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PREFACE

THE main excuses for publishing a book which, like this one, discusses a number of separate topics without attempting to weld them into a single whole must necessarily be that the topics are individually interesting, and that no adequate treatment of them from the point of view which is in question can be easily found elsewhere.

Whatever the faults of the chapters that follow, these claims can, at any rate, reasonably be made on their behalf. The first two of them treat of aspects of recent world economic history on which there is much published material not hitherto brought together and commented upon as a whole. These two chapters make no claim to do so in anything but a tentative and preliminary way. The statistical material is (or is rapidly becoming) available for a reasonably complete account of the structural changes in the main national economies of the world during the past decade or two, in terms of national income and outlay—for the main framework, in fact, of an economic history reasonably satisfactory to a modern economist. It is to be hoped that such a history will some day be written; meanwhile, what is offered here may provide the reader with a rough sketch of some of the ground, and may also, perhaps, provoke some further exploration of it.

The third chapter deals—again, of necessity, very briefly—with the first part of a story which might, even now, be taken a good deal further, but which seems still to be far from what the historian, a generation hence, is likely to regard as a convenient stopping-place. The most spectacular inflation has occurred since this chapter was first written; the reader may, however, find some interest in an account of the earlier and less sensational portion of what is likely to prove a fairly lengthy phase of world monetary history.

The studies of world population trends in Chapter IV are of a different kind, being concerned with the department of empirical economic knowledge in which the abstractions of the theoretical economists' "long run" analysis come probably nearest to life. This analysis has been applied to

the trends of population many times before, but the study and, particularly, the forward projection of those trends have received so much attention since the standard economic works on the subject were written that there seems to be room for the brief new appraisal attempted here.

The chapter on Industrial Efficiency and National Advantages has a three-fold object. In the first place, it seeks to state some of the principles of theory and of definition which have tended, naturally enough, to slip out of sight in the course of the recent very widespread and spirited discussion of relative industrial "efficiencies." Secondly, it seeks to relate the relative efficiencies of different industries, and of corresponding industries in different economies, to the larger movements of national economic development and of technical change. Thirdly (and incidentally) it makes some attempt to interest the reader in the interrelation of technical and economic factors in two new industries, in the belief that technologists are frequently ignorant of economic principles which are of the utmost importance to them, while economists (including the author) tend to stand shockingly aloof from practical details which many of their great predecessors would have pursued, both in applying their principles to practice and in seeking inspiration for their more theoretical studies.

Chapter VI consists of a few casts of an economic analyst's net into yet another great ocean of fact. It is hoped that the facts displayed in the net will be of interest and use to the reader, but, more especially, that the manner of casting it may inspire, or provoke, some other fishers in these waters.

The final chapter is intended, in part, as an attempt to get the enormous new facts of atomic energy into perspective, but also as an economist's exercise in deducing the effects of a largely hypothetical change in the supply conditions of one factor of production. Students of economics may find profit (or, at least, amusement) in re-casting the argument to take account of new facts as they come to light, or of the new possibilities that occur to the imagination so readily in connection with this subject.

The Author wishes to take this opportunity of thanking the Royal Institute of International Affairs not only for its courtesy in allowing him to reproduce in this book much

material which originally appeared in the *Bulletin of International News*, but for the stimulus and the opportunity which it gave him to write and publish this original material at a time when, like most economists, he was concerned primarily with more immediate matters.

A. J. BROWN.

London, March 1947.

CONTENTS

CHAPTER I

STUDIES IN RE-ARMAMENT

1. GERMAN RE-ARMAMENT, 1932-8

GERMAN re-armament constituted one of the main factors in the political life of the world in the period 1933-9; moreover, both by its direct effects on the German economy and its indirect effects in setting the pace for re-armament elsewhere, it constituted one of the main economic factors. It is therefore with German re-armament that any study of the world's preparation for the war of 1939-45 can most conveniently begin.

The story is essentially that of the expansion of Germany's national income from the low levels of the Depression, and the diversion of the increment—or most of it—to military or closely related purposes. The first questions which arise, therefore, are: What was the size and composition of the German national income before re-armament began? and: How did they change in the succeeding years?

THE GERMAN NATIONAL INCOME

These questions are not easy to answer. The German national income during the war years, and for a few years before, has been thoroughly studied by the United States Strategic Bombing Survey, which has published its findings in a Special Paper entitled *The Gross National Product of Germany*, 1936-1944. For earlier years—and, indeed, for all years up to 1944—official estimates of the national income by the Statistisches Reichsamt are available; but these estimates are extremely difficult to reconcile with the U.S.S.B.S. estimates—indeed, the authors of the latter state that "Data for the items necessary to effect conceptual

comparability are not available," and relied mainly on other sources, notably some semi-official estimates by Dr. Grunig. Nevertheless, the Statistisches Reichsamt's estimates must receive a little attention here, since it is desired to carry estimates back to earlier years, with which the Strategic Bombing Survey, and the special German sources from which it drew, did not deal.

For a number of years up to 1931, materials for an independent estimate of gross product exist. Dr. Marschak has estimated expenditure on consumption (in an article in the *Archiv für Sozialwissenschaft*, 1932). The same author's work with Dr. Lederer on capital formation gives the necessary investment data, and the public accounts make it possible to estimate public exhaustive expenditure (*i.e.* public purchases of goods and services) on current account. Statistics of retail sales extend from the period to which these estimates refer to the years after 1936, for which the U.S.S.B.S. has assembled material—including a careful independent estimate of consumers' expenditure. It is likely that these figures of retail sales give a fairly good clue to the proportionate changes in the value of goods and services taken up by consumers; using them for this purpose, however, one finds a considerable discrepancy between the Marschak estimates for 1931 and the U.S.S.B.S. estimates for five years later, the explanation of which seems to be that the former omit a great deal of the indirect taxation which enters into consumers' purchases, and which is fully included in the later figures. If this indirect taxation is added on to the components of the pre-1931 gross product mentioned above, one obtains an estimate of the German gross product which should be approximately comparable with the post-1936 estimates.

There is a further check on this. The chief peculiarity of the Statistisches Reichsamt's estimates of national income referred to above is that they deliberately exclude certain goods and services bought by the public authorities for purposes which are regarded as essential to the maintenance of the national income as a whole—*e.g.*, purchases for road-maintenance, general administration, fire-brigades, police, and (according to the official statement in the Reichsamt's *Sonderheft Nr.* 24 of 1933) defence. Now, it is clear that the last item has never been omitted *in toto*—since the late

1920's, at least—but much has undoubtedly been omitted which is included according to British and United States practice, and which it is not possible to estimate by a study of budgetary data alone. Mr. Colin Clark (in *The Conditions of Economic Progress*) recognised the nature of the problem, but the corrections which he applied in order to make the German national income statistics accord with his own definition were certainly far too low.

Fortunately, it is possible to arrive indirectly at the items which are omitted—they are simply the total of indirect taxes and fees to public authorities *minus* a curious item in the official German statistics which is misdescribed as "taxes not entering into private income." There are certain further adjustments to be made before the German official statistics conform to the British definition of national income (or to the United States definition of gross national product used by the U.S.S.B.S.) for some of which the basic data are lacking. The German official figures corrected for the omitted items of public expenditure might, however, be expected to vary over time approximately proportionately to gross national product. The comparison is made in Table I.

This table suggests that the estimate of gross product made, as described above, for the years 1929-31 may be rather low (assuming that the later ones, adjusted from the U.S.S.B.S. estimates, are correct). They also suggest, however, that the margin of difference is not very great—having regard to the roughness of the whole calculation. The authors of the U.S.S.B.S. Report on gross product used the uncorrected German official figures in a similar way as a check on their estimates of gross product from 1936 to 1944. They found that for every year except 1944 (for which only a very rough preliminary official figure is available) the Statistisches Reichsamt's figure lay between 69 and 72 per cent. of theirs. There is reason to believe that this check would have broken down if they had tried to carry the comparison further back to years in which the deliberately omitted items of public expenditure constituted smaller proportions of the total than they did in the later years of intensive re-armament. The ratio of the official figure to the estimate of gross product arrived at above for the year 1929 is 74 per cent.—well outside the range

TABLE I.

German Official National Income Estimates, corrected for the Omitted Items of Public Expenditure, and compared with Estimates of the Gross National Product.

	(1) National Income Statistisches Reichsamt.	(2) Indirect Taxation and Fees.	(3) "Taxes not Included in Private Income."	(4) Addition for Omitted Items (2–3).	(5) Corrected National Income Estimate (1 and 4).	(6) (5) as a Percentage of Estimated Gross National Product.
1929 ...	75·9	10·5	3·6	6·9	82·8	80·6†
1930 ...	70·2	10·8	4·0	6·8	77·0	83·5†
1931 ...	57·5	9·6	3·7	5·9	63·4	84·1†
1932 ...	45·2	8·8	2·6	6·2	51·4	—
1933 ...	46·5	9·1	2·5	6·6	53·1	—
1934 ...	52·7	9·9	2·3	7·6	60·3	—
1935 ...	58·6	10·6	2·3	8·3	66·9	—
1936 ...	64·9	11·6	2·3	9·3	74·2	80·0*
1937 ...	71·0	13·4	2·3	11·1	82·1	80·4*
1938 ...	79·7	15·0	2·3	12·7	92·4	81·7*

† Percentage of Gross National Product estimated as described above from Consumption, Investment, Government Current Purchases and Indirect Taxation.

* Percentage of Gross National Product adjusted from U.S.S.B.S. Estimate to refer to the Old Reich only.

obtained for the later years. The corrected official figure used here is, *a priori*, likely to afford a better check.

It seems, then, that the U.S.S.B.S. estimates of the German gross national product may, for the particular purpose of this chapter (which is broad economic analysis rather than exact measurement), be taken back to the years 1929-31. Various gaps are left, however, between those years and 1936. The gap in consumption data between 1931 and 1936 may be filled by interpolation with the help of retail sales statistics; official data on net investment are available throughout the period, and estimates of depreciation, necessary to convert these into figures for gross investment, can easily be made with a relatively small margin of error. Governmental purchases of goods and services on current account—the most interesting item of all—is, however, not available from public accounts after 1932 (the publication of the budget having ceased with the Nazi party's accession to power) and estimates of them for 1933, 1934, and 1935 must therefore be very tentative—the course of total tax revenue affords some clue to the way in which they changed from year to year; but only a slight one, for not only was taxation supplemented by borrowing, much of it secret, which was used to an unknown extent for other than the capital purposes included in the official statistics of net investment, but how much of the public authorities' total financial resources were used for transfer payments between the years 1932 and 1936 is also a matter largely for conjecture.

Nevertheless, for the general purposes of this discussion, a sufficiently clear statistical picture of the development of the German economy can be drawn for the whole period 1929-38, as is attempted in Table II. At the bottom of this table the net national income at market prices is shown (it is obtained by the deduction of estimated depreciation allowances) and this is then reduced to factor cost (*i.e.*, to the aggregate prices of the factors of production used in producing the country's net output) by the further deduction of estimated indirect taxation and fees. This figure should be very roughly comparable with the Statistisches Reichsamt's estimate of national income, corrected as described above for the items of public expenditure which are deliberately omitted from it. It will be seen that the two

TABLE II.

Components of the German Gross National Product, 1929-38 (Old Reich only; Milliard Rm.).

	1929	1930	1931	1932	1933	1934	1935	1936*	1937*	1938*
Consumers' Expenditure	78	73	66	53†	52†	55†	56†	59	63	66
Ratio of Retail Sales to Consumers' Expenditure (%)	47%	46%	43%	—	—	—	—	46%	49%	52%
Gross Domestic Capital Formation ...	11	7	1	3	6	8	9	10	11	12
Domestic Output available to the Government	14	12	9	8	10	12	17	24	28	34
Gross National Product at Market Prices (excluding interest on National Debt)	103	92	76	64	68	75	82	93	102	112
Net National Income at Market Prices ...	96	85	71	58	63	70	76	87	96	105
Net National Income at Factor Cost ...	86	74	61	49	54	60	65	75	83	90
Statistisches Reichsamt's Estimate, corrected for Omitted items (for comparison) ...	83	77	63	51	53	60	67	74	82	92

* Estimated from the U.S.S.B.S. figures (which relate to the Old Reich *plus* Austria and the Sudetenland) by deduction of 10½%.
† Estimated from Retail Sales.

series of figures do, in fact, show a fairly close correspondence over the period as a whole.

The outstanding feature of this table is, of course, the enormous growth of Government purchases of goods and services after 1932. Between that year and 1938 the net national income increased by 41 milliard Rm., of which no less than 25 milliard, or over 60 per cent., went to the Government—excluding that which went to publicly controlled capital formation. Private consumption took only 8 milliard, or under a fifth of the increase. It is not hard, therefore, to see the source of the great increase in German economic activity under the Nazis; to an overwhelming extent it was the direct result of increased demand on the part of the public authorities. Recovery from the depression was effected, not by "pump-priming," but by a direct substitution of public for private demand. The situation changed, however, in the course of the years concerned. In the first two years of Nazi government increase in gross capital formation seems to have been at least as important as increase in public purchases of a non-investment nature in stimulating activity; subsequently it played a much smaller part, both relatively and absolutely.

What the changes under discussion amounted to in real terms—*i.e.*, if measured at constant prices—is roughly indicated in Table III. This suggests that the real national product of Germany fell by not far short of 20 per cent. in the course of the depression after 1929, regained its 1929 level by 1935 (as did that of the United Kingdom also), and by 1938 had risen some 33 per cent. above the 1929 peak. Consumption, however, both fell less and rose more slowly; the decline from 1929 to 1932 or 1933 seems to have been only some 12 or 13 per cent.; the 1929 level was, however, not surpassed until 1938. (It is perhaps worthy of note that the Reichskreditgesellschaft in 1939 declared that real consumption in the previous year had passed the 1929 level.) The population had, meanwhile, increased by about 5 per cent., so that the slight excess of total consumption in 1938 above the 1929 level, which these figures indicate, can hardly have meant any appreciable net increase in real consumption per head. The one-third increase of the German national product of 1938 above the pre-Nazi peak level was made up mainly of the State's share (which had

TABLE III.

Components of the German Gross National Product, 1929-38, measured at the Prices of 1939 (Old Reich only; Milliard Rm.).

	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Consumers' Expenditure	64	62	61	56	56	57	57	60	64	66
Gross Domestic Capital Formation ...	9	6	1	3	7	9	9	10	11	12
Domestic Output available to the Government	11	10	9	9	11	13	18	24	28	34
Gross National Product at Market Prices (excluding interest on National Debt)	84	78	71	68	74	79	84	94	103	112

trebled), and, as for the remainder, of a one-third increase in gross capital formation. The consumer had no share in the enjoyment of it, though he had regained the ground previously lost in the depression after 1929. The increase in output was, of course, largely associated with an increase in employment and a diminution of unemployment. The latter had been very heavy, exceeding $5\frac{1}{2}$ million in 1932; by 1936 it was down to a level of $1\frac{1}{2}$ million which, having regard to the size of Germany's occupied population, appears at first sight to indicate a nearer approach to full employment than was attained in the United Kingdom in any year of the pre-war decade. The improvement is to some extent illusory, since, after 1933, those in labour camps were excluded from the statistics of unemployment; and the expansion of the armed forces in any case created a situation which it is hard to compare with that in the United Kingdom. Nevertheless, the great bulk of those formerly unemployed had found normal employment by 1936, by which year, also, total employment in mining and industry seems (from the rather inadequate sample data available) to have regained the 1929 level, *i.e.*, to have recovered from the 40 per cent. fall which had taken place (according to these same data) in the depression. It is noteworthy that the *Institut für Konjunkturforschung* Index of Industrial Production fell by no less than 42 per cent. between 1929 and 1932—a piece of evidence which helps to render this great fall in employment more credible—and that, by 1936, it stood some 6 per cent. above the 1929 level; an increase which, again, accords fairly well with the regaining of the 1929 employment level and a moderate rate of technical progress, or with the 12 per cent. increase in total real income.

After 1936, however—when the rate of unemployment in Germany was already down to a level which would be associated with a pre-war boom year in the United Kingdom—the index of industrial production rose in two years by a further 19 per cent., and the real national income as a whole rose by about the same proportion. This change was accompanied by a 17 per cent. increase in the numbers in industrial employment and a 19 per cent. increase in the total number of hours worked in industry. The number of unemployed in the Old Reich at the same time decreased to

less than half a million—a rate of unemployment similar to that prevailing in the United Kingdom in 1946. The total population to which the number of unemployed should be related is somewhat uncertain, but it seems that most, though not all, of the increase in employment and national product between 1936 and 1938 is to be attributed to the further absorption of unemployed workers into employment —to a reduction of the unemployment rate from something like the United Kingdom's 1937 boom level to its 1946 level. There must, however, have been some absorption of workers into industry from other occupations, or a net increase of the total labour-force. Probably both of these things occurred.

The State was thus taking a constantly increasing share of the national gross product from 1932 (when it took an eighth) to 1938 (when it took nearly 30 per cent. of it). How did it use this large and increasing share of the national resources? For 1932 the Reich budget supplies a fairly adequate answer to this question; after 1936 the U.S.S.B.S. has broken up the total to some extent. It is possible to obtain a reasonably good estimate of the salaries of administrative personnel for all the years concerned, and it is, at all events, clear that this item roughly doubled between 1932 and 1937 or 1938—a reflection both of the growth of state planning in Germany and of the duplication of administrative organs which was a feature of the Nazi system. Deducting these expenditures on administrative salaries from total public purchases of goods and services, one is left with figures which must bear a fairly close relation to those for expenditure connected with re-armament. A rough estimate of the latter may, indeed, be obtained by taking for each year the excess of non-salary expenditure in it over the corresponding expenditure in 1932, and adding the armament expenditure of the last-mentioned year—which is officially (though perhaps rather misleadingly) given as about 1 milliard Reichsmarks.

The result is shown in Table IV. The total "armament" expenditure so estimated for all the years 1933-38 is 69 milliard Rm. As the corresponding figure (for Greater Germany) for the pre-war months of 1939 must have been about 20 milliard Rm., these estimates are in close agreement with Hitler's statement, made on the eve

TABLE IV.

Components of German Public Expenditure on Goods and Services, 1932-38 (Old Reich only: Milliard Rm.).

	1932	1933	1934	1935	1936	1937	1938
1. Pay of Administrative Personnel ...	4•	4†	5†	6†	7§	8§	8§
2. All Other	4	6	7	11	17	20	26
3. Increase of Line 2 over 1932 level, *plus* 1 milliard Rm.	1	3	4	8	14	17	23
4. *Of which* pay of troops	?	?	?	?	4§	4§	4§

• Budgetary data.

† Estimated by interpolation.

§ U.S.S.B.S. estimate.

of the invasion of Poland, that Germany had spent 90 milliard Rm. on armaments in the preceding six years.

What this vast expenditure produced in the way of actual armaments is another story. It is common experience among belligerent countries that, in the earlier stages of the conversion of the economy for total war, a somewhat surprisingly small proportion of " war " expenditure consists in actual purchases of munitions. In the United States (where this proportion was higher than in most other countries) it was well under half in 1941, though later rising to three-quarters. Deliveries of specialised munitions (rather narrowly defined) to the Wehrmacht in 1940, the first year for which such figures are available, were valued at 11 milliard Rm., whereas the pay of the armed forces was 12 milliard, and " armament " expenditure, as calculated above (for the Greater Reich) was some 47 milliard. A great deal of capital expenditure such as that on fortifications, the laying-in of stocks, and on the Four-Year Plan had, of course, to be met by the German state in the later pre-war years, and there can be no doubt that the figure quoted by Hitler related to " armament " expenditure defined in the broadest possible way—it was, of course, quoted as a boast.

It remains to be asked what was the magnitude of the German national income, and of its main components during the re-armament period, in terms of contemporary sterling values. It will perhaps be enough to attempt the hazardous task of answering this question for one year alone—for 1938. To do so it is, of course, necessary to fix a " purchasing power parity " for each of the main components of the German national income. This is done in Table V; the division of consumption there into its main components is a rough one, based on family budget data. For comparison, the corresponding British figures, taken from the White Paper Cmd. 6623, are given alongside.

The choice of these parities is not arbitrary, though they are bound to be subject to a considerable margin of error. That chosen for Government purchases of goods and services and net capital formation is the unweighted average of the figure for industrial products in general (15·5), calculated from an estimate of 17·08 made by the German Institute of Business Research for the year 1935, and 11·5,

TABLE V.

Evaluation of the National Income of the Old Reich for 1938 in Sterling, and Comparison with Corresponding United Kingdom Totals.

	Milliard Rm.	Parity (Rm. to £).	Million £.	Corresponding U.K. Total.
Government Purchases of Goods and Services ...	34	13·5	2520	814
Of which Armaments	23		1710	358
Net Capital Formation	5		370	220
Less Foreign Contributions (not included) ...	—		—	70
Consumers' Expenditure	66	—	4370	4153
Of which—				
Food, Drink, Tobacco, Fuel	39	18	2170	—
Rent	7	9	780	—
Clothing and Durable Goods	10	17	590	—
Services	10	12	830	—
Net National Income at Market Prices	105	—	7260	5242

which seems from wage statistics to be the appropriate parity for direct labour. It seems that the items under discussion consist in fairly equal parts of expenditure on labour and expenditure on finished industrial products, together with some purchases of raw materials, for which the appropriate rate would lie somewhere in between. The parity for food, drink, tobacco, and fuel, is derived from a rough purchasing power parity calculation for a number of the main items included in these classes. The figures for rent and clothing are based on general impressions of the pre-war German scene ; while that for services is based on the figure for labour, mentioned above, and the slightly higher one which emerges from a comparison of railway rates.

The comparison of these evaluations of the German national income in sterling terms with the corresponding United Kingdom figures is very instructive. It seems to indicate that the real net product of the Old Reich in 1938 was some 39 per cent. greater than that of the United Kingdom ; so that, the population being about 45 per cent. greater, the *per capita* product was 4 or 5 per cent. less. On the other hand, it suggests that aggregate consumption in Germany in 1938 was only some 5 per cent. greater than in this country, so that *per capita* consumption must have been less than here by 27 or 28 per cent. Against this, the State took a slice of the national resources more than three times as large as in the United Kingdom. More particularly, it devoted to armaments, in a broad sense, nearly five times as much as was similarly used here. In fact, the discrepancy was somewhat greater still, since Germany obtained a certain contribution even in 1938 from the newly incorporated territories of Austria and the Sudetenland, which are not taken into account in the above comparison.

Thus, out of a national product probably slightly smaller per head of the population than that of the United Kingdom, the Germans were, by 1938, devoting nearly a quarter (when all the components are valued at British prices) to armaments, against rather less than 7 per cent. devoted to that purpose here. In six years they spent on armaments a sum equal to their average net annual product over that period. This was the economic price to Germany of the political victories of Munich and Prague, and a large

part of that of the military victories of 1939 and 1940—by far the greatest expenditure ever made by a nation in peacetime in preparation for war. It proves to have been a very small part of the cost of National Socialism to mankind.

2. THE RE-ARMAMENT OF THE U.S.S.R., 1934-41

It is not possible to assess the economic effort of re-armament in the U.S.S.R. with even that rather low degree of confidence attainable in making the like assessment for Germany. This is not, as with Germany, because defence expenditures are kept secret—on the contrary, a complete series of figures is available for the pre-war and the war years—but because of the great difficulty of evaluating the roubles in which the cost of re-armament is expressed and of relating them to the national income.

The national income forms, as before, the best starting-point for the discussion. The most daring and comprehensive attempt to evaluate it in terms which make it comparable with those in other countries is that of Mr. Colin Clark in his *Critique of Russian Statistics*, which gives a broad picture of the Russian economy in 1934, and another one, based on much less reliable information, of the economy in 1937. In terms of sterling at British prices of the former of these years, he finds it equivalent to £3,546 million in 1934 and £4,980 million in 1937—an increase of 40 per cent., bringing it in 1937 to about the same level as that of the United Kingdom. According to this, therefore, average output per head in the U.S.S.R. was in 1937 about a third of that in the United Kingdom, and of the same general magnitude as in Poland, Japan, and Italy.

