixty years and she has only one-fourth acre of cropland per capita as compared with one-half acre in China. The coal resources of China are vastly greater than those of Japan, and, in addition to small deposits of iron, there are abundant supplies available in India. The innate intelligence and industry of the Chinese people is probably equal to that of any large group of people in the world. The problem in the Orient, even more than in Europe, is that of developing the purchasing power of the people, which means producing power and exporting power. The industrial development of China appears to the writer the brightest spot on the horizon of American agriculture. The vast shipments of silk and pottery and toys from Japan to the United States have been not a small factor in that Island Empire's industrial development, and have enabled it to buy cotton and rice and many other

things from our farmers. Japanese mills now consume as much cotton as those of England, and this is only an inkling of what may happen in the Orient when China adopts the panoply of science and develops into an industrial nation. But it must be realized that the industrial development of a nation is a slow process, and that the exports of farm products to the Orient are not likely to exceed those to Europe much before the time when the population of the United States becomes stationary.

Those who are interested in the future welfare of American agriculture may find comfort in this fact,—that the areas of cultivable land in North America, in Europe including the U.S.S.R., and in eastern and southern Asia are comparable in magnitude, probably 1,500,000,000 acres, more or less, in each of the three areas. But the population of these areas is as 1 to 3.5 to 7, and this ratio seems likely to increase rather than diminish. On the one side of the Pacific are nearly a billion people; on the other side about 150,000,000, excluding South America, and the two groups of peoples cultivate much the same area of land and produce much the same quantity of agricultural products. On the one side of the Pacific millions of people, mostly farmers and their families, are often hungry and sometimes perish of starvation, while on the other side of the ocean less than one-tenth as many farmers are producing more food and fibres than the people of the Continent can consume and are suffering from a surplus. Clearly America and Asia are complementary in their conditions, and certainly the exchange of American food for Asiatic industrial products is not beyond the power of science, economics, and politics to achieve. The interrelationship of the Pacific peoples is the great problem of the world, and in its solution American farmers may find ultimately the solution for their problems also.

5. Meanwhile relief for American agriculture must be found largely at home. One of the ways to improve the situation is through a new national land policy. Although the upward trend in number of beef cattle, and the probability of a similar trend in number of hogs, indicates the likelihood of a gradual and slight increase in the acreage of cropland during the next few years, most of this increase doubtless will occur, as it has been occurring since the war, in the Great Plains region and the Northwest, and most of the 20 to 25 million acres of plow land lying idle in the Southern and Eastern States will continue to lie idle.

A classification of the land in these states especially is needed as a basis for a national land policy, which should be developed in cooperation with the states. Some of this poorer quality of farm land should doubtless be converted into forest, some might be used for pasture, and probably some should be retained in crops. "The basis of such a classification," as the Secretary of Agriculture says in his (1929) report, "would be definite information concerning the physical characteristics of various types of land. Physical and economic information thus assembled and organized would make it possible to determine whether areas of impoverished or decadent agriculture could be restored to prosperity by a reorganization of farming. For farming areas which could not be thus restored, the determination of the fact would indicate the true course to follow. It would also facilitate a program of regrouping population in sparsely settled areas so as to economize expenditures for schools, roads and other utilities. The economic possibilities of areas hitherto not employed for agriculture might also be determined.

"What can be done and should be done immediately is to recognize that there is a great problem of land use, that an early attack upon it is essential, that research is needed in diversified fields, and that it should be carried on systematically under a unified plan of coordinated action."

DISCUSSION OF DR. BAKER'S PAPER

Sir Thomas Middleton.—Must we not lay emphasis on selecting better land for cultivation? This seems to me the conclusion to which Dr. Baker's paper points. In his remarks some days ago, Mr. Dallas urged the need for bringing more land into cultivation, because of unemployment in this country. I am entirely in agreement with Mr. Dallas as to the desirability of providing work on the land, and a few years ago in writing of the position of Britain after the war I used the phrase that this country could not "afford both idle men and idle acres", but in view of the increase in food production in the past few years across the Atlantic, and the difficulty of disposing of home produce at prices that recoup the labor expended, I do not believe that British land could, under present circumstances, provide much extra employment—not at least if the present standard of living is to be maintained by workers. Something could perhaps be done in growing special products, but under present conditions agriculture offers but small prospects of relief to industrial unemployment. Indeed if we are to bring the wages of the agricultural workers into a closer relation with the wages of industrial workers, it appears likely that less, not more, British land must be tilled in the immediate future.