It is hard to ascertain how the national income developed in the succeeding years. It is true that there exists an official estimate of income expressed in " stable roubles " of the purchasing power of 1926-7, but these do not serve as a useful index of real income, as the weighting implicit in the use of 1926-7 prices becomes increasingly inappropriate, and apparently exaggerates the increase more and more as the country's industrial output rises. According to them, for instance, real national income increased by 77 per cent. in the interval 1934-7 whereas, according to Mr. Clark's estimates, this increase was only 40 per cent. If one made the risky assumption that the exaggeration of the increase in subsequent years was the same as in this

period, it would follow that the Russian income of 1940, at British prices of 1934, was in the region of £5,800 or £5,900 million, and the income officially anticipated for 1942 some £7,400 or £7,500 million.

This extremely tentative calculation suggests an enormous rate of growth—a doubling of the real income in eight years. Is such a feat possible? A little light on the question whether the Soviet Union was on its way to accomplishing it comes from the data relating to new investment. In the three years 1934-6, net investment by the State and industry was apparently about 70 milliard roubles or, say, £1,500 to £2,000 million of 1934 purchasing power (Mr. Clark puts the rouble at 35·7 to the £ for the purpose of purchasing capital goods, and there was a considerable price-rise from 1934 onwards). Since the increase in the national income in these three years was apparently some £1,434 million of 1934 purchasing power, the implied ratio of increase in income to increase in capital equipment is very high, and if projected forward over the three years 1937-9, in which net investment at 1934 prices was probably £2,000 to £3,000 million, it suggests an increase in income almost certainly larger than actually took place in that period. It must be remembered, indeed, that the Union in 1934 was still affected by its " collectivisation crisis," so that its resources were at that time not being fully and productively used. The increase in income between that year and subsequent ones must not, therefore, be expected to bear any regular relation to the increase of productive capacity in the meantime.

It is perhaps useful to reflect that, between 1870 and 1913, British real national income (exclusive of income from abroad) increased by an amount equal to about a third of the net investment in industrial and transport facilities in the country. If anything like the same proportion ruled in the U.S.S.R. between 1937 and 1940, the increase in real income suggested above would be adequately accounted for, especially if the extension of the area of the Union is taken into account; and the expectations apparently entertained for 1942 would not have been unreasonable. It is therefore reasonably likely—one cannot say more—that Russian gross national income at the time of the German aggression in 1941 was equivalent to some £6,500 to £7,500

million at British prices of 1934, which is about £10,000 to £11,000 million at British market prices of 1941. If that is so, the Russian national income at that date was some 20 to 35 per cent. greater than the British.

A very rough check on these highly conjectural estimates can be obtained by comparing statistics of output and of livestock populations with those of (for instance) the United States. Output (and consumption) of electric power, coal, petroleum, steel, copper, and aluminium in 1940 were in all cases between 18 and 39 per cent. of those in the United States; an average weighted in accordance with any reasonable estimate of the importance of these commodities in the industrial economy would be somewhere about 30 per cent. The gross output of Russian agriculture, on the other hand, must have been of the same general order of magnitude as that of the United States; there were a larger grain output and larger sheep and horse populations, but fewer cattle and pigs. Most "service" industries are obviously much smaller in the U.S.S.R. than in the U.S.A. (they employ only a tenth of the active population, against nearly half in the United States), though transport—the largest of them—is extremely large, carloadings in 1940 being equal to 85 per cent of the United States total. On this evidence, one might reasonably conclude that the Soviet national income in 1940 was somewhere in the region of a third of that of the United States, and thus not far different from that of the United Kingdom—a reasonable confirmation of the previous estimate, having regard to the very wide margins of error to which both of these rough calculations are subject. The conclusion from both together is that the Soviet national income in the years immediately preceding the German invasion cannot have been very much larger than that of the United Kingdom.

The capacity of the Soviet Union to prepare for or to wage war was, however, clearly greater than this conclusion, taken in conjunction with the low standard of living prevailing, would suggest. In the first place, the Government wields far more effective executive power than those of most countries which are still equally poor, and had a more direct control of the peacetime economy than the government of any other country. Secondly, the fact that the country was in process of rapid development and industrialisation meant

that, as in the United States, the capital goods industries (the industries most directly connected with war-potential) were usually well developed in relation to the rest of the economy—its steel output in 1940 was considerably greater than that of the whole British Empire, and equal to 60 per cent. of that of Greater Germany, while the numbers employed in the metal-working and chemical industries had probably passed the corresponding United Kingdom total about the year 1934 and advanced well beyond it. Thirdly, the enormous population of the Union—four times that of the United Kingdom—ensured that shortage of manpower (or, at least, of untrained manpower) would impose no limit on expansion, especially as agriculture provided a reservoir from which labour could be taken in great quantities without appreciably lowering output.

How much of this income was, in fact, spent on re-armament? Mr. Clark suggests (on evidence based on a study of prices after eliminating the effects of the turnover tax) that defence expenditure should be converted into sterling at the official rate of about 25 roubles to the £ in the circumstances ruling in 1934, whereas the appropriate parity for investment goods was 35·7 and (owing to the heavy turnover tax which is the chief instrument of Soviet finance) the corresponding figures for manufactured goods and for food respectively, bought at retail, were 69 and 147. It seems that Russian prices subsequently rose much faster than those in the United Kingdom; from the rise of wages relatively to productivity Mr. Clark has estimated that the appropriate parity for evaluating in sterling Russian output of goods not subject to turnover tax changed to 30 roubles to the £ in 1937 and 43 to the £ in 1940. This calculation, however, appears to be based on evidence relating to general industrial productivity. It would be very surprising if in the armament industry, with which one is mainly concerned in evaluating defence expenditure, there had not been a greater increase in productivity (accompanying the far faster increase of scale) than in manufacturing industry generally, and it is inconceivable that in 1937-40, which was the period of the greatest pre-war expansion in armament production, output per man-hour in the armament industries had actually declined, as Mr. Clark suggests happened in production for the public authorities as a whole. For

armament expenditure it seems reasonable—though the decision is, of course, arbitrary—to keep the 1934 relation between the rouble and sterling unchanged in the succeeding years.

If this is done, a series of figures is obtained which is shown in Table VI with the corresponding United Kingdom expenditures placed alongside for comparison.

TABLE VI.

Defence Expenditure of the U.S.S.R. and U.K., 1934-41.
(Million £, at 25 Roubles to the £.)

	U.S.S.R.	U.K.		U.S.S.R.	U.K.
1934 ...	200	99	1938 ...	1080	358†
1935 ...	328	122	1939 ...	1644	795†
1936 ...	592	172	1940 ...	2288	2575†
1937 ...	700	251	1941 ...	2830*	3700†

* Budget estimate, representing rate of expenditure planned before the German invasion.

† Public authorities' expenditure on goods and services connected with the war (Table 11 in Cmd. 6623).

It is clear from this that, from 1934 up to the outbreak of war in 1939, the U.S.S.R.'s armament expenditure had been more than twice as great as that of the United Kingdom —a conclusion which would still hold even if one followed Mr. Clark in reducing the sterling value of the rouble in the later years. Even in 1940 the Russian expenditure was, according to this calculation, about the same as the British, though the U.S.S.R.'s only military operations in that year were the relatively small ones against Finland.

How did this Soviet armament expenditure compare with that of Germany? It has been argued above that German military expenditure in 1938 was probably equivalent to about £1,710 million, which was thus about 60 per cent. above the Soviet figure, but two years later the Soviet expenditure had been doubled, and by mid-1941 was, on this showing, of the same general order of magnitude as German expenditure had been on the eve of the attack on Poland. It seems likely, indeed, that the Soviet Union spent at least as much on military purposes in the five years or so before she was attacked as Germany had spent in the corresponding period leading up to her aggression against Poland. Germany's two years' lead in this race, however, gave her a formidable advantage; at the time of her attack

on the U.S.S.R. her military expenditure (which will be discussed in a later chapter) was probably still at least twice as great as the Russian, though not all of it—perhaps little more than two-thirds—could be applied on the Eastern Front.

It follows from what has been said already that the Soviet Union's expenditure on armaments before the war constituted a high proportion of its national income, though a lower one than was being devoted to military purposes in Germany. In 1934 the proportion so spent (valuing the various components of the national income at contemporary British market prices, as Mr. Clark does) was about 6 per cent., which was perhaps slightly less than the corresponding ratio for Germany at the same time. By 1937 the Russian proportion had increased to some 12 or 13 per cent. and the German to 19 per cent. Immediately before the German attack, however, the proportion of the Soviet net national income devoted to military purposes must have been 25 to 30 per cent., whereas the German proportion was about 40 per cent. if military outlay is compared with the Reich's output *plus* the resources accruing to the German government from outside, or rather under 50 per cent. if it is compared with the Old Reich's net output only. When one considers how much lower average incomes were in the U.S.S.R. than in Germany, and how urgent was the need to devote what could be spared from consumption to national development, it becomes plain how great an importance was ascribed to defence in these years, and at what sacrifice the necessary resources were provided. Whatever the margin of error in the calculation, it is clear that the real cost of military preparation to the Soviet Union was, like the subsequent burden which it bore in battle casualties, the heaviest carried by any nation.

3. ECONOMIC FACTORS CONNECTED WITH THE COLLAPSE OF FRANCE IN 1940

The defeat of France in 1940, in spite of the impressive size of her fighting forces, and the collapse of her official resistance to the enemy when she had lost (as General de Gaulle said) "one battle, but not the war," will occupy historians for a long time to come. An important part of the explanation of the military defeat—though it, in its turn, requires to be explained—is the inadequacy of French (and of British) armament expenditure in the years when Germany and the U.S.S.R. were devoting such large amounts of their resources to military preparation. In the background of the psychological factors to which a large part, both of the defeat and of the collapse, must be attributed, moreover, there is a further element which admits of being assessed in economic terms; those sections of French opinion which accepted defeat soonest were largely influenced by the view that the balance of war-potential in Europe was finally tilted decisively in favour of Germany, so that any attempt to redress it was hopeless, and could only be disastrous. This view was based, of course, upon the underestimate of British sea-power (and of the air-power which, since it was largely untried, there was more excuse for underestimating) of which Continental soldiers have, to their cost, so often been guilty. It erred, too, in its view of the U.S.S.R.'s role in European affairs, and of the probability of United States intervention. Leaving this aside, however, one may find plenty of evidence that, as between France and Germany, the balance of power has long been weighted in favour of the latter.

In the last resort, the scale of political power depends upon the power to make war, and this in turn, apart from the incalculable factors of morale and leadership, rests upon the power to provide men and material. The potential supply of material, which for a long time has been assuming greater importance relatively to the supply of manpower, depends both upon the total volume of production in the country and upon production per head, which largely determines how much productive power can be turned to

war material after providing for the support of the population.

In the 18th century when France still held her position as the first power in Europe, she had the leadership in population as well as in wealth. Income depended primarily upon agriculture, and no country had so much highly fertile land as France; her population in 1800 was some 27 million—greater than that of the area which subsequently became the German Empire, and 60 per cent. greater than that of the United Kingdom. The economic burden of the Napoleonic Wars, which cost Britain £800 million, or an average of more than 10 per cent. of the national income during their continuance, fell relatively lightly upon France, largely because the Napoleonic armies lived on the countries they invaded, though the cost in lives was very heavy.

After the wars, France, however, was definitely less wealthy than Britain, though she advanced more rapidly than any other Continental country. Her population did not increase as fast as populations in other parts of Europe, and by 1870 that of the new Germany had just passed it, while that of the United Kingdom was only some 17 per cent. smaller. The French and German national incomes, as well as incomes per head, appear to have been of roughly similar orders of magnitude at the time of the Franco-Prussian war during which strictly military expenditure, on each side, was the equivalent of about £70 or £80 million, or some 12 or 13 per cent. of the national income of each for the 245 days' duration of the conflict.

The indemnity of £200 million probably did not hinder France's economic development greatly after the war, but the loss of territory was a serious matter for her metal industry, and it certainly seems that the intensified internal divisions and the mood of national discouragement, as well as the general fall in world prices which lasted till the 'nineties, held up development. The Great Depression, whether it deserved that name or not in Britain, was certainly an era of relatively slow economic development in France. In Germany, on the other hand, the war ushered in a great burst of investment, especially in the heavy industries, though progress was interrupted by the slump following 1873. In 1870 France had produced 1,178,000 tons of pig iron against Germany's 1,262,000:

in 1875 she produced 1,448,000 against Germany's 2,000,000. The great relative advance of Germany in the heavy industries, however, came in the 'eighties, when both Britain and France were moving slowly in this field, and it was due to the adoption of the basic process, invented in 1878, which enabled Germany to draw upon the immense deposits of phosphoric ore in Lorraine and Luxembourg. By the turn of the century, German pig iron production was nearly three times the French figure, and the same relation persisted in 1913. At that date, Germany produced nearly five times as much worked iron and steel as France.

The relative slowness of the development of French heavy industry must be attributed largely to the poorness of the coal supply. French industry was not able to get under way at all until the completion of the railway network, and, even then, since coal deposits were mostly poor and difficult, about a third of the nation's requirements were imported, so that prices were higher than in Germany or Britain. There was an especial shortage of good coking coal for metallurgy, and this was largely imported from Westphalia, costing much more than German or British ironmasters had to pay. The whole industrial development of France, indeed, was slowed down by the fuel difficulty, a rapid increase of the total power used in industry coming only after 1895. The discovery of great new iron ore deposits in Lorraine late in the 19th century was prevented by the expense of moving fuel from bringing about the expansion which might have been expected in the French metal industries, and, though steelmaking progressed relatively rapidly there after 1900, half the ore from the deposits in Meurthe-et-Moselle went to Germany.

The growth of population in France was also much slower than elsewhere in Western Europe after 1870. In the territories left to France in 1871 the increase was only 10 per cent. by 1913; if the lost population of ceded territory is taken into account, it was only $3\frac{1}{2}$ per cent. In Germany, on the other hand, the increase between 1870 and 1913 was more than 60 per cent. How far the slowness of population growth in France was due to lack of an industrial outlet for the agricultural population, and how far the slowness of population growth held up industrial

development cannot be considered here, but the two phenomena were certainly connected.

Thus it came about that on the eve of the 1914 war the national income of France was (at the British prices then ruling) in the region of £1,500 million, while that of Germany was some £2,500 million. Average incomes per head of the total populations were still similar, so that similar proportions of the total income ultimately could be (and in fact were) devoted to military purposes. Germany, from having a very slight advantage in war-potential in 1870, had come to have an advantage of five to three. The war efforts put forth by France and Germany were comparable in the economic field in that both diverted to war purposes about half their national incomes in the last and most intensive year of war—the French fraction, after allowing for a fall of at least 25 per cent. in national income due to invasion, being perhaps a little higher than the German. The extent of the strain put upon France, however, is not fully measured by this, since France borrowed from her Allies in 1918 a third as much as she provided herself, and the imported material which this and similar earlier loans represent was used in conjunction with French manpower. Indeed, 42 per cent. of the French male population was mobilised, as compared with 33 per cent. of the German, and nearly 7½ per cent. of it was killed compared with just over 6 per cent. on the German side.

The material damage due to the war was fairly quickly repaired, enormous though it was. The losses of men have perhaps had not their least important reflection in the failure to find political leaders of the first rank in the last generation, but this, and the more obvious effects of the human losses, were not peculiar to France alone. The twelve years or so after the war, however, though apparently years of prosperity, with no unemployment problem such as troubled other countries, did not bring the real national income back to the pre-war level, for, while industrial output per head rose, the fall in agricultural prices apparently caused real agricultural incomes to decline more than correspondingly. At the same time, agricultural protection prevented any substantial transfer of the population out of agriculture, which would have been the most potent and natural method of increasing real incomes as a whole. The

available national income statistics are unreliable (on the French side, at least), but it is probable that French and German national incomes in the peak year 1928 stood in a ratio of something like 3 : 4 or 3 : 4½, a more favourable ratio for France, at all events, than that of 1913. The territorial changes, too, coupled with immigration into France, had reduced the surplus of German population above the French from the pre-war 66 per cent. to about 55 per cent.; the outlook for the future seemed somewhat brighter than before, since the French net reproduction rate, which had already sunk below unity in 1900, long before that of any other European country, had been fairly well maintained since (at 0·929 in 1925-8), while that in Germany had sunk (to 0·924 in 1924-6) and was still sinking. The population forecasts of Sauvy, Kahn, and Bürgdorfer, made in the few following years, though not strictly comparable because of the differences in their assumptions, provided a prospect of a substantially stable ratio between French and German populations for the next two generations.

After the depression of 1929 had struck Europe the French position seemed, relatively, better still. Germany received the heaviest blow of any European Great Power, while, until 1932, when the trough of the depression had been reached elsewhere, France maintained substantial prosperity. The lateness of the impact of the depression on France is certainly one of the most important factors in recent European affairs. In 1935, when British and German real incomes passed their previous highest levels, France had reached the trough of her own depression, and recovery was only very slight until 1937. The reasons for this lag of the French conjuncture behind that of her neighbours have not been satisfactorily expounded; it seems, however, that internal activity was maintained in France after it had fallen off elsewhere in 1929-30 by the continuation of building work, perhaps traceable, ultimately, to the arrears accumulated in earlier years when the constructional industries were occupied with reconstruction and fortifications. When this activity came to an end, further expansion being discouraged by the world-wide depression and collapse of foreign trade, France felt the full force of the blizzard. Matters were made worse and

recovery prevented by the political instability, itself no doubt partly due to the depression, which was particularly evident from early in 1934.

The chief attempt to escape from the depression, the Blum experiment, cannot be properly discussed outside its political context. The measures taken were to a considerable extent dictated by political necessity rather than economic logic, but, be that as it may, it is clear that they were, from the economic point of view, misconceived. A country where output per head in manufacturing industry was only two-thirds of the corresponding British figure could ill afford to adopt a working week 17 per cent. shorter than the British. What was even more important than this was the fact that, because prices and wages changed to about the same extent, there was very little net effect on the national economy apart from distributional changes, and the budget deficit was nearly offset by the passive balance of trade which developed, so that the net expansionary effect was very small, and economic activity increased only slightly in the year of the experiment. The persistent passive balance, indeed, frustrated all attempts to institute recovery by Government spending, and it seems that, in the circumstances, the attempt to discourage the speculative export of capital by the use of the Exchange Equalisation Fund merely aggravated the trouble by preventing any rapid adjustment. Either exchange control or a policy of boldly allowing the depreciation of the franc to take its course would probably have been better.

The net results of the Blum experiment in the economic field (though it is arguable that, in the political field, it prevented civil war) were thus the increased distrust of the national destiny on the part of wealthy investors, manifesting itself in the flight from, and successive devaluations of, the franc, and an industrial régime which, while it reduced unemployment, made it impossible for the nation to attain prosperity even with full employment, and, in particular, impossible for it to produce sufficient armaments to meet the new political situation. It is fairly certain, despite the unreliable nature of French national income statistics, that by 1938 the German income (not including that of Austria or the Sudetenland) was more than twice the French. German output per head of the total population, moreover,

was by this time considerably higher than French, so that it should have been possible for Germany to divert a greater proportion of total income to war purposes.

The actual French defence expenditures, including items not so classed in the budget, were equivalent (at purchasing-power parity, so far as that can be estimated) to about £182 million in 1937, and were estimated at £215 million and £750 million for 1938 and 1939 respectively. For 1937 and 1938 these expenditures were less than the British, and very much less than the German, which were probably of the order of £1,100 million in 1937 and £2,040 million in 1938. Yet the need for armaments was obviously very great, and, moreover, larger expenditure upon them would have been the readiest way of lifting France out of the economic depression from which she was still suffering. The reason why larger expenditures were not undertaken was partly budgetary. Receipts from taxation (excluding income from public enterprises) in 1937 and 1938 were only about a fifth of what the Ministry of Finance apparently thought the national income to be, and a considerably smaller proportion of what it really was, but the difficulties of expanding revenue were great. Moreover, the credit situation was not particularly favourable, owing to the suspicious attitude of investors, and the determination of many of them to remove their capital from the country if possible. Purely budgetary difficulties do not often hinder modern States in defence efforts far greater than those made by France; it is largely true that, provided that the Government has sufficiently rigid control, or commands sufficient support, internal financial considerations are of very little account to it in an emergency. Nothing can be more clearly indicative of the divided state of French loyalties than the fact that purely financial considerations proved to be so great an obstacle to the necessary action.

The scale of expenditure which France achieved in the war itself is indicated by the fact that defence costs in the first half of 1940 were equivalent to about £800 or £900 million, compared with a German expenditure in the same period of about £1,900 million, and a United Kingdom expenditure of about £1,100 million. The proportion of French war expenditure to national income in this period was therefore perhaps as high as, and perhaps rather higher

than, the corresponding proportion for Britain, and probably not far, if at all, below the German proportion. It was impossible at that date, however, to make up for the years of inadequate preparation which had gone before.

Looking back at the long decline of France from her old European primacy one may see that the main factors which have brought it about are the decline in the rate of French population growth and the failure to achieve a high degree of industrialisation. These two factors are closely connected; with a peasant system of agriculture, families are limited to avoid subdivision of holdings unless there is an outlet into non-agricultural occupations. To whatever extent industry was hampered by lack of a supply of labour, it is certain that it was hampered also (and probably more) by lack of fuel. The causes of France's relative decline are thus to a large extent independent of policy, though it is no doubt arguable that some of them may be traced to the political strength of the peasant interest, which has been so much more important there than in either Britain or Germany.

4. PRE-WAR ARMAMENT EXPENDITURE

A good deal of light can be thrown upon the political history of the pre-war period and on the events of the war itself by a study of the League of Nations *Armaments Year Book*. Of all the data assembled in that book, moreover, none are so succinctly informative, if placed correctly in their context, as the figures of armament expenditure. Not only is the nature of modern armaments such that their cost is generally more significant than the numbers of men trained to use them, but this cost is easily related in most cases to the whole resources of the nation concerned as measured by its national income, thus enabling a very simple measure to be constructed of the extent to which a country is directing its efforts to warlike ends. The proportion of national income—of the money value of all goods and services produced in the country concerned in a year—which is represented by the production or purchase of arms, the pay and maintenance of troops, etc., requires, of course, careful interpretation, since how easily a nation can afford to devote a given proportion of its total income to armaments depends on a number of further variable factors, notably the average level of income per head and the manner in which income is distributed between individuals. It is necessary to bear these qualifications in mind in the following discussion.

The data in the table below refer to 35 countries and to the two years 1934 and 1938. The former year is chosen because it was the last one in which none of the countries concerned was at war, and the latter year because it was the last one before the outbreak of war on a large scale. In 1934 German re-armament had already begun, so that the situation was governed neither by the letter of the

Footnotes to Table VII.

[1] See Section 2.
[2] Including the cost of public works, etc., relating mainly to National Defence.
[3] See Section 1. The figures for 1938 purport to show *actual* expenditure (not budget estimates).
[4] Including (for 1938) estimates of extraordinary expenditure in Africa.
[5] Including (for 1938) estimates for "China Incident."
[6] Including a rough estimate of expenditure out of foreign loans in 1938.
[7] Excluding sums voted in respect of arrears (these were very large in 1934).

TABLE VII.

ARMAMENT EXPENDITURE, 1934 AND 1938.

	1 Expenditure in 1934 (million £).	2 1934 Expenditure as % of National Income.	3 Average Expenditure per head of population, 1934. (£)	4 Estimates of Expenditure in 1938 at 1934 prices.	5 % increase in real value of Expenditure 1934-38.
United Kingdom	99·1	2·4	2·1	350·0	250
United States	158·0	1·5	1·3	222·0	41
U.S.S.R.[1]	200·0	5·6	1·2	950·0	370
France [2]	149·0	5·1	3·7	210·0	41
Total	606·1			1732·0	186
Germany [3]	280·0	6·1	4·2	1600·0	470
Italy [4]	84·0	8·0	2·1	131·0	56
Japan [5]	75·0	7·5	1·1	415·0	455
Total	439·0			2146·0	388
Canada	4·2	0·6	0·4	6·5	55
Australia	4·2	0·8	0·6	9·3	123
New Zealand	0·7	0·6	0·4	1·9	172
South Africa	1·3	0·4	0·1	3·1	140
Eire	1·3	1·2	0·4	1·6	26
British India	30·2	1·5	0·1	31·6	4
Total: Dominions and India	41·9			54·0	29
Belgium	11·6	2·8	1·4	11·6	0
Netherlands	7·6	1·5	0·9	14·6	92
Portugal	4·9	5·9	0·6	6·5	33
Norway	1·9	1·7	0·7	2·2	14
Sweden	6·7	1·8	1·1	13·3	98
Denmark	1·8	1·1	0·5	3·9	115
Switzerland	5·5	1·4	1·3	10·2	86
Total: small Western countries	40·0			62·3	56
Estonia	0·9	7·0	0·8	1·1	28
Lithuania	1·5	4·2	0·6	2·6	74
Latvia	1·7	3·8	0·9	2·0	15
Finland	3·4	4·7	1·0	4·9	43
Poland [6]	18·3	4·8	0·5	28·8	56
Czechoslovakia	16·4	4·0	1·1	37·7	130
Austria	4·2	1·6	0·6	8·9	112
Hungary	4·8	2·6	0·5	7·0	47
Rumania [7]	12·4	6·9	0·7	15·0	17
Bulgaria	2·1	3·0	0·3	2·7	28
Yugoslavia	8·2	4·9	0·5	9·5	16
Greece	3·5	5·0	0·5	4·9	40
Total: Eastern European countries	77·4			125·1	62
Egypt	1·9	0·9	0·1	7·2	280
Argentina	10·0	2·5	0·8	15·7	57
Chile	3·6	3·9	0·7	4·5	25
Total: All countries listed	1219·9			4146·8	240

[*For notes see opposite*].

Versailles settlement nor by the full urgency of an armament race. It may not be too much to say, indeed, that, but for the aggressive intentions of what subsequently became the Axis Powers, armament expenditure might have continued for a long time at something not far different, in most cases, from the levels of 1934, which do not show any very great disparity as between the seven countries which most definitely claim the rank of Great Powers—the countries which set the pace for the world in general. This makes 1934 an interesting year to take as a starting-point.

The first column of the table on p. 41 shows the total armament expenditure of the 35 countries under discussion in the financial year 1934 or 1934-5, converted to sterling. The rate of exchange at which the conversion has been done is in most cases the market rate, but, for Germany and Japan, where these rates were particularly inappropriate, rates of 14·5 Rm. and 12 Yen to the £ respectively have been used. Some injustice may have been done to certain smaller powers in not using special rates similarly designed to reflect the real purchasing powers of their currencies over armaments for them also, but the general picture is probably not much distorted by the failure to undertake this difficult and laborious correction. The figures for German and Russian armament expenditure used here are calculated on the basis of estimates from Sections 1 and 2.

Several points of interest immediately attract the attention in connection with the position in 1934. In the first place, the preponderance of the seven Great Powers at the head of the table was even then very marked—they were responsible for over 85 per cent. of the total expenditure of all the countries listed, which must be very nearly the total armament expenditure of the world. Nevertheless, there was no marked tendency at that time for the Great Powers to spend a higher proportion of their national incomes on armaments than the smaller countries did. The Eastern European countries (except Austria, Hungary, and Bulgaria, where limitation of armaments under the Peace Treaties was still to a considerable extent effective), all spent about the same proportion of their resources on armaments as did Germany, France, and Russia, though they were much less able to afford this from the economic point of view than Germany or France, and less able still

than Britain or the United States, which spent a much smaller proportion of their resources on armaments. The small countries of Western Europe, on the other hand, with the significant exception of Portugal (significant because Portugal was far poorer than any of the others listed), spent on armaments a proportion of their national income much more like the proportions spent by Britain and the United States. Indeed, it is evident from the data given in the third column of the table that the average armament expenditure per inhabitant was, in 1934, much more nearly constant among the smaller countries of Europe than the great differences in their average incomes per head might lead one to expect. Armaments, in Europe, seem to have been regarded as something like a fixed charge, depending on the size of the country to a large extent, but not at all closely related to the resources out of which it had to be met, so far as states other than Great Powers were concerned. They were a much heavier burden to the poor small country than to the richer small country. Outside Europe the expenditures on armaments were generally much lower, in relation both to national income and to population.

Among the Great Powers, it is very significant that two of the three which spent far the highest proportion of their national incomes on armaments—Italy and Japan—had the smallest material strength, and the loosest hold on the political status which they claimed. The French expenditure was almost certainly considerably less than the German in total, and also, probably, in relation to the population ; how high a proportion of the national income was used for armaments in France is not clear because the national income itself is very uncertain, and the same obscurity exists for Germany because expenditure there is uncertain, but it is probable that (as suggested in the table) the German proportion was higher. What is certain, of course, is that the proportions in Britain and the United States were well below the French and German levels, the *per capita* expenditure on armaments in Britain being somewhere between that of the Great Powers and that of the small powers of Continental Europe, while the United States spent no more on defence, per head of population, than many of the smaller European countries.

In the fourth column of the table, the budget estimates

of armament (and allied) expenditure for 1938 (or 1938-9) have been reduced to the price-level of 1934 by the use of the wholesale price index for each country, and converted to sterling in the same way as the figures in column 1. In column 5, the percentage increase of column 4 over column 1 is shown. In the extents to which various countries increased their real expenditure on armaments between 1934 and 1938, both political and economic factors are to be discerned. The large increase in Japanese expenditure was due, of course, to the cost of the Chinese war, which is included in the figure for 1938. The similar German increase provides the political key to most of the other increases, though it must be remembered that the *actual* (as opposed to the *estimated*) expenditures of some other countries for 1938 would also be larger than those given. Most of the countries directly threatened by German re-armament show large increases in their armament expenditure over the period concerned—Poland, Czechoslovakia, and the U.S.S.R. (especially the last) increased their expenditure heavily, although the burden of it on their resources was already considerable. Many countries whose armament expenditure imposed a smaller burden on their resources in 1934 also increased it very greatly, the ease with which this could be done and the inadequacy of existing armaments in some cases accounting for this result in large measure. This was notably the case in the British Dominions, Denmark, Sweden, the Netherlands, Egypt, and the United Kingdom. It is surprising to find, however, that Belgium, despite the obvious nature of the menace to her security and the fact that the initial drain of armaments on her resources was not large by Continental standards, did not increase her real expenditure on them, being the only one of the countries considered here which did not do so. Other Continental countries—notably the Balkan countries—did not increase their real expenditure very much because they could not afford to do so, the strain of their expenditure in 1934 already being very heavy. This was clearly the case in Italy, where, despite the added commitments of expensive operations in Abyssinia and Spain, the increase in the *real* value of expenditure was not strikingly large. The large increase in Austrian expenditure and the considerable increase in that of Hungary are to be accounted for, of

course, largely by the fact that armaments in those countries were still fairly effectively limited to low levels by treaty in 1934, and that this restraint was afterwards either evaded or (in the case of Austria, in 1936) openly thrown off.

The expenditures for 1938 (at the wholesale prices of 1934) shown in the table are, it must be repeated, nearly all based on the estimates for that year, and the actual expenditure in most cases doubtless exceeded these estimates. Nevertheless, the total arrived at for 1938 shows an increase of no less than 240 per cent. over that of 1934. It is very noticeable that the seven Great Powers are responsible for a proportionate share of this increase far larger than their share for the original expenditure of 1934. Their expenditure increased by 272 per cent., as against only 51 per cent. for the 28 other countries listed; their share of the total expenditure of the 35 states concerned rose from 85 per cent. to over 93½ per cent. What is even more interesting is the change in the expenditure of the Axis countries relatively to that of the other four Great Powers and of the whole world. Axis expenditure on armaments increases in the four years concerned from about 35 per cent. to some 52 per cent. of the total armament expenditure of the countries dealt with here. It increased by some 388 per cent., as against an increase of 186 per cent. on the part of Britain, the United States, the U.S.S.R., and France combined; it started nearly 28 per cent. less than the expenditure of those four powers and finished 24 per cent. above it.

The powers which faced Germany in September 1939—France, Poland, Britain, India, and the belligerent Dominions—had budgeted in the previous year for an armament expenditure little more than a third as great as that of Germany. Russia, which had spent in 1938 more than all of them—nearly enough to make their expenditure up to that of the Reich—was not brought into the struggle for nearly two years: the United States, with its enormous resources, was not only pledged to neutrality, but had hitherto been spending on armaments only about as much as France. When to these facts is added the geographical dispersion of the countries which have fought the Axis powers in this war, the general trend of events after September 1939 is to no inconsiderable extent accounted for.

CHAPTER II

ECONOMIC WAR EFFORTS—A COMPARISON

1. THE UNITED KINGDOM, 1914-18 AND 1939-44

THE preceding chapters have attempted to measure and compare the economic tasks undertaken by certain countries in the years before they became involved in the Second World War. Before going on to compare their economic achievements in the war itself, it may be interesting to see what can be done in comparing the United Kingdom's economic war effort in the years 1939-44 with that of 1914-18. The British economic effort in the recently ended war is extremely well documented; the sources from which resources were drawn for it have been analysed in successive White Papers, the latest of which, at the time of writing, is Cmd. 6623 of April 1945. For the previous World War there is no comparable record; unofficial estimates of the British national income in various years before its outbreak exist, as do similar estimates for 1924 and later years. In between these two points there is little evidence on which to base an estimate. Similarly, there is practically no direct evidence as to the course of private net investment during those years, and little to indicate the course of private consumption, so that it is extremely hard to see from how big a cake the known resources used for war were cut, and what were the sizes of the slices left over.

The problem of estimating the national income and its main components was attacked by the present writer in Oxford Economic Papers, No. 3, of February 1940. Two methods of approach to it were there tried. In the first place, it is found that " Country " bank clearings afford (in ordinary times) an excellent basis for finding by interpolation the national income in years between those for which reliable estimates are available. This method is, of course, somewhat unreliable when applied to the war years, when the monetary circulation was in an abnormal state, and the probability

seems to be, on reflection, that it led to underestimation for those years—partly because the proportion of total transactions carried out in cash probably increased, and partly because it cannot take adequate account of incomes received in kind by the Forces, or of large parts of the incomes of those serving abroad.

Secondly, data exist on employment changes throughout the war of 1914-18 in a number of occupations comprising, in all, about half the total occupied population. By applying these changes to the net outputs of the occupations concerned (and related ones) as revealed by the 1907 Census of Production, the Board of Agriculture inquiry of 1908, and Professor Bowley's *Division of the Product of Industry*, 1911, inflating the various components to allow for price changes, and then adding an estimate of the income (in cash and kind) of the Forces and income from abroad, it is possible to make an independent estimate of national income in, say, 1918.

The gross figure arrived at for 1918 by the first of these methods was £4,720 million; the second yielded a result of £5,000 million. The first, as has already been mentioned, is probably too low; the second may also be too low, since an allowance was made in it for lower output per man-hour owing to labour dilution, but it was assumed that overtime, technical progress during the war years, and any falling-off of productivity due to the ageing of the labour force, depletion of capital, etc., cancelled each other out—whereas in fact their net resultant may well have been on the credit side. Nevertheless, it does not seem likely that this second estimate is far below the truth, in which case it follows that real gross national income in 1918 was little higher than that of 1914; the home-produced income excluding the Forces' share appears, before inflation to 1918 prices, to have been at about the 1914 level, and while the Forces' contribution was of course far greater in 1918 than in 1914, this was partly offset by a decline in the real value of income from abroad. On balance, it does not seem that the gross national income of 1918 can have been more than 10 per cent. above the pre-war level, and it may, indeed, hardly have equalled it. In current values it was probably some £5,000 to £5,500 million. Depreciation was probably such as to bring the net income figure down to

£4,600 to £5,050 million. It may be estimated (with the help of the clearing statistics) that the corresponding figure for net income in the financial year 1917-18 would be £4,000 to £4,400 million.

Exhaustive public expenditure in that year (the heaviest of the war) amounted to about £2,500 million, of which some £1,960 million was due to the Fighting Services, the Ordnance Factories, and the Ministries of Munitions and Shipping. Purchases of goods and services for war purposes (in a fairly narrow sense) thus equalled about 44 to 49 per cent. of the net national income, and total exhaustive expenditure by public authorities some 57 to 62 per cent. of it. In that year, however, the United Kingdom's flotation of loans abroad amounted to £627 million, and this figure does not fully measure net foreign disinvestment, since some British-held foreign securities were repatriated, and there may also have been changes in foreign holdings of assets in the United Kingdom. Much of the war expenditure, therefore, was provided from abroad.

If the flotation of loans abroad had, in fact, corresponded to total foreign disinvestment, then the portion of the national income available for private use in the absence of net disinvestment at home would have been £2,127 to £2,527 million. This is to be compared with some £2,104 million privately used in 1913-14, which, at the prices of 1917-18, would have been about £3,600 million (£2,810 million consumption and £790 million private net investment). Thus, with private net investment at zero in 1917-18, the amount available for private consumption would have been only two-thirds of the amount consumed in 1913-14. What evidence is there as to what actually did happen to consumption?

There is not much; consumption data are available for 14 principal foodstuffs and for tea, beer, and tobacco, from which an index can be constructed which, after allowance is made for consumption by the Forces stationed at home, shows a fall of about a quarter between 1913-14 and 1916-17. Average sales per member by the Co-operative Societies, deflated by Professor Bowley's adjusted Cost of Living Index, however, show a fall of rather under 20 per cent., which is probably a more representative figure. Since there is no evidence available which bears upon considerable

portions of consumption (*e.g.*, travel, luxury expenditure), it is impossible to form any definite estimate of the course of consumption as a whole, but it seems certain that it fell by considerably less than a third in real terms, though there doubtless was a substantial decline. There must, indeed, have been some disinvestment at home; an uncertain amount of borrowing from abroad, in addition to the £627 million already taken into account, must also be allowed for.

What, in comparison with this blurred and incomplete picture, are the salient features of the United Kingdom's war effort in 1939-44? The figures in Table VIII are taken from Cmd. 6623, and show the changes in the national income and its chief components.

TABLE VIII.

The National Income of the United Kingdom and its Main Components, 1938-44 (Million £).

	1938	1939	1940	1941	1942	1943	1944
Net National Income at Market Prices ...	5242	5657	6759	7974	8762	9365	9594
Government Purchases of Goods and Services	939	1360	3081	4204	4577	5151	5179
Of which connected with the War ...	358	795	2575	3700	4062	4647	4678
Net Investment Abroad	−70	−250	−796	−795	−666	−684	−655
Private Net Investment at Home and War Losses made good*	220	283	51	−68	−58	−84	−146
Private Consumption	4153	4264	4423	4633	4909	4987	5216

* Including work in progress on Government account held under private finance.

It is a little difficult to say what is the real change in the national income here set out in current values. The real change in private consumption has, indeed, been officially estimated; the White Paper puts 1943 consumption (the lowest of the war) at £2,798 million at 1938 prices (excluding the effects of indirect taxation and subsidies), or 78 per cent. of that of 1938. The levels of the previous and the succeeding year were both a little higher—80 per cent. of 1938. As to the remainder of the national income—Government purchases and net investment at home and abroad—it must be valued in the light of the facts that wholesale prices of materials rose by 64 per cent., wage rates by 44 per cent., and the tax and subsidy-free retail

prices of goods and services bought for consumption by 45 per cent. between 1938 and 1944. It is therefore likely that the rise in the price of the national income components concerned was some 50 to 55 per cent.—the increase in the cost of labour would be rather higher than that of wage rates owing to the increased frequency of overtime, and the still higher rise of material prices must be given due weight. By excluding indirect taxation entering into it, and deflating by the rough price index just discussed, Government purchases of goods and services in 1944 may be estimated at about £3,180 to £3,280 million at 1938 values ; war expenditure would be perhaps £2,800 to £2,900 million at this price-level. Disinvestment in 1944 may be similarly estimated at £550 to £570 million at 1938 prices—the whole net national income of 1944 at the prices of 1938, excluding the effects of indirect taxation and subsidies would therefore have been perhaps £5,488 to £5,570 million, or about 20 per cent. higher than the 1938 income similarly valued. A similar calculation by the *Economist* shows a rise of 23 per cent. The proportion of the net national income devoted to war purposes reached a maximum of 61 per cent. in 1943 if indirect taxes and subsidies are excluded—if the calculation is made on the basis of market prices (as was done in the 1917-18 calculation above) the proportion is 55 per cent.

Thus, the real national income increased very substantially more between 1938 and 1944 than it did between 1913-14 and 1917-18 (if, indeed, it increased at all between the latter pair of years). Consumption appears to have fallen, proportionately, about as much in the Second World War as in the First, or perhaps a little more. The ratio of public exhaustive expenditure to net national income does not seem to have been higher in 1944 than in 1917-18—if as high—and, while it is somewhat difficult to say precisely what items in the 1917-18 accounts correspond to the White Paper's definition of " goods and services connected with the war " for 1944, it seems that the ratio of war expenditure to net national income was also no higher in the later than in the earlier of the two years compared.

The ratio of war expenditure or of total exhaustive public expenditure included in the Budget to net national income may, however, be misleading. In neither of the

two wars has either the economic war effort or private consumption been provided fully from current home output or current overseas earnings—and it is impossible to say to what extent the drafts upon domestic capital and capital receipts from abroad have contributed to the public and the private sectors of the economy respectively. All that can be said is that the net national product was supplemented by borrowing abroad, and that the total of national output and borrowing was divided in a certain way between certain uses. The total available resources in 1917-18 were, apparently, some £4,627 to £5,027 million, *plus* whatever was made available by private disinvestment at home and by disinvestment abroad additional to the Government's loan flotations—say £5,000 to £5,500 million in all. Of this, 45 to 50 per cent. was used by the public authorities, most of it for war purposes.

Secondly, in the Second World War (in contrast with the First) some foreign contribution to the United Kingdom's war effort did not enter into its budget accounts. In 1944, the total available resources were : a net national output (at market prices) of £9,594 million, £655 million borrowed from abroad, £146 million by private disinvestment at home (less expenditure on making good war losses), and some £1,300 to £1,400 million of goods and services delivered by the United States under lend-lease and by Canada under mutual aid. The resources made available to (or by) the United Kingdom were thus, in round figures, some £11,700 to £11,800 million, of which private consumption accounted for about 44 per cent., the public authorities using 56 per cent. Thus, owing to the fact that in the Second World War lend-lease and mutual aid contributions did not enter the United Kingdom budget, a comparison in terms of the ratio of Government exhaustive expenditure to the net national income (or even to the net national income *plus* disinvestment) is misleading. Of the total resources given or lent to us, currently produced by us, or taken from our own stocks, a markedly higher proportion were used by the public authorities (and used for war purposes) in 1944 than in 1917-18.

To make any comparison between the national incomes of the United Kingdon, between the total magnitudes of the resources made available, or between those used for

war, in 1917-18 and in 1944 respectively is a hazardous task. The net national income of 1917-18 may first be reduced to the prices of 1913 by deflating its various components with the help of what seem the most appropriate price indices —the *general* price index for 1917-18 (1913 = 100) implicit in the result is 171. Mr Clark, in *National Income and Outlay*, has calculated (or left implicit in his results) general price indices, applicable to the whole national income, which connect 1935 with 1913; the different composition of the 1917-18 income, however, requires some change in the weights of the various components for which a rough allowance can be made. The index can then be carried down to 1938, and from there to 1944, using the fact that the money national income of 1944 was 83 per cent. greater than in 1938, but (as calculated above) probably about 20 per cent. greater in real terms. (The compositions of the incomes of 1944 and 1917-18 are sufficiently similar to render this basis an adequate one for the very rough calculation in hand.) When all this is done, it seems probable that the 1917-18 net national income would, at the prices of 1944, have amounted to perhaps £6,000 to £6,500 million. The net output of the United Kingdom was therefore perhaps some 50 per cent. greater at the height of the Second World War than at the height of the First.

Resources obtained otherwise than from British current net output seem to have formed roughly the same proportion of the total made available in 1917-18 as in 1944—in both years they were apparently something approaching a fifth of the whole. It is therefore likely (despite many qualifications that might be made) that the resources made available to (or by) the United Kingdom were about half as great again in the second of the two years compared as in the first. As has been suggested above, however, the public authorities' relative share of these resources was greater in 1944 than in 1917-18, and the same is doubtless true of the proportions of them used for " war purposes," however defined.

The summarised result of these very tentative comparisons is thus as follows: The United Kingdom entered the Second World War with a net national output (or income) considerably greater, in real terms, than that with which it entered the First—probably, indeed, about 25 per cent. greater; an estimate consistent with a rate of increase

of rather over 1½ per cent. per annum between 1924 and 1938 if (as is probable) the output of 1924 was similar to that of 1913. In the First World War, however, the net output of the country was not substantially increased, whereas in the Second it rose by probably some 20 per cent. —a contrast to be explained partly by the higher rate of unemployment in 1938 as compared with 1913 (which made a greater expansion of the active labour force possible) and partly by the relatively high productivity of labour in certain war industries, such as the aircraft industry, which were more important in the Second World War than in the First. Contributions to the United Kingdom's war effort from abroad and from disinvestment at home were equivalent to something like a quarter of its own net output in 1944, and possibly about the same proportion in 1917-18, but their absolute magnitude, like that of the war effort, was, of course, much greater in 1944. As for consumers' expenditure, it may be that it fell from 1913-14 to 1917-18 in much the same proportion—a fifth—by which it fell from 1938 to 1944, but no precision can be given to this comparison.

Consumers' outlay was, of course, smaller (in real terms) in 1913-14 than in 1938; it constituted, moreover, a smaller proportion of the net national income reckoned at market prices (75 per cent., against nearly 80 per cent. in 1938). Thus, the contribution to the war effort, either in absolute value or as a proportion of total output, which might be attributed to a given proportionate reduction in consumption was smaller in the First World War than it has been in the Second.

These rough comparisons of the rates at which resources were produced or used for war purposes by the United Kingdom in the two wars fail, however, to reflect two important differences relevant to any comparison of the country's total economic efforts in the two emergencies—namely, the fact that the Second World War lasted (for the United Kingdom) some 40 per cent. longer than the First, and that she entered it with a higher proportion of her resources devoted to defence, and reached a high state of economic mobilisation sooner in it. If these facts are taken into account, it seems that the country's real expenditure of resources for war—whether the calculation is confined to

those she produced herself, or includes those received from abroad—was more than twice as great, and possibly 2½ times as great in 1939-45 as in 1914-18. Whether that portion of the real economic cost of the war which remains to be discharged after it—the arrears of normal economic progress, and the after-burden of external disinvestment—will bear a similar high proportion to that which fell on British shoulders in the twenty years after 1918 is, however, still a largely open question.

2. THE UNITED STATES, 1939-44

The economic war effort of the United States in the Second World War has been as well documented as the British; the story of the remarkable development of the United States economy and the national income has been set out in detail in a number of official publications, so that all that it is necessary to do here is reproduce Table IX, drawn from the Department of Commerce's *Survey of Current Business*, and point out the salient features which it presents.

Its most remarkable feature is, of course, the more than doubling of the national income (measured at current prices) within four years. The increase in real income was not as great as this; it was, nevertheless, a most astonishing one—there can be no doubt that gross (and net) national income, measured at the prices of 1939, rose by at least 50 per cent. between 1939 and 1944; an increase to be compared with one of about 20 per cent. in the United Kingdom. The anatomy of this increase is plainly visible. In the first place, the total labour force was expanded by nearly 10 million, or 18·3 per cent. (from 54·1 to 64 million in all), almost entirely by drawing normally unoccupied persons into work—this went far to cover the withdrawal of over 11 million into the Armed Forces during the same period. An almost equally large reserve of manpower, however, was provided by the unemployed, who numbered 9½ million in 1939, but less than 1 million in 1944. Thus, the population in work (including the Forces) rose by no less than 40 per cent., and the employed civilian labour force alone by 17 per cent. This is to be compared with the much smaller expansion in the United Kingdom, where a higher proportion of the total adult population was occupied (*i.e.*, in or seeking work) at the beginning, so that it could be expanded only by about 11 per cent., while the reserve of unemployed (ultimately almost exhausted) was also much smaller, proportionately, than in the United States, with the result that the proportionate increase in the population in work (including the Forces) between 1939 and 1944 was only 19 per cent. (about the same as the proportionate

[1] See note on p. 61.

increase in real output), and the civilian labour force in work was actually diminished by more than a million (nearly 7 per cent.) through withdrawals for the Forces and Civil Defence.