Mr. Orr.—Since Malthus, men have lived with a blue or black or gloomy outlook towards the time when the human race would perish because it could not produce enough to feed itself. Dr. Baker has now proved that the opposite is the truth, but he should not be pessimistic. Malthus was wrong. Men have looked after themselves. Dr. Baker's statement and figures are as epoch-making as Malthus' were. They are true, and we should not indulge in fear, but work hard and have a jolly good time.

Mr. Dallas.—Our exportable surplus is industrial. We must take in agricultural products from the United States and elsewhere or we shall be compelled in the future to supply our own needs. Therefore we must maintain our industrial exports.

Mr. Maxton.—There are just two points which I would like to make, the one on what Sir Thomas Middleton has just said, and the other on the main trend of Dr. Baker's address. On the first point, I quite agree that an undefined political slogan of "More men on the land" ignores completely certain elementary economic considerations. To employ more men per acre for the existing types of farming might be expected to result in a somewhat greater production to be disposed of on an overstocked market and also a lower, and not a higher, standard of living per man employed. These are elementary economic considerations. Arable cultivation in Great Britain is declining and land is being put under grass and men are being displaced for these reasons.

But that does not preclude, by any means, the possibility that at the same time that some land is reverting to less intensive farming, the number of men engaged in farming as a whole, and in its widest sense, cannot be maintained or even increased. The reason is, as Dr. Baker pointed out, that there has been an expanding demand for certain types of farm produce like milk, fresh vegetables, and fresh fruits. Now, while land devoted to the production of corn and beef may have to face inevitable over-production with the resultant decrease in the intensity of farming and with the resultant displacement of labour, an increasing amount of land is being devoted to the production of these other products. All of them are more or less high-priced commodities and repay fairly intensive production. Milk production requires about the same labor per acre in this country as corn growing. Fruit and vegetables require much more labor per acre. It is, therefore, possible to conceive that while in large areas in Great Britain labor is being displaced, in other areas, much smaller in extent, the demand for labor on the land is increasing. That can, I think, be borne out by an examination of the agricultural labor employed in the county of Norfolk.

With regard to my other point, Dr. Baker has, all through his excellent paper, correlated agricultural production with population. No one will deny that the ultimate essential factor in demand is the number of available mouths to be fed and backs to be clothed, but in the present organization of world society that does not appear to me to be the only or even the most important aspect of demand. In this country, it is unfortunately true that a large proportion of the population cannot afford to buy food and

clothing up to their consuming capacity. In potatoes and wheat, there may not be very much room for further consumption, but in commodities like milk, fresh fruits and vegetables which we have just been discussing, it is certainly true that unemployment and low wages of workers cause consumption to be very far below the physical capacity and desire for these commodities. In discussing over-production, therefore, it seems to me essential to remember that all-important fact, that without any increase at all in the numbers of population, a quite small improvement in the incomes of the workers, of Great Britain at least, would bring about a very much increased demand for agricultural produce and especially for the products in which the British farmer has most nearly a monopoly in his own market, namely milk, fruit and vegetables. I do not wish to detract in any way from the value of Dr. Baker's address, but I should like to emphasize that certain of his conclusions as to over-production are based upon the assumption that all classes of the community are purchasing up to the limit of their desire for foodstuffs and that unhappily for Great Britain this is not the case. The purchasing power of the industrial and rural workers is as vital an immediate factor in agricultural trends as the rate of increase of the population. Dr. Baker's paper directs our attention only to the latter very long-term factor, but I am sure that he himself does not completely ignore the former.