In addition, the working week in the United States industry was lengthened (by about 20 per cent.) and physical productivity per man-hour increased, largely, no doubt, owing to the 50 per cent. addition which was made to industrial plant and equipment. Physical productivity in agriculture also increased, owing largely to a succession of unusually favourable seasons. The proportionate lengthening of the working week was, again, greater than in the United Kingdom, where the initial hours of work were more than 20 per cent. longer, and—though the evidence is scanty—it does not seem likely that British productivity increased to anything like the same extent as in the United States. Thus, there is no difficulty in accounting for the enormous increase in the real national output of goods and services in the U.S.A., or for the fact that it was, proportionately, much greater than in the United Kingdom. The United States' initial unused reserves, especially of manpower, were vastly greater, a fact which had not only the obvious, direct bearing on the possibility of expanding output, but some important indirect ones also. In the first place, the fuller utilisation of plant by multiple-shift working and the lengthening of hours increased the average output per man-hour by spreading the overheads over more units of output; secondly, the fact that plant was extended so much—new plant and equipment was, in fact, installed to about half the value of that already existing—meant that overall average technical efficiency of plant in use was increased very rapidly, especially as this great expansion followed a decade of semi-stagnation. A further factor connected with the initial expansibility of the economy was the improvement in the general level of nutrition which accompanied United States economic mobilisation, and doubtless contributed something to the general increase in the productivity of labour there. In comparing the United States' experience with that of the United Kingdom—where the output of very heavy workers, at least, has probably suffered because of food shortage—it must also be remembered that air bombardment appreciably affected the expansion of British output by the physical damage and loss of time it caused,

by the strain which it (and the blackout) imposed on the population, and by necessitating some uneconomic dispersion of munition production which the United States were able to avoid.

In proportion to the enormous total net output attained in 1944, output for war (including, of course, all lend-lease) was rather smaller than in the United Kingdom—45·5 per cent. against 48·8 if income is measured at market prices in both countries. As was pointed out in a previous section, however, it may be misleading to relate the resources used for war (or any other specific purpose) to the current net output when that output is not the sole source of the resources which are currently available. The United States, like the United Kingdom, drew some resources for current use from the depletion of capital, though, relatively, to a much smaller extent. Net investment (excluding public capital formation) became negative in 1942, after standing at a very high level in 1941, and in both 1943 and 1944 current net output was supplemented to the extent of rather less than 4 per cent. by disinvestment (the corresponding British figure, excluding lend-lease receipts and counting war damage repairs as investment, was over 8 per cent. from 1940 onwards). Only 29 per cent. of the United States disinvestment in 1944, however (and less of it in 1943), was in the form of net imports of goods and services, excluding lend-lease; over four-fifths of British disinvestment was in that form. There is, naturally, a stricter limit to the depletion of home than of overseas capital over any considerable period of time if the economy is to be kept in working order; since the United Kingdom drafts on capital were so much heavier (in relation to national income) and longer continued than those of the United States, it was inevitable that they should consist to a greater extent of disinvestment abroad.

If, therefore, one considers the proportion of the resources made available (by disinvestment as well as current net output) which was utilised for war purposes in 1944, it is about 44 per cent. for the United States and 45 per cent. for the United Kingdom. If, however, one includes the lend-lease and mutual aid receipts of the United Kingdom as resources made available to it and used for war, its ratio is raised to 51 per cent.

Ignoring the lend-lease and mutual aid receipts of the United Kingdom, one finds, therefore, that it did not devote to war purposes a significantly greater proportion of the resources made available by net output and disinvestment in the year 1944 (reckoned at local market prices) than did the United States. The greater expansibility of the United States net income under war conditions,

TABLE IX.

U.S. National Income, 1939-44 (Billion $).

	1939	1940	1941	1942	1943	1944
PUBLIC EXPENDITURE.						
Defence Expenditure on Goods and Services ...	1·4	2·8	13·3	49·5	82·5	86·3
Non-defence Public Expenditure on Goods and Services	12·7	12·4	13·2	12·4	12·3	13·0
PRIVATE EXPENDITURE.						
Consumers' Durable Goods	7·1	8·3	9·1	6·3	6·6	6·7
Consumers' Non-durable Goods and Services ...	56·4	59·4	65·4	75·5	84·4	90·9
Gross Private Investment	10·2	13·2	19·4	7·7	2·1	1·8
GROSS NATIONAL INCOME AT MARKET PRICES ...	87·8	96·1	120·5	151·5	187·8	198·7
Depreciation, etc. ...	7·0	7·1	7·8	8·3	8·9	9·1
NET NATIONAL INCOME AT MARKET PRICES ...	80·8	89·0	112·7	143·2	178·9	189·6

however, enabled it not only virtually to equal the British achievement in this respect with smaller drafts on capital, as already explained, but to do so in spite of an increase in the real volume of consumers' outlay of some 10 per cent., whereas the United Kingdom had to effect a reduction of about 20 per cent. This was, indeed, the most striking difference between the economic war efforts of the two countries; whereas the United Kingdom both suffered a reduction of consumption during the war, and finished it with a much depleted stock of capital wealth, the United States, owing to its larger initial reserves of unused productive resources, was able to consume more during the war and to finish it with an increased stock of capital—since Government-constructed additions to plant useful for peace as well as for war purposes more than counterbalanced the considerable wartime drafts on private capital goods and stocks.

Any comparison of the magnitudes of the British and United States national incomes and war expenditure is, like all such comparisons, fraught with difficulties and dangers. With the help of the remarkable data published in the Report to the Combined Production and Resources Board on *The Impact of War on Civilian Consumption*, something can be attempted. First, it will perhaps be useful to reproduce in Table X the estimates there given of the British and United States national products adjusted as far as possible to identical definitions, which, however, do not correspond exactly to those used in the official Statistics of either country, which have hitherto been used here. (The " gross national product " is the same as the " gross national product at market value " of Cmd. 6623, *minus* indirect taxes and rates, *plus* net indirect taxes falling on exports, *minus* war risk insurance premiums, *plus* subsidies.)

From these figures of total income at current prices and in different currencies, one may work towards figures in sterling from both countries. First, consumption may be dealt with—the data needed are all given in the above-mentioned Report. From a direct comparison of pre-war real *per capita* consumption (showing British to be 80 to 90 per cent. of the United States), coupled with the statistics of consumers' expenditure in the two countries, it appears that, in 1938-9, a pound sterling was equivalent to about 4·93 United States dollars over this field as a whole, whence the United States consumers' expenditure in 1938 may be seen to be equivalent to £13,450 million, United States real consumption increased by some 19 per cent. in real terms between that year and 1944, and the price index of British consumption increased in the same interval by 53 per cent., whence it may be estimated that United States consumers' expenditure in 1944 was equivalent to about £24,500 million at the British prices then ruling. The British equivalent of United States military expenditure is rather harder to estimate; it is known from the Report just cited that United States munition production in 1943 was about four times as great as British in real terms, and roughly the same ratio would hold for 1944. Unfortunately the total value of the United Kingdom munition output is not published; in the United States it was then $64 billion,

or three-quarters of all war expenditure. Here, the proportion would probably be smaller (since we were net receivers, not exporters, of munitions under lend-lease and mutual aid); the value of United Kingdom munition output might be put at £2,500 million (out of a total war expenditure of £4,493 million). In that case, United States

TABLE X.

U.K. and U.S. Gross National Products as defined in C.P.R.B. Report.

	United Kingdom. Million £.		United States. Thousand Million $.	
	1938	1944	1938	1944
National Cost of—				
Consumption (including Subsistence of Forces)	4090	4752	66·3	107·3
War	348	4493	1·1	86·3
Gross Non-war Capital Formation at Home and Abroad	691	−358	8·8	3·1
Gross National Product	5129	8887	76·2	196·7
Depreciation and Maintenance ...	440	475	9·2	12·3
Net National Income	4689	8412	67·2	184·5

munition output would be worth some £10,000 million at current British prices, and the £ would, in this field, be worth some 6·4 dollars—a figure well in accordance with the remark in the first White Paper on mutual aid, which declared (with regard to goods transferred under lend-lease) that "American book costs probably exceed similar British costs by more than 50 per cent." The remaining United States war expenditure might be converted into sterling at a higher rate, in view of the high level of United States service pay in relation to British; $22 billion in this field of expenditure was probably equivalent to no more than £2,500 or £3,000 million. Finally, the gross capital formation of $3·1 billion may be put down as equivalent to £500 million. The total United States gross national product, on this reckoning, appears to have been equivalent at the British prices of 1944 to some £37,500 to £38,000 million, or just over four times the British.

According to these rough comparisons—which, however, seem well in accordance with the available data—the United States gross national product per head of the population in 1938 was only about 10 per cent. greater than the British,

whereas in 1944, at the height of the war effort of both countries, it exceeded it by some 50 per cent. It is also perhaps worth noting that, when the valuation of the various components of the national product is made at the same prices (in this case the British) for both countries, the proportions of those products which were devoted to war compare rather differently from the proportions measured at national prices. The British proportion, according to the definitions used in the C.P.R.B. Report, was 50·5 per cent.; the United States figure (calculated from the dollar values given in the same Report) was some 44 per cent., but if calculated in sterling values as above it works out at about one-third. This is probably the best measure which can be given, from data so far published, of the relative extents to which the British and United States economies were geared to the war effort in 1944.

Note.—In this section about the United States the word "billion" is used in the traditional American sense of a thousand million. It thus has of course exactly the same connotation as "milliard" in other sections; it would appear more incongruous to use "billion" in the American sense in a European context or "milliard" in an American one than to make use of both these terms in the appropriate places.

3. GERMANY, 1939-44

As was mentioned in Chapter I above, the United States Strategic Bombing Survey, Overall Economic Effects Division, have prepared an extremely careful estimate of the gross product of Germany, Austria, the Sudetenland, and Memel for the years 1936 to 1944, which (like the Strategic Bombing Survey in general) has received far less than the attention which it deserves. So complete is the picture of the structure and the general development of the German economy in the war period which it affords, that it will hardly be necessary here to draw upon other sources.

The main components of the national product of Germany, as delimited in September 1939, are shown in Table XI, measured (as the U.S.S.B.S. measures them) at

TABLE XI.

Gross Product and Total Available Resources of Germany, Austria, the Sudetenland, and Memel 1939-44, valued at the Prices of 1939 (Milliard Rm.).

	1939	1940	1941	1942	1943	1944
Consumers' Expenditure ...	81	75	73	66	65	59
Gross Domestic Capital Formation	14	10	7	6	5	3
Domestic Output available to the Government	43	53	66	74	77	87
Gross National Product at Market Prices (excluding Interest on National Debt) ...	138	138	146	146	147	149
Foreign Contributions ...	—	9	19	26	29	21
Total Available Resources ...	138	147	165	172	176	170

the prices of 1939. This table is, indeed, the continuation of Table III in Chapter I, except that the latter refers to the Old Reich only. Making allowance for the territorial changes of 1938-9 by speaking throughout of Germany as constituted at the outbreak of war, one sees that gross national product rose by about 10 per cent. from 1938 to 1939, made a further jump of nearly 6 per cent. from 1940 to 1941, and a final, smaller, one towards the end of the war. In 1944 it was, however, only some 17 per cent. higher than in 1938—a striking contrast with the course of events in the United States, and a smaller increase, in all probability,

than was attained in the United Kingdom. Contribution from abroad—in the form of taxation from the territories incorporated in the Greater Reich during the war, in the form of " occupation costs," requisitions, etc., from defeated countries, and against the clearing balances accumulated by other countries—produced a much more impressive increase in the total resources available to the Germans. This total, in 1943 (when it was at its peak), stood 37 per cent. higher than in 1938, foreign contributions constituting about a sixth of it. It may be roughly estimated that the gross product of Greater Germany, as delimited in 1943 (including the incorporated parts of Poland, France, and Yugoslavia, as well as Austria, Memel, and the Sudetenland), was about 25 per cent. greater than that of the Old Reich alone in the same year, and perhaps 12 per cent. greater than that of " September 1939 " Germany, which is referred to in the table. Thus, after the outbreak of war, the resources available to the German nation as a whole were increased more by conquest and various forms of borrowing and taxation abroad than by its own labour.

To return, however, to Germany as constituted at the outbreak of war; how was the wartime increase in its output achieved? Moderate though that increase is, it must be remembered that it followed on a 28 per cent. increase during the years 1936-8, achieved under conditions which, even initially, corresponded to substantially " full " employment as understood in other advanced countries in peacetime, and is therefore more remarkable than its magnitude alone would suggest at first blush. In fact, the increase in national product after 1939 was proportionately smaller than the increase in the total labour-force (including the armed forces) which expanded from 40·8 million in May 1939 to a peak figure of 46·1 million in May 1943. This increase in the labour-force was, in turn, more than accounted for by the net influx of foreign labour between the dates concerned, which amounted to nearly 6 million. Thus, the rate of gross output ascribable to the German people (or rather, the population resident within the Reich boundaries at the beginning of the war) actually declined between 1939 and 1943; it did not rise substantially in any year after 1939. Virtually the whole increase in the product available to Germany after 1939 came, essentially, from

foreign contributions, which, including that of foreign labour in Germany, accounted for well over a quarter of the total in the last two years of the war.

Of the total available product, the State eventually came to absorb some 63 per cent. How this portion was used is shown, so far as possible, in Table XII. "War"

TABLE XII.

German Government Expenditure, 1939-44; Milliard Rm. at the Prices of 1939.

	1939	1940	1941	1942	1943	1944
1. Total Government Expenditure on Goods and Services	43	62	85	100	106	108
2. Pay of Administrative Personnel	11	12	13	13	14	16
3. Estimated War Expenditure (*i.e.*, Line 1—Line 2—3 md. Rm.)	29	47	69	84	89	89
Of which :—						
4. Pay of Armed Forces ...	5	12	16	18	18	18
5. Specialised Munitions ...	?	11	12	17	27	34

expenditure, broadly interpreted, is again estimated, as in Chapter I, by deducting from exhaustive expenditure other than that on the pay of administrative personnel a fixed sum representing expenditure on goods and non-administrative services in the years before re-armament began. The resulting figure for 1944 constitutes just over half the available gross product—probably a similar proportion to the corresponding one in the United Kingdom, and appreciably higher than the United States proportion of about 44 per cent.

The wartime expansion of the State's share of the available product was, as in this country (and, again, in contrast with the United States) very largely made possible by the reduction of the share going to private persons. Consumers' expenditure and gross capital formation, together, fell by no less than 33 milliard Rm. between 1939 and 1944, thus accounting for three-quarters of the increase in the domestically produced resources at the disposal of the state. Consumption alone fell by 27 per cent. from the abnormally high 1939 level (which is probably greater than the corresponding British reduction) or by some 21 per cent. below the more normal levels of 1938 and 1940—a proportionate cut roughly similar to that undergone here. Drafts on domestic capital were also important; there are

no good estimates of depreciation for the war period, but it is clear that the national capital of Germany was not maintained in any year after 1940, and the rate of depletion in 1944 must have been of the order of 7 or 8 milliard Rm. Certainly, the total depletion of German capital during the war through lack of maintenance alone (quite apart from war damage) reached a formidable total, requiring several years of net investment at the highest rate ever achieved to make it good.

So much for the sources, composition, and changes of the gross product available to Germany during the war. It remains to try to compare it with that of the United Kingdom and the United States. Some comparisons of this kind follow easily from what has already been said in the present chapter and in Chapter I. The net product of the Old Reich in 1938, for instance, has already been estimated to have been about 39 per cent. greater than that of the United Kingdom; the increase between that year and 1944 was some 17 per cent., while the corresponding increase in the United Kingdom was 20 per cent. or a little more. Thus, it may be deduced that the net product of the Old Reich in 1944 was something like 35 per cent. greater than that of the United Kingdom. The output of Greater Germany in 1944, however, was some 25 per cent. greater than that of the Old Reich alone, so that it must, on this calculation, have exceeded that of the United Kingdom by about 70 per cent. Since the net national income of the United Kingdom in 1944, measured at the market prices then ruling, was some £9,594 million, the net income of Greater Germany, measured at the same prices, must have been about £16,000 to £16,500 million. Both the United Kingdom and Greater Germany, however, borrowed and received other contributions from outside, and depleted their domestic capital. The total to which these factors brought the resources made available in (or to) the United Kingdom in 1944 has been estimated in an earlier section of the present chapter at £11,700 to £11,800 million; the corresponding figure for the Greater Reich, as constituted at the beginning of the year concerned, must have been £18,000 to £19,000 million, or, again, about 70 per cent. more than was available here. The contributions which Greater Germany exacted from surrounding countries, *plus* her drafts on her

internal capital cannot have been far different in relation to her total net product from what our foreign borrowings and other receipts and our depletion of our own internal resources were in relation to ours.

A comparison of German war expenditure with that of other countries may also start from the comparison made for the year 1938 in the preceding chapter. There, the purchasing power of the Reichsmark over armaments and other goods and services related to war preparation was estimated tentatively at 1/13·5 of that of the £. Between 1938 and 1944 the prices of the goods and services concerned may have risen by 50-55 per cent. in the United Kingdom, and appear to have risen by less than 10 per cent. in Germany; the appropriate rate of conversion for 1944 would appear from this calculation to be about 9·6 Rm. to the £. Applying this to the "war" expenditure of Germany for that year, estimated in the way described above, one arrives at something in the neighbourhood of £10,000 million, or rather more than twice the White Paper figure of £4,678 million for the United Kingdom.

The Strategic Bombing Survey has, however, made available some data which permit a more direct comparison between the British and German war efforts. Both the relative numbers of the armed forces of the two countries and their respective outputs of the main types of munitions are known, and the main difficulty in checking these against comparisons derived from the estimates of national product measured in terms of money is that of assigning appropriate weights to the various ratios between corresponding German and British statistics. In the field of munitions the relation of German to United Kingdom output varied enormously from one type to another: in aircraft (measuring by structure weight) it was (in 1943) only 0·75; in armoured vehicles about 1·3; in heavy guns over 3·0. Weighting the various items in proportion to German expenditure on them, one obtains an average ratio of about 1·7; the composition of United Kingdom expenditure is not available as a source of the alternative system of weights on which the computation might be based; to base it on weights derived from German expenditure is, of course, to favour Germany in the overall comparison, and it may be conjectured that the best estimate of the "average" ratio

of German to British output would lie between 1·7 and (say) 1·5. This is for the year 1943—for 1944, by which time an improvement of 25 per cent. in German armament output had been achieved, despite bombing and other difficulties, the comparison would probably be somewhat more in Germany's favour, since the available statistics do not suggest an equally substantial overall increase in U.K. munition output. A ratio of 1·8—2·0 appears probable. Estimates of the numbers of workers employed on orders for the Supply Departments in the two countries afford some slight check on this; the numbers so employed in Germany (1939 frontiers) in 1944 are somewhat uncertain owing to the incomplete coverage of the statistics, but seem to have been at least 60 per cent. and perhaps 90 per cent. greater than in the United Kingdom; and there was, of course, an appreciable (though uncertain) amount of work done for the Wehrmacht in factories outside Germany so delimited. Thus, there is fairly good evidence that the munition output available to Germany, while probably somewhat less than twice that produced in the United Kingdom in 1944, was not much less. The numbers in the armed forces are, of course, susceptible of more exact measurement; in the middle of 1944 the German forces were almost exactly twice those of the United Kingdom—9·1 million against 4·54. Thus, the ratio of 2 : 1 obtained by applying a conversion factor to the money measure of Germany's "war" output, and comparing it with the corresponding United Kingdom figure, though perhaps a little on the high side, is, in general, well supported by more direct evidence.

It must be remembered, of course, that, in this, comparison is between all that accrued to Germany (including contributions to her war effort from outside the Greater Reich) and the output of the United Kingdom alone, excluding the great contribution received from Lend-Lease and Mutual Aid. These outside sources probably added about a fifth to the United Kingdom's own munition production, so that, with this addition, it was exceeded by that of Germany in a ratio of not more (and probably less) than 5 : 3.

A comparison with the United Kingdom having been made, it is a relatively simple further step to relate the

German war effort to that of the United States. It is clear that the munitions output of the latter country, in 1944, must have been more than twice that of Greater Germany; while the United States expenditure on goods and services for war was estimated in the preceding section of this chapter at about £12,500 million, which is in excess of the corresponding German figure by at least 25 per cent., and probably by considerably more. Thus, in the general provision of goods and services for war, the United Kingdom and the United States together exceeded Germany in 1944 by something like 75 per cent., while in munitions output they outweighed her in the ratio of 5 : 2, at least. That is, of course, not a measure of the whole extent to which Germany was economically outweighed in the west, but as a first indication of the odds against her it is sufficiently impressive.

4. THE U.S.S.R.

For the war period, as for the pre-war years, evidence on the development of national income and defence expenditure in the Soviet Union is very scanty. There was, indeed, virtually no direct evidence at all until, in January 1944, a budget report was published for the first time since 1941. Since the budget of the U.S.S.R. comprises a much higher proportion of the national income than does that of any other country in normal times, it throws rather more light on the development of the economy as a whole than one might at first glance expect, and is well worthy of study.

In Chapter I it was estimated that the national income of the U.S.S.R. in mid-1941 was equivalent to some £10,000 to £11,000 million at the British market prices of that date, of which defence expenditure (assuming that it had reached the average rate planned for the year in the previous budget estimates) was £2,830 million. Applying what seem to be appropriate purchasing power parities to the rouble values of other portions of the national income at that time, one arrives at the following rough and tentative estimate of the way in which the income of that time may well have been composed :

Defence	£2,830	million.	
National Economy ...	1,700	,,	
Social Development ...	1,200	,,	
Administration	800	,,	
Civil Consumption not already counted ...	4,000	,,	(A very rough estimate, based on the fact that it seems to have been about £2,288 million in 1934.)
Total Gross Product ...	£10,530	,,	

Subsequent budgets afford some evidence of the changes in these items in the course of the war. The turnover tax receipts for 1943, for instance, were only 71·1 milliard roubles, against the 124·5 milliard expected for 1941, and the 105·8 milliard realised in 1940. This certainly indicates a fall in the volume of private consumption, on which the bulk of the turnover tax falls. It may be that consumption fell by as large a proportion as the tax receipts—43 per cent.—for the population under the Soviet Government's

control was some 20 to 25 per cent. less in 1943 than in mid-1941, and consumption per head may very well have fallen by 25 to 30 per cent.; but this does not follow from the data, since prices and rates of taxation both rose, while the items which declined most may have borne rates of tax different from the average. Expenditure on "Social and Cultural Development" (education, etc.) fell by 22 per cent. in rouble value (*i.e.*, probably by about the same proportion as the population served); in 1944 expenditure under this head was above the 1941 level again, but the general rise of prices which seems to have occurred probably means that the fall in real resources used for these purposes between 1941 and 1943 was greater than 22 per cent., and that the 1944 level was still lower than the pre-war one.

Expenditure under the head of National Economy (*i.e.*, the bulk of the country's fixed investment) also fell very drastically—in 1943 it was 57½ per cent. below the planned 1941 level, and in 1944 still 33 per cent. below it, and the decline was probably greater still in real terms. As to defence expenditure, the 1944 figure was almost double that planned for 1941. It is doubtful whether this figure was affected by price increases as much as the other items in the budget, and likely that there were increases in the efficiency of the factors employed, so that the real increase also may have been, proportionately, as great as this.

Thus, one may perhaps translate the main portions of the national income for 1944 very roughly into contemporary sterling values as follows:

Defence	£5,500 million.	
National Economy ...	1,100	,,
Social Development ...	1,000	,,
Administration	800	,,
Civil Consumption ...	3,000	,,
	£11,400	,,

In view of the increase of British prices between 1941 and 1944, this would mean that the real resources available were slightly smaller in the latter year. Indeed, it would be very surprising if they were not. It is true that the average territory under Soviet control in 1944 was little below that of mid-1941, and that there had been great developments of war industry in the meantime, but the

losses of population and productive capacity had been severe.

At all events it is clear that the economic war effort of the Union may be represented as a combination of two simultaneous struggles—a struggle to maintain the total resources at the disposal of the State, both by harder work and development (including the moving of industrial plant and population out of the reach of the enemy) on the one hand, and by the foregoing of civilian consumption on the other ; and a struggle to divert to war purposes the resources thus kept at the State's disposal. Since the budget total fell a little between 1941 and 1943, the purchasing power of the rouble falling somewhat at the same time, it seems that the first struggle did not quite succeed—it would be very surprising if it had done so in the circumstances, though the position may have been restored by 1944. The second, however, produced a remarkable result in that defence expenditure was almost doubled (in terms of roubles) by 1944, rather more than half of the increase being obtained by the diversion of resources from industrial development and social services. It is, of course, inevitable in a country where so high a proportion of the national income was already at the disposal of the State at the beginning of the war that the sinews of war should be provided much more by changing the use made of State resources and much less by the assumption of additional control over private resources than is the case elsewhere.

There is no room for doubt that the proportion of the national income devoted to war was remarkably high for a country which could not, in the circumstances, expand its total output, and where the standard of living was so low. According to the rough and conjectural reconstruction above, about half the resources available from home sources in 1944 were devoted to military purposes—at least as high a proportion as in the United Kingdom or the United States.

The absolute volume of resources devoted to military purposes by the U.S.S.R. at the height of its war effort is extremely hard to assess. According to the above estimates it was somewhat greater—perhaps about one-sixth greater—than the home-produced resources similarly used in 1944 by the United Kingdom. By the same token, it was very

considerably smaller than the volume of resources used for war purposes by Germany in that year. If, however, account is taken of the extent to which the German war effort depended on the resources of conquered territories, it may be conjectured that the U.S.S.R.'s economic war effort at its peak was little less than that of the Old Reich alone, excluding the contributions levied in the form of occupation costs, clearing balances, taxation and long-term borrowing in conquered territories, and imported labour. It must be remembered, too, that the U.S.S.R. received from her Allies in 1943 and 1944 supplies equivalent to a tenth or an eighth of what she herself provided for war purposes, according to the estimates made here. Moreover, she had two great points of superiority to Germany which are not reflected in these economic comparisons—namely, her superiority in first-class military manpower and her vast spaces, of which such good strategic use was made. Thus, when one takes into account also the fact that Germany was fighting on other fronts—even though they occupied a minority of her resources—it is not hard to reconcile the Russian inferiority to Germany in total economic resources available for war with the course of the war on the Eastern Front.

5. JAPAN

Superficially, the problem of evaluating the Japanese economic effort in the war is no harder—if as hard—as that presented by Germany. Budgetary data are available in fairly full detail up to the outbreak of the Pacific War, and the amounts of money voted to the Government are available even since then, while rough official and semi-official estimates of the magnitude of national income and of savings are made known from time to time. In fact, however, the general knowledge of the Japanese war economy is very much slighter than the general knowledge of the German, chiefly because far less unofficial attention has been paid to it outside Japan, and far less unofficial Japanese analysis and speculation concerning it has been published.

How large, in the first place, is the Japanese national income? Up to 1939 fairly reliable estimates are available for most years, either from the Cabinet Bureau of Statistics, the Mitsubishi Economic Research Bureau, or (especially for earlier years) from other sources. It is difficult to ascertain how the national income is defined by the authors of some of these estimates (the Cabinet Bureau of Statistics, for instance); Mr. Colin Clark, in *The Conditions of Economic Progress*, however, quotes the estimates of Professor Hijkata for certain years up to 1931 and brings them more nearly up to date, thus providing us with estimates which conform very closely to the British definition of "net national income at factor cost." The Cabinet Bureau of Statistics' figures are consistently higher than these estimates—for the earlier years by an amount not far different from the country's total indirect taxation (though apparently by a margin wider than this in the later years). It therefore seems reasonable, though it certainly is not very satisfactory, to assume that the Cabinet Bureau of Statistics' estimates are intended to represent the net national income valued at market prices. For 1939-40 the total given by this source is 26,600 million yen; no equally convincing estimate is available for a later year, but Japanese ministers have given rough figures—presumably intended to be comparable with these—of 30,000 million

yen for 1941-2, 45,000 million for 1942-3, 50,000 million for 1943-4, and 65,000 million for 1944-5.

This enormous increase is, of course, largely due to the rise of prices (it is to be presumed that all the figures refer to Japan proper, so that no question arises of their being swollen through the extension of the area under Japanese control). The cost of living and the wholesale price index were both, in 1944, more than 50 per cent. above the 1939 level. Thus, the real national income had risen (according to the figures quoted above) by perhaps about 60 per cent. in five years. In the previous four years (1935-9) the national income at current prices had risen about 75 per cent., and prices, in that period also, had apparently risen by about 40 per cent., so that real income had risen by perhaps 25 per cent. Thus, if the data quoted are correct, there seems to have been an acceleration in the rise of real income since 1939.

These rates of increase are, in any case, very surprising —6 or 7 per cent. per annum during 1935-9, and 9 or 10 per cent. per annum, 1939 to 1944. They are credible only in the light of the immensely rapid investment which was going on and of the enormously greater productivity of labour in the industries which were being set up as compared with the alternative occupations from which that labour was drawn. The total private new issues of capital in Japan during 1935-9 amounted to about 12,000 million yen, of which perhaps 7,000 or 8,000 million were invested at home. Experience indicates that such an investment in plant and buildings over a wide range of industry might make possible an additional annual net industrial output of 10,000 or 12,000 million yen. The actual increase in the national income, at current prices, in these years was about 11,000 million yen. While recognising that there was certainly a great deal of investment financed out of industries' own profits and therefore not taken into account here, and that, on the other hand, in so far as the new industrial workers were drawn out of agriculture there may have been a loss of potential agricultural output (though equal to less than half the corresponding gain in industrial output) to set off against the increase, one can see that the increase in national income is probably not so large as to be unaccountable, especially if the increase in population and

improvements in skill and efficiency are also taken into account. In the years 1940 and 1941 the increase of private capital through new issues seems to have been proceeding at a rate sufficiently in advance of that in the preceding four years to explain a substantially accelerated rate of progress. In the years 1941-2 to 1944-5 total net private investment in industry is stated to have totalled 23,000 million yen.

How much the national income which Japan had attained by 1944 would amount to in terms of British purchasing power is a question which can be answered only roughly and provisionally. Mr. Colin Clark made a comparison of sterling and yen purchasing powers for the year 1933, as a result of which it may be judged that for buying consumers' goods (including food) the £ was then worth perhaps 6 or 7 yen, while for buying investment goods it was worth perhaps 12 or 13 yen. Between 1933 and 1944-5 Japanese prices in general, both wholesale and retail, more than doubled, while British rose about 95 per cent. (wholesale) and 45 per cent. (retail). No precise comparison of wage changes after 1939 is possible; it is probable, however, that Japanese wage rates had not increased more than British. Thus, one may perhaps say on this evidence that the £ in 1944-5 was worth 10 or 11 yen for the purpose of buying consumers' goods, and 14 or 15 yen for the purpose of buying investment goods. The latter figure is the more doubtful; probably one should take account of a very large increase in Japanese efficiency in producing such goods in recent years; against this, however, one has to set the fact that prices of metals (for instance) in Japan have risen more rapidly than other prices.

Before applying these rates to the Japanese income of 1944-5 it is necessary to divide it into the classes of goods concerned. Civilian consumption in 1943-4 was officially stated to have been 13,000 million yen; it was planned to reduce it to 11,500 million in 1944-5, but it seems unlikely that this was done, since savings fell below the planned figure. Probably, therefore, it was equivalent to £1,200 to £1,300 million at British prices. As to the rest of the national income, it appears that Government expenditure, national and local, was designed to be about 47·5 milliard yen. Of this, about 2,500 million would be national debt interest,

and some unknown further portion would consist of mere transfers of other kinds. Perhaps, therefore, 40 or 42 milliard yen would be a reasonable estimate of the public authorities' purchases of goods and services. Net private investment was officially put at 6 milliard yen.

Thus, it seems reasonable to put net investment at £400 to £450 million at current British prices, and purchases of goods and services by the public authorities at something like £3,000 million, of which perhaps £2,700 or £2,800 million would be for war purposes. Adding up these components, one arrives at a total national income for 1944-5 of some £4,500 to £4,700 million.

If these very tentative estimates are anywhere near the truth, Japanese net national income at that time was about half that of the United Kingdom, or a little less; per head of the population, therefore, it would be under a third of the corresponding level here. These relative magnitudes are not in themselves unplausible; it is rather more surprising that so high a proportion of the Japanese net output should be devoted to war purposes as these figures indicate. The ratio of purchases by the Government for war purposes to net national income appears from this to have been over 60 per cent.—a proportion very markedly higher than the United States' 45 per cent. or the United Kingdom's 49. For a country where the standard of living was already so low that reduction of consumption would appear to be much harder than in the English-speaking countries, this is a most remarkable achievement, especially as, on this showing, it was accompanied not by net disinvestment but by substantial net additions to capital.

How was it done? In the first place, it seems that civilian consumption was, in fact, very severely reduced; it seems to have fallen in money value by 20 or 30 per cent. between 1941-2 and 1944-5, while the cost of living was rising by about 35 per cent., making a real reduction of more than 40 per cent. in these three years alone. Since 1937, therefore, Japanese civilian consumption was possibly halved. To see how this was possible, starting from such a relatively low level, one must realise that even a halving of *per capita* consumption would mean going back to the standards of only a generation earlier. A similar proportionate reduction in the more advanced countries would have meant

slipping back to standards which had hardly been endured within living memory, and for that reason might have been even less acceptable than were the wartime cuts to the much poorer Japanese.

Secondly, the part played by expansion of output was even greater than that played by reduction of consumption in making so large a war effort possible. The proportionate increase in total real output between 1939 and 1944 seems to have been of the same order as that achieved in the United States—and it was achieved without drawing on any large reserve of unemployed industrial workers such as the United States possessed. The main condition which made it possible was, of course, the very low marginal productivity (in value terms) of labour in Japanese agriculture in comparison with that of labour in the munitions industries—even though the Japanese munition worker may still be less productive than his counterpart in the west. A further condition was the high rate of investment in war plant which had already begun in the second half of the 1930's and was accelerated during the war. The chief source of the Japanese war effort was, indeed, a rapid industrialisation of the country during and immediately before the war—though the transfer of workers and other resources from the textile and other peacetime industries to munition production also played an important part.

6. THE BRITISH DOMINIONS

The information available for considering the economic war efforts of the four belligerent Dominions—Canada, Australia, New Zealand, and South Africa—naturally varies from one to another. It is probably most complete for Australia, for which official statistics have been published in a form very similar to that of the United Kingdom White Paper on National Income and Sources of War Finance. They may be summarised as follows :

TABLE XIII.

Australian National Income, 1938-9 to 1944-5 (Million £A).

	1938-9	1939-40	1940-1	1941-2	1942-3	1943-4	1944-5
Consumers' Outlay	653	666	710	754	745	750	807
Public Purchases of Goods and Services	113	149	260	391	613	564	470
Of which for War	13	50	170	308	537	486	385
Gross Private Investment at Home ...	150	170	110	90	45	30	50
Net Exports of Goods and Services ...	14	16	14	17	27	124	110
Gross National Income at Market Prices	930	1001	1096	1252	1430	1468	1437
Depreciation, etc. ...	45	46	48	50	53	55	55
Net National Income at Market Prices	885	955	1048	1202	1377	1413	1382

Perhaps the most striking fact revealed by these figures is that the war effort reached its peak remarkably early—in the financial year 1942-3, when the Japanese threat to Australia had suddenly become acute. Thereafter the production of goods and services for Australian war use declined, but there was a large increase in net exports of goods and services to Australia's allies, which must also be considered as part of the country's contribution to the conduct of the war, and the sum of the two items reached its maximum (in real value, no doubt, as well as in money value) in 1943-4. War expenditure in the narrower sense reached 39 per cent. of net national income (at market prices) in 1942-3, but war expenditure *plus* net exports reached 43 per cent. of net income in the following year—

a proportion almost as great as that attained by the United States at the peak of its war effort.

As elsewhere, this devotion of a large part of the national product to war purposes was accompanied by an increase in the size of the product. In current money value it rose by 58 per cent. between 1938-9 and 1943-4; as the cost of living had risen meanwhile by about 25 per cent., however, and wholesale prices by over 40 per cent. (though wages did not rise greatly), it seems that real income probably increased by 25 to 30 per cent. The employed population, including the Forces, increased by some 22 per cent. in this period; hence, most of the increase in income is accounted for by the growth of the labour force in work—a growth almost two-thirds of which was accounted for by the employment of normally occupied persons unemployed in 1938-9, and by the natural increase of the population which would normally be occupied, the remaining third being composed of normally unoccupied people.

Consumption, meanwhile, declined, though much less, proportionately, than in the United Kingdom. It seems that consumers' outlay in both 1942-3 and 1943-4, if valued at the prices of 1938-9, would have been 8 or 9 per cent. lower than it had been in that year. In 1944-5, however, it rose again to something like the 1938-9 level. Private home capital, too, was depleted; in each of the years 1942-3, 1943-4, and 1944-5 gross private investment in Australia fell below the level of maintenance and depreciation expenditure required to keep capital intact; but the deficiency was not great, and there can be little doubt that capital accumulation on Government account was adequate to offset it.

To express the Australian national income and war expenditure in sterling, it seems to be adequate to use the official rate of exchange without alteration. If this is done, the national income of 1943-4 appears to have been rather over £1,100 million sterling, of which nearly £500 million sterling was devoted either to armament expenditure or to net exports of goods and services to the United States and United Kingdom. It is to be noted that, on this reckoning, Australian net output per head of the total population in 1943-4 was about 18 per cent. less than in the United Kingdom.

For New Zealand, there is a dearth of recent national income estimates. Totals of personal incomes (*i.e.*, the gross total of wages and salaries *plus* the net incomes of firms, farmers, landlords, employers, etc.) increased by about 40 per cent. between 1938-9 and 1943-4. If the net national income produced, measured at market prices, increased between 1937-8 and 1943-4 in roughly the same proportion as private income *plus* indirect taxation (as is probable), then it must, in the latter year, have been rather over £NZ 300 million. The public (central and local) expenditure on goods and services in New Zealand must have been about £NZ 45 million in 1938-9, leaving private consumption and net investment equal to some £NZ 170 million. By 1943-4, home-provided public expenditure on goods and services was about £NZ 130 to 140 million, leaving about £NZ 160 to 170 million for private use; hence, consumption and net investment by non-public agencies seem to have been roughly stationary in money value. Cost of living had apparently risen by about 16 per cent., and cost of investment goods probably much more (wholesale prices rose by some 45 per cent.); it is not certain, however, that private real consumption had declined, or, if it had, by how much, because private net investment had probably declined considerably.

The New Zealand war expenditure in 1943-4 was £NZ 152·9 million, of which, however, £NZ 40 million was derived from lend-lease and £NZ 12 million from the United Kingdom, so that home-provided war expenditure on goods and services (including the £NZ 20 million provided under reciprocal aid) was probably little short of £NZ 100 million, or, in sterling, perhaps about £75 to £80 million out of a net national income of £240 to £250 million.

The Canadian economic war effect was extremely well analysed in *National Accounts, Income and Expenditure* 1938-45, published in 1946, some of the main statistical results of which are shown in Table XIV. This shows that national output was much more than doubled in dollar terms, and therefore (since prices rose by little more than 25 per cent.) was roughly doubled in volume between 1938 and 1944. This astonishing increase is attributable in part to an increase of 35 per cent. in the numbers occupied (including the forces); perhaps a 10 per cent. increase in

TABLE XIV.

Canadian National Income and Outlay, 1938-45 (Million Dollars).

	1938	1939	1940	1941	1942	1943	1944	1945
Net National Income at Factor Cost ...	3940	4221	5112	6514	8277	9069	9685	9627
Indirect Taxes, *less* subsidies	646	743	843	1062	1092	1125	1125	992
Depreciation, etc.	504	528	581	684	771	819	771	750
Gross National Product at Market Prices (including adjustment for errors) ...	5075	5495	6628	8335	10296	11124	11771	11359
Government Expenditure on Goods and Services :—								
War	37	210	826	1952	3585	4407	4542	3726
Non-war	854	880	688	645	738	952	783	667
Gross Private Investment at Home	450	705	1004	1122	793	304	620	746
Net Private Investment Abroad	18	−97	−90	−268	−175	−324	−252	−365
Personal Expenditure on Consumers' Goods and Services	3700	3799	4293	4956	5511	5896	6268	6576
Gross National Expenditure at Market Prices (including adjustment for errors) ...	5075	5495	6628	8335	10296	11124	11771	11359

total output is attributable to the transfer of labour from agriculture to other occupations where its output per head (in value terms) was much higher; the rest must be attributed to a general increase in average hours of work and in productivity per man-hour.

It is quite clear that, as in the United States, civilian consumption per head increased in real terms between 1938 and 1944—by some 15 per cent. according to the C.P.R.B. Report on *The Impact of the War on Civilian Consumption.* At the same time, private investment first rose, then fell; there had been some net private disinvestment in 1938, but private internal capital was increased by as much as $423 million in 1940, after which investment fell, being negative after 1942, with an annual rate of disinvestment which reached $514 million in 1943 and then dwindled virtually to nothing by 1945. Meanwhile, private transactions with the outside world resulted in substantial net borrowing, though this was, of course, small in comparison with operations on government account, which resulted in the wiping-out of most of Canada's external debt.

Very little material exists in a convenient form for the evaluation of the Canadian national product in terms of sterling. The C.P.R.B. Report makes it clear that no comprehensive direct comparison of Canadian with United States or United Kingdom *per capita* consumptions is possible, though its data give the following rough percentages of United Kingdom *per capita* purchases in three sub-groups for pre-war and for 1944:

	Pre-War.	1944.
Food	100	110
Alcoholic Beverages	60	70
Tobacco	75	85

It seems probable, in view of this, that the $532 of Canadian consumer purchases per head of the civilian population in 1944 would be at least the equivalent of—probably more than equivalent to—the corresponding United Kingdom figure of £114, which would mean that the official rate of exchange (4·40 $ to the £) is perhaps not entirely inappropriate as a conversion factor in this department of expenditure. The British volume of munition output in 1943 is stated in the C.P.R.B. Report to have been rather over 5 times the Canadian. The ratio would be much the same in 1944, when Canadian munition output was valued

at $2,402 million; if, as has been conjectured above, United Kingdom munition output in that year amounted to some £2,500 million, it seems that about 5 Canadian dollars were equivalent to £1 in this field. It seems likely, therefore, that a reasonable sterling equivalent of the Canadian gross national output can be obtained by dividing it by a factor of 4½ or 5—giving (on the definition used in the C.P.R.B. Report, which excluded indirect taxation) a figure of £2,000 to £2,300 million for 1944, including a war product of well over £1,000 million.

For South Africa, comprehensive estimates of national income and war expenditure have been published by Professor Frankel, the latest version of which, from the *South African Journal of Economics* for June 1945, is summarised below:

TABLE XV.

Professor Frankel's Estimates of South African National Income, 1938-9 to 1943-4.

	1938-9	1939-40	1940-1	1941-2	1942-3	1943-4
Net National Income Produced (at Factor Cost)	394·8	433·5	477·1	530·9	565·6	585·0
Interest and Dividends paid abroad	30·0	28·0	27·0	26·0	23·6	21·3
Available in the Union ...	364·8	405·5	450·1	804·9	542·0	563·7
Net Non-war Investment	56·8	38·9	30·2	23·8	19·3	27·1
War Expenditure	1·8	6·1	59·4	70·0	90·3	103·2
Available for Consumption	306·2	360·5	360·5	411·1	432·4	433·4
Do. at Market Prices of 1938* ...	319·0	368·6	355·2	382·6	371·3	357·4

* Deflated by the Cost of Living Index, and including indirect taxation.

It is plain from this how much lighter was the economic war burden of South Africa than those of the other belligerents discussed in this book; war expenditure on goods and services there never exceeded 18 per cent. of the net national income at factor cost, and net non-war investment, though heavily reduced, never became negative. Consumption, moreover, though it fell from its 1939-40 peak, remained never less than 11 per cent. above the level of 1938-9. "Consumption" here includes public services, but a similar conclusion would doubtless hold for "consumers' outlay" in a more usual sense.

Real national income probably rose by something like

15 per cent.; Professor Frankel believes that it reached its peak as early as 1941-2, and thereafter remained almost constant. Certainly, its increase was considerably smaller than that experienced in the United Kingdom and the other main belligerent countries. An increase of this order is not hard to account for, since the total number of gainfully employed white persons in the Union rose by about 10 per cent. between 1936 and 1941 (mostly, doubtless, between 1938 and 1941), while the number of white and coloured workers in industry rose by more than 17 per cent. between 1938-9 and 1941-2. The wartime expansion of economic activity has been little more than an acceleration of the normal economic development of the country.

The total economic war effort of the four Dominions just discussed has thus been very remarkable in scale. At its peak in 1944 their war expenditure (including mutual aid and other net exports to their Allies) was probably equivalent to nearer £1,700 than £1,600 at the sterling prices then ruling, considerably more than a third of the peak war expenditure of the United Kingdom. It is a fact of some importance, too, that Canada alone exceeded the highest rate of war expenditure attained by one country—Italy—which traditionally claimed, and at times was accorded, the status of a Great Power.

7. THE WORLD AT WAR

By the end of 1943 the world economy was far more fully mobilised for war than at any other time. Italy, it is true, had been eliminated as a sovereign belligerent; Japan reached her highest pitch of mobilisation at a somewhat later date; but, since both the United States and the United Kingdom subsequently decreased their output of certain munitions, it may be said that the later months of 1943 saw the economic mobilisation of the world at its peak. The countries whose war efforts have been discussed in the preceding pages—the United Kingdom, the U.S.A., the U.S.S.R., Canada, Australia, New Zealand, South Africa, Germany, and Japan—were devoting to war purposes resources worth perhaps £36,000 to £38,000 million a year (at the British market prices of the time), while the rest of the world was spending on war or defence (apart from what it was in some way lending or giving to the belligerents) at an annual rate of perhaps £1,000 to £1,500 million. The main belligerents mentioned had attained a total net output (measured also at current British market prices) of some £78,000 to £80,000 million, but they were drawing resources from the rest of the world (in the form of "occupation costs," taxation, loans, and direct labour for which no current payment in goods or services were made) at an annual rate of something like £3,000 to £3,500 million. The net product of the rest of the world from which these resources were drawn is harder to estimate, but is likely to have been somewhere between £25,000 and £35,000 million. Thus, considerably more than a third of the world's net output was being devoted to war purposes.

Of the total world output, on this reckoning, the United States in 1943-4 contributed about 30 per cent.—a proportion which put her in a class by herself, with probably more than twice the output of her nearest rival, Greater Germany. After Greater Germany came the U.S.S.R. and the United Kingdom, the former probably with the greater output—some 10 per cent., perhaps, of the world total—and the latter with about 9 per cent. of

it. Japan contributed half as much as either of the two last-mentioned countries; it is probable that India's and China's total outputs were greater in value than Japan's, but they are very hard to estimate with any considerable precision. The four belligerent Dominions, together, probably produced about as much as Japan.

Economic war efforts were distributed somewhat differently from total net output. If one imputes the goods and services used for war to the countries which assumed budgetary responsibility for them—as the United Kingdom did for resources obtained from overseas against sterling balances or sales of securities even though she did not produce them, or as the United States and Canada did for lend-lease and mutual aid resources even though they did not themselves use them—the United States must again be credited with some 30 per cent. of the world total; but Greater Germany—by virtue of her exactions and borrowings in conquered territories and her internal disinvestment—ran her closer than in respect of net output, with more than a quarter of the whole. The U.S.S.R. was responsible for perhaps a seventh of world war expenditure, the United Kingdom for perhaps an eighth, and Japan for a fourteenth—the five belligerent Great Powers were responsible (in a budgetary sense) for eleven-twelfths of the world's war expenditure.

How were these great outputs of goods and services for war provided? A distinction must be made between the countries which produced them and those which used them, and the difficulty of (as well as the necessity for) doing this is increased by the fact that the account of the situation given by the national statistics examined in previous sections of this chapter do not make the distinction clear. These national statistics refer, in general, to the goods and services for which the countries concerned assumed a definite liablity, by either producing them for their own use, producing them for the use of an ally (but not in return for a definite monetary obligation), or which they obtained for their own use from some other country in return for such an obligation. Thus, lend-lease goods and services are, rightly, credited to the United States war effort, but goods obtained by the United Kingdom from India or Argentina in return for sterling

or for formerly British-held Indian or Argentinian securities are credited to the British war effort.

The United States output of goods and services for war was of course, greater than is shown by United States Government's expenditure on armaments, since the United Kingdom was still, in 1943, making some purchases from the United States which were not covered by exports. In earlier years of the war some £1,500 million was lent to the United Kingdom alone by the U.S.A. (for the most part, exported in return for United States securities repatriated), but the importance of such transfers was, of course, greatly diminished after the institution of lend-lease. In the same way, the extent to which Canadian aid to the United Kingdom war effort failed to be shown in Canadian statistics of public expenditure was very much reduced by the decision to make a gift of $1,000 million in 1942 and subsequently to continue this assistance under mutual aid—by which these large sums were transferred from the United Kingdom to the Canadian Budget. United Kingdom borrowings abroad, however, remained important in regard to the other Dominions, India, and certain foreign countries; it is not possible to apportion exactly between countries the net foreign disinvestment of £655 million carried out by the United Kingdom in 1943, but it seems that some £330 million or more was in India, about £20 million in Australia and New Zealand, and perhaps £13 million in South Africa, while, to judge from the events of the previous year, there may well have been disinvestments of £30 million each in Egypt and Eire, and some disinvestment in South America too—Argentina's sterling balance increased by about £17 million in 1942, while Brazil's active balance of payments on current account in that year (due, no doubt, mostly to transactions with Britain and the United States) had been about £30 million.

Thus, the economic "war effort" (in the sense of current output of goods and services for war purposes) of India amounted in 1943 to something like £530 million, instead of the £200 million or so which the Government of India raised in the country for defence expenditure; the resources of the belligerent Dominions devoted to war purposes were perhaps £33 million greater than was shown in their Budget statements; while neutrals, such as Eire,

Egypt, and Argentina, contributed some scores of million pounds' worth of their current resources to the United Nations' war effort. On the other hand, Germany was drawing over £2,000 million worth of goods and services a year from outside the Greater Reich, in the form of "occupation costs," increases of clearing-balances, contributions from the Protectorate and General Government, and proceeds of sales of Reich bonds to foreigners, so that the Greater Reich's home-financed war effort amounted to, perhaps, £7,000 million, out of a total war effort of £9,000 million.

Alternatively, one may classify the flow of goods and services devoted to war according to the countries to whose Governments they are finally made available—*i.e.*, according to the users instead of to the producers. The most important factor which causes the picture so obtained to differ from the one just drawn is, of course, lend-lease. Of the United States output of warlike goods and services in 1943, amounting to some £12,000 million worth, £1,800 or £1,900 million* were transferred under the lend-lease programme to other United Nations. The United Kingdom appears to have received about £1,000 million worth, *plus* about £300 million sent directly to British Forces in Africa and the Middle East; against this, however, must be offset perhaps £300 million worth of reverse lend-lease furnished by the United Kingdom to the United States, so that the net transfer for that year remains about £1,000 million. The U.S.S.R. was the next largest recipient—in 1943 United States lend-lease aid to her amounted to £450 million, to which must be added probably well over £100 million of United Kingdom aid in the same year. To Australia the United States in 1943 apparently gave about £75 million of aid, against an almost equal amount of reverse lend-lease goods and services rendered to United States Forces in the S.W. Pacific area, while New Zealand received perhaps £25 million worth, to which is to be added some £10 million from the United Kingdom, against about £6 million worth of reciprocal aid to the United States.

It is unnecessary to enter into further details here;

* The amounts transferred under lend-lease are here converted into sterling, like other war expenditure, not at the official rate of exchange, but at one which appears to reflect purchasing powers more correctly, *i.e.*, about 6½ dollars to the £.

the chief result of these complicated transfers was that the United Kingdom had in 1943 for its own use perhaps £900 million more of goods and services for military and essential civilian purposes than it had assumed direct budgetary responsibility for, and about £1,550 million more than it produced, while the U.S.S.R. in the same year received a net benefit of the same kind of between £500 and £600 million.

So much for the extent to which the several principal belligerents at the climax of the war were obtaining the sinews of war from outside themselves, or lending them to others. One of the great sources of their home-produced war efforts has been increase of output above peacetime levels. The United States increased its gross real output between 1939 and late 1943 (measured at British market prices of the latter year) by some £10,000 million—an amount equal to the whole United Kingdom national income at the height of the war, and equal to four-fifths of the United States war output finally attained. The remaining fifth was obtained mostly by stopping the increase of private capital and, indeed, by making heavy inroads into it, but partly also by cutting down the public use of resources for non-defence purposes (especially those incidental to the peacetime unemployment problem). Canadian output seems to have increased between 1938 and late 1943 by an amount at least sufficient to provide the whole of the country's economic war effort in 1943—£800 million or more—without trenching on the resources available for private use, and the same is true of the Union of South Africa, while in Australia and perhaps also in New Zealand both consumption and net private investment declined by only relatively small amounts.

Thus, the main overseas belligerents on the United Nations side provided the sinews of war overwhelmingly by expanding their real incomes; the total expansion in this group of countries (at British 1943 prices) amounting to some £11,000 to £12,000 million, while civilian consumption in the group as a whole was somewhat increased (it was not decreased very greatly in any one of the countries concerned), and their total private capital was being depleted in late 1943 at an annual rate of £800 to £1,000 million. In Japan, also, the degree in which the war effort was provided by the

expansion of real income was very high—the expansion between 1935 and 1943 (at British prices of the latter year) probably amounted to something like £1,500 million, and that between 1939 and 1943, alone, to something approaching £1,000 million per annum. These expansions of output cover, as in the United States and the Dominions, far the greater part of the war expenditure, but, in Japan, there was also a great reduction of civilian consumption, and a rapid extension of private capital.

The United Kingdom and Germany present a different picture from any of the overseas countries in that they have combined much larger measures of capital depletion (internal and external) with substantial reductions of personal consumption, the immediate pressure of necessity upon them being greater, and the possibilities of expansion of output being smaller than was the case overseas. The way in which the Soviet Union's home-produced war resources were provided is, of course, obscure; there has certainly been a reduction of civilian consumption, and probably some drawing on capital, though these cannot be evaluated; again, there has no doubt been (after the effects of invasion are discounted) a considerable increase, though still one which cannot be estimated, in the total output of goods and services. The factor in the Soviet Union which has certainly been relatively much more important than elsewhere, however, is the diversion of resources controlled by the Government from civil to war purposes, for a quarter of the defence expenditure of 1943—or nearly half the increase in it since 1940—was apparently covered by reductions in the resources devoted to development and cultural services.

Wartime developments in the economy of Continental Europe and the U.S.S.R. were thus very different from those in the overseas belligerent countries. Whether there was any net increase in their total output is doubtful; the enemy-occupied countries were mostly producing at well below their peacetime levels, so that the great increases in the Reich and uninvaded U.S.S.R., obtained largely by transferring labour from other regions, must have been largely offset; certainly any net increase there may have been as compared with before the war cannot be very large. The depletion of capital of non-military kinds for

war purposes—quite apart from destruction by military action—has however also been very heavy ; probably much heavier than in the overseas countries.

The world as a whole at the height of the war was probably depleting its capital resources to the extent of well over 2 per cent. of its total output annually, quite apart from what had been deliberately destroyed. The task of replacement and rehabilitation, even apart from the repair of war damage, will therefore be very great ; but even more striking than the extent to which the war was sustained by drawing on capital is that to which it depended on the increase of the output of goods and services above the peacetime level. The increase in total net world output (valued at late 1943 prices) can hardly have been less than £14,000 to £15,000 million, and was probably much more—and it may reasonably be said to have constituted an increase of between 15 and 25 per cent. as compared with before the war. Some of this increase—most notably in Japan and the Dominions, but to some extent elsewhere—sprang from an increased industrialisation ; some of it was due to the adoption of long hours of work which are naturally being abandoned afterwards ; but probably the biggest part of it was due to the virtual elimination of unemployment overseas and, to a smaller extent, in the United Kingdom. If this great reduction of unemployment can be maintained, the material destruction and wastage of the war years can be speedily made good. Nor will a generation which has seen both abnormally severe unemployment and its elimination—even though that elimination was a by-product of war—readily tolerate systems which do not promise reasonable security against involuntary idleness on anything like the pre-war scale.

CHAPTER III

WARTIME INFLATION

1. WHAT IS INFLATION?

"INFLATION" has been held up as a danger before all the belligerents in the war; it is not clear, however, that the understanding of what it is (still less of how it is caused and how it can be avoided or remedied) has become as widespread as the fear of it. Before going on to glance at the progress of inflation in a number of countries, it may be useful to set down some general remarks about the phenomenon.

In the first place, it is clear that by "inflation" most people understand a substantial and rapid rise of the general level of prices, and it will be convenient to use the word here in this usual sense. At the outset, however, one must distinguish an inflation which (like that of the major Allies in and after the 1914-18 war) is arrested before the currency becomes so worthless as to require the institution of a new unit of value from one which (like the German inflation of 1923) proceeds faster and faster until there is no remedy but to introduce an entirely new currency. The first may conveniently be called "ordinary," the second "runaway" inflation; the essence of the difference between them—of the factor which may cause the former to turn into the latter—will be examined later.

The social and economic effects of the two kinds of inflation, about which a word may first be said, differ in degree only. Inflation of either kind reduces the real incomes of those whose money incomes are in any degree fixed—bond holders, pensioners, salary earners, and wage earners. If the fixity of the money income is complete (as in the case of bond interest) and a runaway inflation proceeds to its ultimate goal, the real income of the person concerned is virtually extinguished; where pressure can be exerted to raise money incomes, as with wage earners and salary earners, the reduction of real income will be smaller, but there is still almost certain to be such a

reduction since the rise of the money incomes concerned can hardly catch up with that of prices—so long, at any rate, as the rise of prices is proceeding. Since the real incomes of those whose money incomes are fixed or contractual fall, those classes whose incomes are not contractual, but who, on the other hand, are responsible directly or indirectly for the paying out of contractual incomes, fare correspondingly better. If the real national income as a whole is not actually falling, their real incomes will rise. In such circumstances, entrepreneurs are likely to be able to finance large extensions of capital equipment out of their swollen profits (unless these are taken from them by taxation), and as bottlenecks in materials and labour begin to limit the amount which can be done in this direction, the most prosperous businesses are likely to employ part of their profits in buying up less profitable ones. It is clear, too, that the redistribution of income just described is generally in the direction of greater inequality between rich and poor, since (though some contractual incomes are large and not all independent business men or holders of ordinary shares are rich) the great mass of the smaller incomes are in fact contractual. Hence the general pattern of consumption is changed by inflation ; more luxury goods and fewer of the ordinary necessities are consumed. It follows that much of the extension of capital equipment which takes place in times of inflation is ill-adapted to the needs of ordinary times.

The social and economic effects of inflation, as here defined, are thus highly disturbing. It may sometimes happen that they are mitigated by the existence of full employment accompanying inflation, so that, while the real income of the typical individual wage earner falls, the number of people in receipt of wages is higher than at other times. The full employment (or something very nearly approaching to it) could, however, be attained without any rise of prices sufficient to produce social disturbances of the sort described ; moreover, this mitigation is by no means always present—the conditions which are most likely to produce inflation in an advanced economy are indeed likely to produce unemployment as well, as will be explained later.

So much for the superficial appearance and the chief

social and economic effects of inflation, whether " ordinary " or " runaway." What are the causes tending to produce it ? Any general rise of prices obviously involves an increase in the total expenditure of money in relation to the volume of commodities becoming available. It therefore involves one or more of three things—an increase in the supply of money, an increase in the average frequency with which the existing stock of money is spent, or a decline in the volume of available goods and services. These three possibilities may be briefly reviewed in turn.

The precise ways in which an increase in the supply of money comes about are various, partly because there are different kinds of money—meaning by money any important means of payment.

In advanced countries such as the United Kingdom far the most important form of money is bank credit, to the volume of which the quantity of notes and coin in circulation generally adapts itself ; in less advanced countries notes issued by the Central Bank or the Government make up the major part of the monetary circulation. In either case, however, the most usual way in which the supply of money can be expanded is through additional lending by the banks—especially lending by the Central Bank to the Government, which creates new reserves in the other banks, enabling them in turn to expand their loans. Bank loans may be expanded in this way because of an urgent Government need for credit (as in time of war), or because the banks take an optimistic view of the credit-worthiness of private business ; they may also increase because of an increase in reserves of gold or foreign exchange due to a rise in the country's exports, not matched by a rise in its imports. As a source of serious inflation, however, Government borrowing is far the most important cause. The money newly borrowed (whether by the Government or by private agencies) is spent on goods and services, partly or mostly within the country ; its recipients within the country then proceed in their turn to spend part or most of it on internally-produced commodities, and so an infinite, but convergent, series of new expenditures is created, the sum of which may be several times the original increase in the stock of money created by the banks' new lending. An increase in borrowing from the banks can

fail to have this effect only if the whole of the additional income it generates is saved or spent on imports. If the supply of home-produced goods and services expands *pari passu* with total money expenditure on them (a condition which may be nearly fulfilled if there is widespread unemployment of all kinds of labour and resources when the expansionary process starts), then the rise of the general price level may be small in relation to the increase in the stock of money. As soon, however, as there is any check to the increase of physical output (either from general full employment, or from " bottlenecks " in the supply of particular essential goods and services), the general price level must rise at a rate tending to become proportionate to the increase in monetary expenditure.

Alterations in the average frequency with which the existing stock of money (or a representative coin or note belonging to it) changes hands depend principally on the general state of public opinion. In the ordinary course, the amount of money (in the widest sense) which the public likes to keep in hand is closely related to the volume of its transactions and to the rate of interest (which measures the loss involved in holding cash instead of securities). Reasons of convenience and security normally tend to keep a man's average money holdings fairly near to a constant proportion of his annual expenditure. In times of boom, it is true, the proportion tends to fall, because there are profitable opportunities for investment in non-monetary assets of many kinds, and his confidence in his ability to liquidate some of his property if pressed is high; in depression, on the other hand, his cash balances and bank accounts are likely to be higher in relation to his expenditure, because opportunities for investment are fewer and the desire for liquidity greater. The ratio of money holdings to annual expenditure for the community as a whole does not, however, normally vary very much. This ratio is the inverse of the average number of times a unit of money changes hands in the year—of the average velocity of circulation.

Exceptional circumstances, however, can change the velocity of circulation of money very considerably. In war, for instance, there tends to be an increase in liquidity —a fall in the velocity. This is due in part to the desire

of individuals to provide against the unusually high degree of general uncertainty, but mostly to the restricted range and attractiveness of possible purchases and investments, despite the high level of money incomes. Or, on the other hand, if inflation is proceeding at a sufficient rate to make the public realise that money is a bad asset to hold (since it is rapidly losing its real value) the scramble to get rid of money in exchange for other commodities as soon as possible may send up the velocity of circulation very sharply.

The two changes instanced are of great importance in the study of wartime inflationary tendencies. On account of the first, there is a strong tendency for a belligerent to finish a war with a volume of money in circulation much larger than is needed to pay for the available goods at current prices once the public's cash-holding habits return to normal—once the contingencies against which they have been holding cash recede and the various checks, patriotic and material, on their desire to spend and invest are removed. The boom in the United Kingdom in 1919-20 was marked by an increase in the velocity of circulation of bank deposits (abnormally low in 1918) quite as much as by an increase in their volume.

The second change in velocity of circulation mentioned above—its increase owing to loss of faith in the security of money when inflation has been proceeding for some time—is that which marks the transition from ordinary to runaway inflation. It greatly accelerates the rise of prices, tending to make it faster, proportionately, than the increase in the supply of money, while this acceleration of the price rise in turn raises the velocity of circulation by further shaking confidence in the value of money. A self-reinforcing process is thus started which can hardly be halted save by the institution of an entirely new currency.

Changes in the supply of commodities are the third factor to be considered in studying price changes in general, including inflation. The effect of a harvest failure in raising agricultural—and general—prices has been familiar from time out of mind; the effects of war and blockade in restricting the supply of goods in particular areas are similar, though sometimes more drastic. They cannot, however, be sufficient by themselves to account for even the greater part of the more serious inflations of modern

times. For the total supply of goods and services available annually in a country to be suddenly halved would indeed be catastrophic ; it is doubtful whether it has ever happened, except when a country has been invaded and its organised economic life brought to a standstill. Prices, on the other hand, have often been very much more than doubled in a relatively short time. This is not to say that sudden scarcity may not be sufficient to increase the public's desire to hold goods instead of money to such an extent that the resulting rise of prices is quite disproportionate to the reduction in supplies of goods ; nevertheless, it seems that all the really serious inflations on record have also been marked by great increases in the amount of money in existence.

Such great increases in the supply of money—unaccompanied by corresponding increases in the supply of goods or in the public's desire to hold cash—are nearly always the result of weakness or indifference on the part of the authorities. The weakness may take the form of inability to collect taxes adequate for its needs, to persuade the public to save money in sufficient quantities, or to control prices directly. There have been notable cases of indifference in territories under enemy occupation and control.

It is noteworthy that strong and determined Governments had little difficulty in preventing serious inflation in the recent war ; only in countries with weak executives or countries under enemy occupation did it assume alarming proportions. The far greater success attained by the main belligerents in the Second World War, as compared with the First, has been largely due, not to any improvements in fiscal or monetary policy in the narrow sense—Governments have again had to borrow extensively from banks, and cannot possibly be sure that their patriotic appeals will increase saving sufficiently to neutralise the extra purchasing power so created—but to improvements in price control and rationing. The enforcement of a limitation of prices demands great thoroughness in the executive as well as a law-abiding attitude on the part of the public ; it cannot succeed unless the individual has confidence that he can meet his essential needs—or secure his fair share of the available supplies—by purchases at the controlled prices. Hence, not only a strong arm but an efficient and comprehensive system of rationing is essential to a

Government seeking to control prices by decree in the face of a surplus of purchasing power such as is almost certain to arise in total war. The distinction between the Governments which have and those which have not been able to achieve these conditions has been a remarkably clear one, as the discussion of some particular cases will show.

2. SOME OUTLINE CASE-STUDIES

What, to begin with, was the general world situation at the end of 1943? In every country for which information is available there had been some rise of general price levels since 1938 or 1939. The extent of this, however, differed enormously from country to country, and was not, in fact, easy to measure. Official indices of prices—especially "cost of living" indices—are frequently very unreliable, especially where "black markets" are of considerable importance; nevertheless, the collection of such indices published by the League of Nations generally enables one to form some idea of the seriousness of the inflation which has taken place. It may be useful to classify the increases which cost of living indices (mostly derived from the League's Monthly Bulletins of Statistics) showed, between June 1939 and December 1943, as follows:

Less than 50 *per cent.:* United Kingdom, United States, Germany, Japan, Australia, New Zealand, Canada, South Africa, Sweden, Switzerland, Argentina, Brazil, Colombia, Uruguay, Venezuela, and (probably) the U.S.S.R.

50 *to* 100 *per cent.:* Newfoundland, Chile, Costa Rica, Cuba, Spain, Portugal, Finland, Hungary, Norway.

100 *to* 300 *per cent.:* Egypt, Bolivia, Manchuria, India, Palestine, Iceland, Slovakia, Croatia, France.

Over 300 *per cent.:* Turkey, Iran, Yugoslavia, Greece, China.

This classification shows little correspondence between inflation and active participation in the war. On the contrary, it may be shown that, in Europe, the neutrals have experienced greater increases in their cost of living indices than have the principal belligerents, while the neutral countries of the Middle East have suffered in this way to a far greater extent still. The obvious correlation is rather between the success with which inflation has been resisted and the degree of economic advancement, though inflation has been heavy irrespectively of this where the country concerned has been occupied by, or had quartered in it, the military forces of another State—either a hostile State (as in the German-occupied countries of Europe)

or sometimes, unfortunately, a friendly one, as in the Middle East and Iceland. In short, control of the financial situation by the Central Government has proved to be a more important factor in deciding how far inflation shall proceed than the degree in which a country is involved in the war. The European neutrals—even such an economically advanced country as Switzerland — have probably been handicapped in fighting inflation, as compared with belligerent countries, by the greater difficulty of imposing controls in a country not actually at war.

In dealing with specific cases, it may be best to begin with some of the major belligerents, both on account of their intrinsic economic importance, and because in regard to them, alone, sufficient information is available to make the whole working of the monetary system plain. This is, of course, most notably the case with the United Kingdom and the United States, for which the change in the money value of the national income is accurately known. Between 1938 and 1943 the increase in this amounted to 77 per cent. here and 128 per cent. in the United States. Total monetary transactions appear, however, to have increased rather less than proportionately—total debits (cheques drawn) rose in the United States by 97 per cent., while bank clearings in the United Kingdom rose by only 44 per cent. This lag of monetary transactions behind national income was due, no doubt, largely to two causes; in the first place, the national income in war includes many more deliveries not paid for in money (*e.g.*, food, clothing, equipment, etc., issued to the Forces) than is the case in peacetime; secondly, the "financial circulation" connected with the stock exchange, the money market, etc., which is always a large part of the whole circulation, has not increased very much under the prevailing conditions of Government control and of limited private investment. This second cause is illustrated for the United States by the fact that the (largely financial) debits in New York City increased by only 87 per cent. over the period mentioned, as compared with an increase of 105 per cent. in debits elsewhere.

So much for total payments; what has happened to the *means* of payment? In the United Kingdom the chief means of payment — current accounts — increased proportionately more than national income and, *a fortiori*,

more than the total payments made with them—*i.e.*, by 116 per cent. In the United States demand deposits increased somewhat less than national income (*i.e.*, by 114 per cent.) but more than money transactions. In both countries, therefore, the "transactions velocity" of circulation of current accounts, and in this country their "income velocity" also, fell. It should be added that in both countries deposit accounts (time deposits) increased relatively little, so that the velocity of circulation of "bank money," as a whole, rose, but that is less relevant; it is the accumulation of idle current accounts which is interesting and symptomatic of war conditions.

The increase of cash (mainly bank notes) in circulation in both countries outstripped the rise of national income even more decisively than did the increase of current bank accounts. Here it rose by 111 per cent., in the United States by 170 per cent., between 1938 and 1943. In some degree this was no doubt attributable to the fact that wage bills in both countries increased rather more (proportionately) than national income as a whole, for the payment of weekly wages gives rise to far the greater part of the demand for cash. There can be no doubt, however, that cash holdings increased in relation to cash transactions; there is even more markedly increased liquidity in regard to cash than there is in regard to bank accounts.

In normal times increased liquidity—in the sense of an increase in cash or current accounts in relation to the transactions actually carried out with them—has a strong tendency to be associated with a reduction of interest rates, particularly of short-term rates. This association was not very apparent in the United Kingdom and U.S.A. during the war; both day-to-day and bill rates rose in both countries. The great increase in outlets for short-term funds in the shape of Treasury bill issues, etc., no doubt accounts for this, but the fact that it was accompanied by an increase of both idle cash and idle deposits argues a genuine change in the monetary habits and requirements of the community due, presumably, to war conditions. This disposition to hold more money in relation to the amount of spending done with it, despite a higher rate of interest, seems to indicate that both countries were very far from experiencing that apprehension of dangerous inflation which

causes a flight from money ; the same conclusion is suggested by the fact that the prices of fixed-interest securities rose, and by the smallness of the increase (only 7 per cent. in the United States and 5 per cent. here) in the prices of ordinary shares—a rise which, so far from indicating a scramble for assets which would rise in value during an inflation, entirely fails to discount the increased earnings which some experts anticipate (apparently with good reason) from the shares concerned after the war.

To what extent did inflation actually take place ? Over the period hitherto discussed (1938-43) the Cost of Living Index in the United Kingdom showed an increase of 30 per cent., and that in the United States one of 24 per cent. In the United Kingdom, however, this result was drastically affected by the inappropriateness of the index number and by State subsidisation of prices ; the data given in the White Paper on Sources of War Finance show that the actual market prices of goods and services bought out of personal expenditure had risen by 54 per cent., and would have risen by 60 per cent. but for State subsidies. A large part of this rise, however, was due to the increase of indirect taxation ; if neither this nor the subsidies had been introduced, the rise in the general price level would have been about 41 per cent. British wholesale prices, it may be added (according to the Board of Trade general index), had risen by some 68 per cent., as compared with about 34 per cent. in the United States. It is evident, however, that these price increases were, in both countries, far from shaking general confidence in the value of money so as to produce a flight from cash and fixed-interest assets into (*e.g.*) ordinary shares ; it has been shown above, indeed, that the trends were all in the opposite direction.

The position in Germany is harder to ascertain, if only because the area in which the Reichsmark circulates was so greatly expanded since the beginning of the war. National income estimates, moreover, are not available for comparison with monetary data beyond the financial year 1942-3. In the four years 1938-9 to 1942-3 the net home-produced income of the Reich, at market prices, rose by about 74 per cent.—taking the Old Reich for the beginning of the period and the Greater Reich, as then delimited, at the end of it. A somewhat better idea of the increase

in transactions may perhaps be obtained by adding to the net home-produced income of the Reich the transfers of income effected by the public authorities and the contributions paid to the German Government from abroad, whereby the increase is raised to 96 per cent. This, however, probably overestimates the increase in the "transactions demand" for money in the Reich, since some of the foreign contributions for the German authorities never entered Reich territory, and some of the expenditure of the German authorities and troops was likewise outside it. On the other hand, a certain amount of German money circulated in the Protectorate of Bohemia-Moravia, which is not covered by these income estimates. It is thus impossible to obtain a precise measure of the increase in either income or transactions corresponding to the increase in German means of payment; it seems safe to say, however, that the demand for such means of payment, if it were a function purely of income or transactions, would have increased rather less than two-fold in the period concerned.

The increase in the means of payment available is certainly much greater than this. Between March 1938 (when the introduction of German money into Austria had hardly begun to affect the position) and March 1942 the note issues of the Reichsbank (which compose most of Germany's cash) had increased by no less than 264 per cent. Between December 1938 and December 1942 sight deposits at the five big Berlin banks rose by 123 per cent., and their total deposits by 130 per cent. That the rise in the deposits of these banks should be smaller proportionately than that of Reichsbank notes is natural, since they had not usurped the functions of banks in the annexed territories in the same way in which Reichsbank notes replaced the national currencies there.

It is clear from these data, imperfect though they are, that the supply of money in Germany outstripped the growth of the payments for which it was required to a far greater extent than happened in the other two major belligerent countries already discussed. This flood of liquidity was not without some effect on interest rates both long and short term. The yield of Government bonds fell from 4·53 per cent. in 1938 to 4·23 per cent. in 1942; the day-to-day money rate fell in the same period from

2·79 to 1·83 per cent., and the rate on commercial bills from 2·88 to 2·13 per cent. These reductions, however, are trifling in relation to the cause to which they have just been attributed; it seems certain that the propensity of the German public to hold liquid resources—especially bank notes—rose in an astonishing way. Many causes may have contributed to this; the insecurity and movements of population due to air raids in particular. It seems, however, that the representative German entertained little apprehension of a fall in the value of money, though ordinary share prices rose somewhat more than in the United Kingdom or the United States (*i.e.*, by some 46 per cent. between 1938 and 1942 and a little further in the following year). Indeed, price control was so strict that the cost of living index rose only by 9 per cent. over the period in question, and even in early 1945 stood only about 11 per cent. above the 1938 level. Nor is there substantial evidence that any important prices rose much more than this indicates. Thus, there is in Germany a great flood of purchasing power dammed up by the joint operation of the official price control and the public's propensity to hold cash. If the propensity to hold cash should return far towards its normal level, the price control would need additional strength to prevent inflation; if the price control should be weakened it is likely that the public's faith in cash would be sufficiently shaken to render inflation inevitable in the circumstances.

The countries where the increases of prices had begun to be serious present, unfortunately, less complete statistical pictures. In the groups where official cost of living indices showed a rise of 50 to 100 per cent. between 1938 and 1943 it may suffice to mention two countries—Portugal and Hungary. In Portugal the official index, even by the end of 1943, stood only 61 per cent. above its mid-1939 value, but it is clear that this was not representative of what had in fact happened to prices: the black market was of great economic importance. Whether the public's propensity to hold liquid purchasing power had increased very much is not clear (though it probably had), but the note issue had more than trebled between 1939 and the end of 1943, while bank deposits on current account had increased nearly five-fold. The source of inflation was, of course, different

from that in the belligerent countries; it arose chiefly from the country's enormously increased exports of wolfram and other commodities for which the European belligerents were competing, coupled with a scarcity of imports. Indeed, however far inflation has gone, it seems that it might easily have gone farther but for the restrictive action of the central banking authorities. The country's foreign exchange reserves—mainly in the form of sterling and blocked marks—rose from 730 million escudos at the end of 1939 to 13,794 million (more than twice the total of current accounts and notes in circulation) in mid-1944.

Concerning Hungary rather more information is available, in so far as official estimates of national income have been published. There, as in Germany, extensions of territory have complicated the issues, but statistics are available which refer to the territory in which the pengö was actually circulating at each of the dates concerned. In Trianon Hungary in 1938-9, for instance, the national income was estimated at 5·2 milliard pengö; in the enlarged territory under Hungarian sovereignty in 1943-4 it was estimated at 16·5 milliard pengö, an increase of 218 per cent. In the same time, however, the note circulation had increased by over 400 per cent., though current accounts (which were only half the total magnitude of the note issue) had only just trebled. This discrepancy between the growth of bank deposits and that of cash may be partly due to the lower development of banking in the territories acquired after 1938. By the end of 1943 the official cost of living index in Budapest had almost doubled, as compared with its mid-1939 level. This, however, is far from showing the true price rise, since the black market, here again, was very important. The wholesale price index had nearly trebled, while the most significant indication that inflation was beginning to affect the general outlook was the fact that industrial share prices had increased almost five-fold. Hungary was thus considerably ahead of the three major belligerents discussed above on the road of inflation.

Under the pressure of " occupation costs " credited to German account, inflation had gone somewhat further still (so far as official cost of living indices revealed it) in France, before the liberation. In 1943 the cost of living stood some 109 per cent. above its 1938 level, and the wholesale price

index some 149 per cent. above it, while the wage index showed a rise of 43 per cent. in the same period. How far the effective (as distinct from the official) cost of living had risen it is impossible to say with any precision—certainly more than official figures would indicate. The note issue had increased by 330 per cent., and the (much smaller) volume of current accounts had more than doubled; it would appear likely that, in France as well as elsewhere, the money held by the public had increased more, proportionately, than the total of transactions, especially since the latter was so severely restricted by shortage of goods. *A priori*, one would hardly expect that confidence in the value of the franc would prove very strong under the trying conditions of occupation. Indeed, since the value of industrial shares had increased more than five-fold (*i.e.*, more than prices or profits) it seems that there was some pressure to escape from assets yielding fixed cash incomes; on the other hand, since the prices of Government bonds had risen by about a third (before the liberation) there must have been considerable faith in the future value of money—indeed, the absence of general price inflation much worse than that which took place proves that this was so.

As suggested earlier, however, it is when one comes to countries with little of the complex administrative machinery of a modern State that one sees inflation on the grand scale. The countries of the Middle East, in most cases, had foreign armies quartered in them, and in all cases they experienced great increases in demand for many of their products and severe shortages of imported supplies. Lacking machinery whereby the increases of purchasing power so generated could be absorbed, either by heavy taxation or additional savings, they experienced far more severe price inflations than occurred in response to the proportionately greater expansions of spending in more advanced countries. By mid-1944 increases in cost of living (as compared with late 1939) amounted to 121 per cent. in Palestine, 162 per cent. in Egypt, 258 per cent. in Iraq, 342 per cent. in Turkey, 407 per cent. in Lebanon, and 746 per cent. in Iran. For similar reasons, Indian prices were well over double what they had been before the war. Unfortunately, relatively little is known about the monetary positions in these countries; in particular, there

is no indication how far total transactions increased. In most cases the increase in notes and bank deposits was far greater, proportionately, than that in retail prices—nearly twice as great in India, Iraq, and Palestine, for instance—for real output rose and the propensity to hold wealth in the form of money may have increased also. In Turkey and Iran, however, the increase in prices appears to have been proportionately greater than that in the means of payment; it may be, of course, that the statistics are highly misleading, but their deficiency must be gross if this appearance is false. If it is not false, it seems that something in the nature of a flight from money—the essence of runaway inflation—may have begun in these two countries.

The only countries in which a runaway inflation actually occurred in the years in question, however, are Greece and China. In the former, the issue of notes by the German occupying authorities proceeded to such lengths that, at the time of their departure, the drachma was virtually worthless, and had to be replaced by new units each worth 50,000 million of the old. In free China the wartime borrowing of the Government, mainly from the four chief banks, was mainly responsible for increasing their note issues from 1,242 million yuan at the end of 1936 to 3,962 million (in a much reduced territory) at the end of 1940, and to 22,500 million at the end of 1942. Between 1939 and 1941 the cost of living in Chungking increased nearly fifteen-fold; in the same period the note issues of the four banks referred to rose only between four- and five-fold. Since a large part of the circulation consists of coin, of which no record is available, it would be wrong to draw any firm conclusion from these facts; nevertheless, they suggest that prices were probably rising proportionately faster than the supply of money—how far this may have been due to reductions in the supply of goods and how far to changes in the public's cash-holding habits being a further question impossible to answer at present. At all events, the monetary situation in China developed (though relatively slowly) with many of the marks of a runaway inflation; the cost of living stood in late 1944 at well over a hundred times its 1937 value, and by late 1945 had risen again ten-fold.

As suggested before, therefore, the conclusion which

emerges most strongly when one looks at the recent history of inflation, as incompletely sketched here—especially when one compares it with its earlier history—is that inflation is, after all, an easily preventable disease in the circumstances which prevail in most advanced countries to-day. The forces which debased the Continental, the Assignat, the Greenback, the Franc, the Lira, and the Rouble (to name only a few currencies) in the century and a half before 1939 are well under the control of the modern State so long as its Government is not prevented from functioning by some entirely abnormal cause. (Whether the depreciation of the mark in 1922-3 should be included in this gallery of accidental inflations is open to debate.) In the Second World War it has been left to the Balkan and Middle Eastern countries to suffer from inflation as severe as that from which even some of the main victorious Allies suffered in the First; only China and occupied Greece had by the end of the war suffered the monetary fate which overtook the three great defeated Empires after 1918; the success of monetary control in all the major belligerents up to then had no parallel in comparable circumstances in the past.

CHAPTER IV

WORLD POPULATION STUDIES

1. THE ECONOMIC SIGNIFICANCE OF SOME TRENDS IN NATURAL INCREASE

THE great changes brought about by the Second World War, and the international distribution of productive power which was discussed at the end of Chapter II, should, alike, be looked at against the background of certain fundamental trends in world economic development, of which the most striking are, perhaps, those connected in some way with long-term changes in population. It is therefore appropriate, after the preceding studies of aspects of re-armament and war, and before proceeding to consider some of the more normal aspects of industry and of international trade, to glance at some main tendencies in this field. It is particularly convenient to do so at present because of the availability of the studies and projections of population in Europe and the U.S.S.R. recently made by the Princeton Office of Population Research, and of some admirable studies of rather wider scope which were published in the January 1945 number of the *Annals* of the American Academy of Political and Social Science. The present section will therefore be devoted to a consideration of the economic implications of trends at present discernible in the natural growth of population in the main regions of the world, and the succeeding one to an analysis of some past experience and future prospects of international migration.

The population of the world in 1940 was estimated at 2,100 to 2,200 million; it had roughly quadrupled in the 290 years since 1650. Its percentage rate of growth, however, had not been constant over that period, but had risen fairly steadily from 0·29 per cent. per annum between 1650 and 1750 to 0·75 per cent. per annum in the first forty years of the present century. Rates of growth, moreover, differed —and had differed—enormously from one area to another. While world population had quadrupled, that of Europe (including European Russia) increased five- or six-fold (from

about 100 to 530 million); that of the overseas countries which received heavy immigration from Europe (the Americas and Oceania) increased perhaps eighteen-fold (from about 15 to 270 million), and that of Asia perhaps rather less, proportionately, than the world total (*i.e.*, from perhaps 300-350 to some 1,200 million); while the population of Africa has certainly increased much less than this—possibly by less than 50 per cent. (from 100 to 150 million). The fairly even increase of the percentage rate of growth in the world total is the sum of less regular regional patterns of change; from 1650 to 1800 there was probably some tendency for the rate of growth to rise in all the great areas distinguished above, but during the nineteenth century the acceleration of growth in Europe, Oceania, Africa, and Central and South America began to be offset by a slight slackening of the rate in North America, where the enormous proportionate rate of growth of early years could not be maintained when absolute numbers increased. The first forty years of this century brought further acceleration in Asia, Africa, and Central and South America (areas now containing two-thirds of humanity), but a decrease of the rate of growth in Oceania, North America, and Europe.

The mechanism of these great developments is clear up to a point—but not beyond it. On looking far enough back into the history of any country, one tends to find a condition of stable, or nearly stable, population, in which numbers are adjusted to the society's existing stationary, or very slowly changing, capacity for controlling the material environment. The great modern increase of population in Europe and in lands colonised by Europeans is associated with that enormous acceleration of the growth and application of technical knowledge which (in perhaps the most important of the senses in which the ambiguous term is used) constitutes the Industrial Revolution. First, mortality decreased, fertility remaining about the same as before; population therefore increased rapidly, but technical knowledge and its application to economic life advanced more rapidly still, so that real incomes rose. Finally, after an interval, the rise of real incomes, urbanisation, and the changes in the social values which accompanied them led to a reduction of fertility. Hence the great increase in the rate of population growth in these countries, followed by a fall, but leaving, of course,

a much increased population behind it for the time being. The fall in fertility has not yet begun to reduce total numbers (save in one or two countries), though the reduction is already inevitable in most of the countries concerned, unless the present balance between fertility and mortality is changed in favour of the former.

So far the story is clear; there are, however, both complications and points of obscurity. One set of complications arises from the self-reinforcing, or mutually reinforcing, nature of some of the changes involved. The application of scientific knowledge, for instance, increases the prestige of science and makes for further concentration on scientific discovery and its practical application; the increase of population above what can be supported with traditional ways of agricultural production both encourages the search for more productive methods of farming (though in some circumstances it makes them harder to apply, because of poverty), and creates a surplus of labour which is available (but, again, is not necessarily utilised) for manufacturing industry. In some ways, too, no doubt, the mere increase of numbers tends to promote investment and to keep the economy working at full capacity, which in turn has a favourable effect on mortality (and perhaps on fertility also) and raises the rate of increase; but this factor has probably been overestimated by some economists. At all events, however, an industrial revolution of the kind which has occurred in Western Europe and North America certainly derives increased drive and momentum from these mutual reinforcements and self-reinforcements of its various elements, including population growth, in much the same way in which an ordinary economic boom develops a momentum of its own, additional to (and often much greater than) the impetus given to it by the original disequilibrium from which it may have arisen.

The gaps in our knowledge of the precise mechanism of the great expansion of population associated with the Industrial Revolution are, however, considerable. Advances in the applications of science and technology which reduce mortality are of two kinds: improvements in hygiene and innovations in diet which have a large effect in lowering mortality and only a secondary influence on *per capita* productivity; and, on the other hand, increases in the

general productivity of labour which enable mankind to enjoy more of all goods and services, including those which help to improve health and reduce mortality. The relative magnitudes of the two kinds of advance at various stages in the industrial revolution are not clear, though they have practically everywhere gone together; it is certain, however, that the relation between them is of great importance. Improvements in hygiene, etc., alone may bring about increases of population which are sooner or later checked (in countries where natural, especially agricultural, resources are already fairly fully used) by sheer starvation and the diseases to which malnutrition lays a population open. Increases in productivity, on the other hand, may have important secondary effects on mortality and so cause population to increase, but the increase will not, in this case, be stopped by sheer want; on the contrary, average incomes will rise despite the increase in numbers.

At about the same time when industrialisation and population increase were proceeding at high speed in Great Britain, population was increasing rapidly in both Ireland and China; mortality-reducing influences must have been at work in both those countries, but their nature is doubtful, and they certainly were not accompanied by an increase in total productivity sufficient to outstrip the increase in population. The course of events in some eastern countries in more recent times is similar; in Java, population has increased perhaps eight-fold in a century; the reduction in mortality has presumably been due jointly to settled political conditions, simple hygienic improvements, and agricultural development, including sugar and rubber production for export, which enabled foodstuffs to be imported. There, too, however, the standard of living has hardly risen; population has kept pace with total output, partly because the mortality-reducing improvements were large in relation to those tending to increase *per capita* productivity, and partly because even the improvements in methods of production were not of kinds liable to become self-reinforcing in the same degree as technical improvements in manufacture. Indeed, agricultural improvement and specialisation appear to be constantly creating obstacles to their own success in the shape of plant diseases, which

are relatively unimportant in the natural state or under primitive methods of cultivation, but become formidable when intensive monoculture is introduced, or when improved transport introduces parasites into new environments where the natural resistance to them is weak. The battles against potato blight, phylloxera of the vines, coffee rust, and numerous other diseases which increased their menace under nineteenth-century conditions absorbed a large part of the energy of agricultural science, and though they were mostly won, they were defensive battles of a kind which does not generally occur in the field of manufacturing industry. Improvement in agricultural productivity, indeed, encounters more obstacles than does improvement in manufacturing techniques because agriculture in any case involves interference with a natural equilibrium of living things—the more intensive and specialised the agriculture, the greater the interference.

The most important distinction between different parts of the world, for demographic purposes, is thus that between the areas which have entered upon an industrial revolution and those which have not. In practically all parts of the world factors are at work which are tending to depress mortality rates, though in some (such as China) they are weak or ineffective. In the areas where marked increases in standards of living have gone with this (through the help of industrialisation) a reduction of fertility has followed or is likely to follow at an interval of half a century to a century behind the reduction in mortality. In areas where standards of living do not improve as mortality falls (as is the case in areas which remain dependent almost solely on agriculture), this development is not, apparently, to be expected, and the increase in population can be checked only if mortality rises again—as it certainly will if increases in total productivity fail to keep pace with the growth of numbers.

So much for the mechanism (so far as it can be discerned) behind the main developments of the last two centuries. The position which it has produced may be briefly summed up. As was mentioned earlier, about a third of mankind now lives in the three continents—Europe, North America, and Oceania—in which the rate of increase of population is decreasing owing to the

reduction of fertility. One important country in Asia—namely Japan—must, however, be included in this category also since its rate of increase has begun to fall in the last thirty years. The rate of increase in the U.S.S.R. has not until very recently begun to fall, apart from the effects of the war of 1914-18 and the succeeding disturbances; it seems, however, that it might by now have just begun to decline even apart from the effects of the Second World War. Hence the areas with decreasing rates of growth, which are also the areas which have achieved, or are beginning to achieve, a considerable degree of industrialisation and urbanisation, are the U.S.S.R. (174 million in 1940 within the 1938 frontiers), Europe west of the U.S.S.R. (399 million), North America (141 million), Oceania (10 million), and Japan (73 million)—a total of about 797 million or some 36 per cent. of the world total. These areas commanded probably some three-fifths or two-thirds of the total real income of the world before the war, and an even higher proportion of the income that can be produced with levels of economic activity such as have prevailed during the war. Average real income per head in them is thus perhaps almost three times as high as in the remaining poorer areas.

Within the regions of slackening growth there is a second important distinction between the countries where increase has become very slow—well under 1 per cent. per annum—and those where it is still rapid. North-Western and Central Europe (with the exception of the Netherlands), the United States, and Oceania, with total populations of some 366 million in 1940, fall into the first of these groups; the U.S.S.R., Eastern and Southern Europe, Canada, the Netherlands, and Japan, with total populations of about 431 million, fall into the second. It is clear that, but for Canada and the Netherlands, the second group was at a much lower level of *per capita* income than the first—its average *per capita* income was, indeed, probably little more than a third as great as that prevailing in the areas of slower population growth.

It may be useful, therefore, to divide the world of 1940 into three divisions according to their patterns of population growth—divisions which correspond (with the exceptions just named) to distinctions of *per capita* income levels:

1. Countries with falling rates of growth, already well under 1 per cent. per annum: 17 per cent. of world total population.
2. Countries with rates of growth falling, but still about 1 per cent. per annum or higher: 20 per cent. of world total population.
3. Countries with rates of growth showing no tendency to fall systematically: 63 per cent. of world total population.

The third division, as well as being the largest, is the most miscellaneous, and, in general, the one about which least is known. Nothing is known for certain about the population of China—not even its total size (generally put at 400 to 500 million) and certainly not its rate of increase, which shows erratic changes from year to year owing to famine and political disorder, but has probably been low, on the average, during the last few decades. The population of India, now approaching 400 million, also shows an erratic rate of increase, but the average rate is high—about 1½ per cent. per annum over the last intercensal decade. Great uncertainty veils the course of population growth throughout practically all of Africa between the tropics, but the rate of growth is perhaps more likely to be increasing than decreasing over considerable portions of it. In South-East Asia and the East Indies a prodigious increase is going on, the average annual rate of growth being over 2 per cent. per annum; Egypt, which also enjoys settled conditions and mainly intensive agriculture, has a rate of growth of over 1½ per cent. The rate of growth in Latin America as a whole is also certainly very high; it is possible that in some areas (*e.g.*, Argentina and Uruguay) it is systematically falling, but the statistical data are too scanty to render this certain.

The changes in the relative sizes of the three groups here distinguished during the next generation are certain to be great. The first group—Northern, Western, and Central Europe (except the Netherlands), together with the United States and Oceania, would on the assumption made by the Princeton Office of Population Research and similar ones made by other statisticians have in 1970 a total population of about 386 million, an increase of only 14 million or 4 per cent. on the figure for 1940; the

populations of all the European countries included, and of Oceania, would by then be declining, while the United States would be within ten or twenty years of attaining its maximum of about 161 million. In fact, the war (no allowance for which is made in the assumptions referred to) renders even this modest increase most unlikely to be attained. The war of 1914-18 is estimated to have been responsible, directly and indirectly, for a population deficit of over 10 million, as compared with what would have happened in its absence, in North-Western and Central Europe alone; these regions are, indeed, unlikely again to be as populous as they were in 1939, for their predicted maximum (on assumptions which exclude the war) is only five or ten years distant and only some 3 million above the pre-war level.

Eastern and Southern Europe, the U.S.S.R., Japan, Canada, and the Netherlands (the countries which, in 1940, had a still large though probably systematically declining rate of growth) would, on similar assumptions, have some 560 to 570 million inhabitants by 1970. This group's increase since 1940 would thus be 130 to 140 million, or 30 to 33 per cent.—a sharp contrast with the insignificant increase in the lands of the first group. The war will, of course, be found to have altered this picture considerably; in Eastern Europe and the U.S.S.R. alone it might easily give rise to a deficit or more than 20 million below the forecast, and its effect on the course of Japanese population may also be drastic. In any event, however, the population increase in the countries in question is bound to be large. Nor is the total increase likely to have come to an end by 1970; the U.S.S.R.'s population will (according to the Princeton projection) still be growing at a rate of nearly 2 million (or 0·8 per cent.) per annum, and will therefore be a relatively long way from its maximum. That of Eastern and Southern Europe, on the other hand, will be within one or two decades and two or three million of its maximum; it will in fact be in much the same position in which North-Western and Central Europe stood in 1940. The Netherlands will just have passed its population maximum according to this projection; Canada, according to a similar projection, will be within a few years of achieving her maximum of just under 14 million. Japan,

like the U.S.S.R., will be still increasing rapidly; according to a forecast which probably exaggerates her future increase as compared with the European projections just quoted, a maximum population of about 123 million would be reached about the year 2000, given a continuance of the trends prevailing before the war.

All the countries which have recently substantiated their claim to be regarded as Great Powers are included in the two groups just discussed. It is interesting to take the six leading ones and express their populations as percentages of the total for all the six, first in 1940, then (according to the Princeton and similar projections) in 1970, thus:

	1940	1970
U.S.S.R. ...	32·6	38·2
U.S.A. ...	24·3	23·6
Japan ...	13·7	15·2
Germany ...	12·9	10·7
U.K.	8·8	6·7
France ...	7·7	5·6
	100	100

The ratio of the populations in 1940 was, of course, far from corresponding to the ratios of political and economic importance; the U.S.S.R. and Japan, in particular, with markedly lower degrees of industrial development and levels of *per capita* productivity than the other Powers named, weighed far less than proportionately to their populations in the scales of world affairs. There is some probability that the percentages of 1970 may bear a more direct relation to the economic and political weights of the Powers (apart, of course, from the special positions which will doubtless be assigned to Germany and Japan under the peace treaties). In spite of the U.S.S.R.'s greater suffering in the war as compared with the other Great Powers among the United Nations, it is likely that her economy will develop faster, proportionately, in the next generation than will their already more advanced systems (this is not certain, but it can hardly fail to be the case unless the whole basis of economic organisation and policy in some of the countries concerned is altered). Extensions of U.S.S.R. territory will probably more than make up the deficiency of population due to the war, of which no

account is taken in the above projection. At all events, the general direction of the change which the coming generation is likely to bring in the hierarchy of the Great Powers, so far as population affects the matter, is sufficiently clear; the countries which were early with their industrial revolutions (and the accompanying population increases) can hardly fail to decline relatively to those whose industrial revolutions have but recently begun.

The future of population in the rest of the world is, of course, far more obscure. In most of it, the factors reducing mortality are likely to operate, but how fast the factors which have elsewhere reduced fertility will be brought into play is in the highest degree uncertain. It is clear, however, that in some areas where population is particularly dense in relation to agricultural resources—notably China, most of India, Java, and Egypt—no very great growth of population is likely to take place without a very considerable degree of industrialisation. If the recent rate of population growth persists in South-Eastern Asia and India, the population of that area alone will grow from some 538 million in 1940 to 825 million by 1970—a 53 per cent. increase. It is doubtful whether irrigation and other modes of agricultural improvement could keep pace with such an increase in these already crowded lands so long as their inhabitants were confined to agriculture to the same extent as at present; industrialisation and urbanisation, on the other hand (which are already under way in some degree), would both enable the increase to go faster and further than would otherwise be possible, and also create the conditions for its eventual slowing down. It is extremely unlikely that the increase of Chinese population will be as rapid as that of South-East Asia and India, but political stability and economic improvement may well, within the next generation, make possible the beginning of an increase like that which India has shown in recent decades.

Assuming that extensive industrialisation occurs in the at present overpopulated agrarian countries of the world (especially of Asia) the course of their population growth is likely to be sensational indeed. In England and Wales the interval between the commencement of industrialisation (with rapid population growth) and the attainment of a

maximum has been 170 to 180 years, and population in that interval has increased roughly five-fold; in Japan, the interval from the beginning to the estimated future date of maximum population will have been 120 to 130 years (the effects of the war apart), and population in that interval is likely to have grown three- or four-fold. A smilar development in Asia would give that continent a population, a century and a half hence, of some thousands of millions. Is the possible rate of expansion of the world's food supply sufficient to support this without increased stringency elsewhere? It may well be; the answer to the question depends on the unpredictable march of technology. Or again, may not fertility decline without very extensive industrialisation, as it long since did in rural France, and has done more recently in many parts of Eastern Europe? The answer there depends largely on cultural details whose significance is still largely unexplored. In no other branch of the social sciences can one see a generation ahead with such clarity as in the new demography, but even there, beyond that distance, the view is so obscure that it is of little use to look.

2. THE PROSPECTS OF INTERNATIONAL MIGRATION

The part which international migration may be expected to play in the future is a factor of very considerable importance which must be taken into account in attempting to answer many questions relating to post-war prospects and policy in many parts of the world. Within living memory there has been an enormous reduction in the part which migration has been allowed to play in the affairs of the world, and this reduction has been blamed for creating, or aggravating, many of the ills of the inter-war period. It is therefore useful to consider the factors which govern migration and the effects of migration itself, with a view to forming some judgment both of the desirability and the possibility of migrations after the war.

It will perhaps be best to start by glancing at the most general factors which operate for and against migration, and to do so by giving attention in turn to those affecting the country of emigration, the country of immigration, and the migrants themselves. Emigration means, to the country from which the emigrants go, the loss of probably some of the most energetic, enterprising, and adaptable of its young working population, which has just reached the point of ceasing to be a liability and becoming an asset to the community in general. It is therefore only if there are strong reasons on the other side of the account that such a loss can be regarded as anything but a misfortune. The existence of unemployment is rarely a good reason for welcoming emigration; since it is mostly due either to an insufficiency of enterprise which should be quickly curable by appropriate public action (and is in many cases only an intermittent phenomenon), or to difficulty in adapting the labour supply to changes in the demand for it, which would be aggravated by the emigration of the most adaptable parts of the population (which are most likely to emigrate). There are, of course, exceptional cases, as when, for instance, the people who are thrown out of work by some change in economic structure are able to go to another country to

enter the industry there which has ruined their original livelihood by its successful competition.

The condition for which emigration is most commonly the appropriate remedy, indeed—namely, overpopulation—is not necessarily accompanied by heavy unemployment at all. It is simply the state of affairs when the decrease (brought about by emigration) in the scarcity of natural resources in relation to population benefits those who remain behind more than other effects of the emigration harm them. It is particularly likely to exist in a country where a large part of the population is dependent on primary production, so that a reduction of the population would confer substantial benefits by leaving more land per head and enabling the least efficient of the mines to be abandoned, thus raising the average output per worker. Where there is acute overpopulation in this sense, emigration may be regarded with general satisfaction.

The country of immigration has, on the other hand, generally a good *prima facie* reason to be satisfied, for it receives, without incurring any costs of education and upbringing, a usually young and vigorous increment to its active population. Nevertheless, strong groups within it are likely to feel the competition of the immigrants especially keenly, and to object to their entry. Most people will be pleased to see immigrants entering occupations not competitive with their own (and so increasing the demand for their services), but will resent their entry into their own occupations, or those competitive with them, unless the general expansion of the economic system goes so smoothly that they themselves do not find their incomes reduced at any point either through a disproportionate recruitment to their trade or through a general depression. It is quite possible, of course, that the country of immigration may be overpopulated in the strict sense in which the word is used in the last paragraph—*i.e.*, that the entry of immigrants, no matter how well they are distributed afterwards, will lower the average standard of living by rendering the natural resources of the country relatively scarce. In this case there will be a more general reason for opposing immigration. If, on the other hand, it is underpopulated in the sense that the better division of labour made possible by an increase in the occupied population more than offsets

any increasing scarcity of natural resources, there is a general reason to welcome immigration, quite apart from the fact that it means the acquisition of workers without the usual upbringing and training costs.

The reasons why migrants themselves move are simpler—they move because they think they will be better off economically or will find a more congenial political, social, or religious atmosphere in the country to which they go than in that from which they come. So far as the purely economic motives are concerned, it is plain that they have no essential connection with the existence of overpopulation in the country of emigration or of underpopulation in that of immigration. An overpopulated country may still offer better economic prospects than an underpopulated one, and migrants, in going from the latter to the former, may lower the average standards of living in both, while the benefit which they themselves obtain in the process either may or may not be such as to offset this in the general account of world income.

So far as economic motives go, indeed, there are several possible combinations of desires to promote or to resist migration. In the absence of political constraints, people have a general tendency to move from countries of low average income to those of high average income—a type of movement for which there is obviously a vast amount of scope, and which, despite the qualification suggested in the last paragraph, is likely in most cases to bring about an increase in the total real income of the world. When the motive for a movement of this kind exists, however, it still rests with the Governments concerned to hinder or to expedite it. It is not certain to be allowed to take place (or to take place on a large scale) unless the Governments both of the country of emigration and of that of immigration approve it as being in the general interests of their supporters. They are, on the whole, likely to do so if the country of emigration is thought to be overpopulated and the country of immigration to be underpopulated, but the attitudes adopted will, of course, depend ultimately on the whole structure of political forces and economic beliefs. A belief on the part of either or both Governments that the movement is not in their interests may serve to prevent it, and the likelihood that such a belief will be imposed on at

least one of them by some sufficiently powerful interest is amply great enough to explain why migrations are so much rarer in practice than what would seem to be adequate motives for them.

On the other hand, there are many cases where the motives for migration are insufficient in the absence of political constraint but where that constraint is applied to bring migration about. It is possible to imagine economic situations which would justify this; the country of emigration may be overpopulated, for instance, and that of immigration underpopulated, and it may be that the benefits conferred on the non-migrant populations of the two countries by the migration may more than offset the inconvenience to (or fall in the standards of living of) the migrants. It is possible, moreover, that the Governments concerned may be more far-sighted than the individuals who are reluctant to migrate. Whether a belief that the situation was of this kind has been the reason for Governmental promotion of migration in any actual case, however, is doubtful. It would not be unduly cynical to expect, rather, that sponsored migrations have usually resulted from a coincidence of a desire in one country to check the growth of its population and a desire of another country to augment its own, or from a desire to provide a ruling class for a dependent empire, and that the questions whether the migrants themselves were made better or worse off in the process, and to what extent, were nobody's concern.

How these considerations fit in with the experience of the past, and what light they throw upon the future, may now be briefly considered, beginning with an attempt to apply them to the migration history of the last century.

The century between the end of the Napoleonic Wars and 1914 witnessed the emigration of between 50 and 60 million Europeans (of whom perhaps a third subsequently returned) to the Americas, Africa, and Oceania—far the biggest migration of which we have any knowledge. The primary reason for this migration was the usual one that the standard of living offered by the overseas countries was higher than that offered by Europe; the secondary impetus given to it by political persecution in some European countries was probably of relatively little importance. The United States, which took about 70 per cent.

of the migrants during this century, provided for its occupied population an average income per head 60 per cent. higher than that in Great Britain, and probably nearly twice that ruling in Germany in the middle of the period, when most of its immigrants came from those two countries; the potential improvement in standard of living which it offered to the Italians and Slavs, who made up the bulk of the immigrants from the 1880's onwards, was even greater. Canada and Australia, which took most of the British emigrants from 1900 onwards, probably did not provide average standards of living higher than those of the Mother Country, but offered infinitely better prospects and easier beginnings to those who wished to engage in agriculture. Argentina and Brazil held out the prospect of great improvements in standards of living to the Latin peoples (and, in the mid-nineteenth century, to the Germans) who went there.

While these great overseas movements were beneficial to the migrants themselves, they appear also to have been acceptable to the general populations of the countries both of emigration and immigration. There could be no doubt that the overseas countries were underpopulated, in the proper sense that an increase in population raised the general standard of living, for, as long as settlements were small and scattered, it remained unprofitable to link them up, and so open the country, with railways, roads, and canals, and to specialise production in the various localities as much as was necessary to obtain the greatest possible benefits from the diverse and widely separated resources of large territories. Moreover, although the opening up of the Western United States, for instance, caused complaint from farmers in the Eastern States, who felt the competition of the new cheap produce, there were powerful sections of the community interested in the effective occupation of the West, with all the opportunities for profitable investments and the expansion of markets which went with it, and immigrants were therefore widely welcomed.

That there was general overpopulation in the countries of emigration is not so evident. In some of them it certainly existed; there could be no clearer instance of overpopulation than Ireland in the mid-nineteenth century, while Italy, Poland, and the Balkan countries were also clearly over-

populated, especially towards the end of the period. Whether Great Britain and Germany were overpopulated is doubtful, though it is likely that Britain, at least, would have been had the enormous emigration from her not taken place. If there had been no emigration of natives from England and Wales between 1850 and 1910 (the immigration into the country being assumed to remain what it actually was), the population in 1910 would probably have been some 9 million—or 25 per cent.—higher than was actually the case, for the number of English and Welsh emigrants in those years was over 6 million, and their natural increase, had they stayed at home, has also to be taken into account. It is hardly likely that the extra need for imports due to a population so much larger than the actual one could have failed to cause the terms of British overseas trade to be much less favourable than in fact they were, especially as the absence of emigration would also have meant fewer overseas producers of cheap primary products for us to import and smaller overseas demand for our manufactures. Any economies obtained through a larger scale of working in manufacturing industry, partially offset as it would have been by a greater pressure on our agricultural and mineral resources, would probably have been quite insufficient to counterbalance this adverse effect on our foreign trade relations if the population of England and Wales in 1910 had been 45 million instead of 36, and if overseas territories had been deprived of the 6 million English and Welsh migrants and their progeny.

What is generally more important in practice than the often unanswerable question whether the countries of emigration are overpopulated, is the fact that whatever loss a country incurs through the emigration of some of its inhabitants is diffused very widely over those who remain—it does not strike any particular interest with great force. Indeed, the groups which are benefited by the departure of emigrants are often more vocal than the more numerous ones which are harmed; the Trade Unions welcome a restriction of the labour supply and the shipping companies naturally encourage emigration, while the employers who would employ the labour so removed, the consumers who would enjoy its products, and the workers in complementary industries who are deprived of their

markets do not feel their interests much affected. It is for this reason that restrictions on emigration are so much less widespread and severe than those on immigration. Thus, in many European countries in the nineteenth century, whether they were overpopulated or not, there were various private or semi-official agencies encouraging emigration, and there was little opposition to it where serfdom no longer existed.

Thus, all three of the factors most favourable to migration—economic benefits to the migrants, to the country of immigration, and at least to the most vocal interests in the country of emigration—were operating in the nineteenth century. What changes came about in the operations of these factors?

In the first place, the difference in standard of living between the new countries and those of the old ones which supplied most emigrants in the middle of the century gradually decreased. The average output per occupied person in the United States, which had been some 60 per cent. above the corresponding figure for Great Britain, and nearly 100 per cent. above the figure for Germany in the middle of the century, was in 1913 only about 25 per cent. above the British figure and probably less than 45 per cent. above the German. The gap increased again after the war; in 1929 the American advantage was probably about 45 per cent. as compared with Britain and once more almost 100 per cent. as compared with Germany, but it subsequently narrowed still more drastically. In the depth of the slump, British *per capita* output was probably as great as American, and was only about 10 per cent. below it in 1937. Canada's income level, since the beginning of this century, has been closely similar to those of the United States; Australia and New Zealand, on the other hand, have apparently increased their attractiveness in relation to Britain (from this point of view) from the beginning of this century right up to 1939—a fact probably connected to some extent with the diversion of the main British migration from the United States to the Dominions, which happened about 1900. The supply of potential emigrants from North-Western Europe, moreover, was sharply reduced after the first decade of this century, first by the war of 1914-18, then through the fall in fertility, which had begun

about 1880, and which was accelerated after 1920. The rate of natural increase in 1936-8 in the area as a whole was scarcely half of what it had been in 1911-13.

The attractiveness of the United States to emigrants from Southern and Eastern Europe, however, did not decline as did its attractiveness to British and German emigrants. Moreover, the fall of mortality rates in Southern and Eastern Europe, coming about a century later than the similarly caused reduction in North-Western Europe, brought about a sharp rise in the rate of natural increase there after about 1870. The population pressure so generated in an area where there was little development of manufacture was largely responsible for the great Latin and Slav emigration to the United States after about 1885, and this emigration, once begun, became institutionalised, information about prospects in America (very accurate information, to judge by the way in which emigration varied with prosperity) being passed back continually to friends and relatives of the emigrants.

Thus, the potential supply of emigrants to the overseas countries remained high, though the sources had changed, and the inducements to emigrate, apart from periods of acute unemployment (such as that after 1929) also remained high, though, again, they appealed to other people than formerly. The attitudes of the public authorities in the most important countries of immigration and (to some extent) of emigration underwent, on the other hand, a great change. The action of the United States Government in 1921 and again in 1924, in limiting immigration first to 357,000, then to 154,000 per year, of which number less than a third might come from the countries which had recently supplied most of the immigrants, was particularly important, and the reasons for it deserve attention.

First, since the 1880's, land settlement had ceased to absorb an important fraction of the immigrants—hence, the establishment of newcomers required the provision of man-made capital (as distinct from gifts of nature) to a greater extent than before, involved closer competition with workers already established, and was less evidently (though not necessarily less truly) stimulating to economic activity than the earlier immigration which had been connected with territorial expansion, railway building, and the increase

of land values. Secondly, the great growth of manufacturing industry strengthened the political position of the interests naturally most opposed to immigration—the Labour Unions. Thirdly, the change in the main sources from which immigrants were drawn meant that the competition with established labour became fiercer, since the standard of living demanded by the new immigrants was much lower than that demanded by the old (a condition aggravated by the fact that they had no longer the opportunity of acquiring free land in the West), and gave the exclusionists the support of those interested in maintaining the old "racial" composition of the nation, and of those who feared the divided loyalties and the "dangerous" political opinions of the newcomers. These factors have also been at work, in widely varying degrees, in other countries of immigration, and to them have been added, since 1929, the still more powerful ones arising from the existence of long-continued agricultural depression and of the (generally) shorter industrial depression which completely reversed the direction of net migration. The increased general awareness of the existence and evils of unemployment, which is so largely a product of the inter-war period, has, by a muddled (but natural) process of thought, helped to induce the belief that no immigration can be beneficial so long as any substantial number of the existing population is involuntarily unemployed—a criterion which, had it been rigorously applied in the past, would have excluded most of the migration which has ever taken place.

The obstruction has not been all on the one side of the countries of immigration, though they have, not unnaturally, done most of it. The growing intensity of nationalism in many European countries has caused two policies to be adopted which make migration more difficult —the actual obstruction of emigration (as practised in Italy since 1927) on the ground that the country needs a large population, usually for military reasons, and the hindering of the assimilation of emigrant nationals or their descendants in the country to which they have gone (as long practised by Germany, but especially since 1933, and especially in Latin America). To hinder emigration may often be justifiable on economic grounds—the loss incurred by a country when its more enterprising citizens, educated at

great public and private expense, go abroad, is too frequently neglected—but a course which makes a country's emigrants suspect of being potentially hostile to the country which receives them is the surest way of closing the doors to them, and can achieve the political results hoped for from it only in the very short run.

The decline of international migration since 1914 is, therefore, easily accounted for. In what ways are the factors responsible for it likely to be modified in future? In attempting to present some considerations relevant to this question, it will be best to confine the discussion to emigration from Europe, leaving the special problems of Asiatic emigration aside.

It is necessary to take account of both economic and political factors. Among the purely economic ones, the possibilities of over- or underpopulation in the chief countries concerned, which would form rational bases for their policies, and the probable developments of differences between income levels, which supply the chief incentives to migrants, must be considered. Among the political, or semi-political, factors which are relevant are (in addition to any "racial" or "cultural" prepossessions), the beliefs which the groups likely to be politically important may be expected to entertain about their economic interests in the matter.

The probable natural growth of population is, therefore, one of the factors at the heart of the matter, but, if a study of it is to throw light on the relevant questions of under- or overpopulation, it must be considered in connection with the natural resources of, and possibilities of economic development in, the countries concerned. The bare probabilities of population change, discussed in the preceding section, may be easily summarised. There is likely to be little natural increase in the United Kingdom, France, the Low Countries, Germany, and Scandinavia (taken altogether) in the next twenty years, though locally (in the Netherlands, for instance) there will be exceptions to this. At the end of the twenty years the total population of the area named is far more likely to be decreasing than increasing. On the other hand, South and East Europe will almost certainly have a fairly rapidly increasing population throughout the period—though, in parts of it at least, the increase may

well be coming to a standstill by the end of it. As regards the countries of immigration, the United States and the British Dominions are likely to maintain a natural increase in their populations, though at a decreasing rate, for something like a generation, but it is very improbable that the rates of increase over this period (except in South Africa) will be anything like as high as in Southern and Eastern Europe. The natural increase in South Africa seems likely to be higher, and to go on longer, than in the other Dominions. The statistical data for Latin America are inadequate, but it seems certain that the rates of natural increase which prevail there will continue high for a generation at least, even though they fall from their present very high levels.

The economic settings of these various rates of growth are harder to summarise. As regards Northern and Western Europe as a whole, it may certainly be said that both its natural resources and its acquired skills and institutions make it eminently suited to maintain a dense population—*i.e.*, make the optimum density a high one. Nevertheless, a good *prima facie* case might be made that the area is at present overpopulated, given its present determination to maintain large proportions of its populations in agriculture. It might even be suspected that, quite apart from the price paid by Europe for this maintenance of a somewhat artificial economic structure, the inferiority of its *per capita* industrial production to that of the United States is traceable in part to the greater scarcity of its resources in relation to population —not entirely to the qualitative inferiority of the resources. If this is true, then the prospective cessation of population growth in Western Europe is not without its compensations.

Whether the United States is over- or underpopulated is even more difficult to say. The probability that it is overpopulated is, of course, very much less than in the case of Western Europe, in that the ratio of its population to its natural resources (however they are measured) is much smaller. Nevertheless, there is always the theoretical possibility that the optimum of population may have been passed even there—it is safe to say, however, that if this is so it matters very little ; the rate at which real output per head falls off as the optimum is exceeded must be quite slow, or Western Europe, with its very much greater

population density in relation to natural resources, would fall further below the American standard of living than, in fact, it does.

The probability that the British Dominions are overpopulated is much less than in the case of the United States—so much less that it is reasonable to dismiss it. They may all be regarded as underpopulated, so scattered are their populations and so limited the local markets which they present. The same is probably true also of South America as a whole, where potential supplies of water power open the prospect of a certain amount of industrial development.

Southern and Eastern Europe, on the other hand, are almost certainly overpopulated. Given anything like their present economic structure, this is obvious; and it seems that, since their natural facilities for industrialisation are not as great as in the West, the fullest possible development would still, for a considerable time to come, leave a state of affairs in which the standard of living could be yet further improved if there were fewer inhabitants.

Taking the probable natural changes in population of the next generation in conjunction with the general economic background, one therefore sees a substantial case for considerably more migration, so far as the general interests of the people who do not migrate are concerned. Southern and Eastern Europe is overpopulated, and likely to remain so for some time; Western and Northern Europe is perhaps also overpopulated, though no considerable aggravation of this condition seems likely. The British Dominions and Latin America, on the other hand, are almost certainly underpopulated, and the United States is, to say the least, not seriously overpopulated. There is a broad, general presumption that the countries of the first group would benefit from emigration and those of the second from immigration.

The incentive to migrate also exists, and is likely to remain. The Americas and the Antipodes will in almost any circumstances offer the prospect of great improvements in income to potential emigrants from Southern and Eastern Europe, at least. How great this attraction is, however, and whether it would be strong enough to draw migrants from Western Europe also (Governments

permitting) depends on various other factors, especially on the level of employment which the potential countries of immigration are able to maintain, and on how quickly and thoroughly the pre-war disequilibrium as between primary and industrial products disappears.

If there is reasonably full employment in the United States, for instance, the attraction to emigrants from Western, as well as Eastern, Europe should be considerable, for, before the war, *per capita* real income in the U.S.A. was more than 50 per cent. higher for those actually in work than for those working an equal number of hours per week in the United Kingdom, and correspondingly higher still as compared with other European western countries. Only the higher unemployment and the smaller proportion of total population occupied in the United States made the gap between real incomes there and in Western Europe so small in the pre-war decade. The level of activity in the United States will also be one of the major factors affecting the ease with which the disequilibrium between primary and secondary production can be dealt with, but there are, of course, others. One of these is the willingness (or unwillingness) of the manufacturing countries to abandon the artificial support of branches of agriculture in which costs of production are high, while another is the extent to which manufacturing industries are developed in the world at large—especially in countries hitherto devoted mainly to primary production. Given prosperity in the United States, some moderation in the agricultural protection policies of the manufacturing countries, and a further increase in the supply of industrial goods relatively to the supply of primary products, the attractiveness of the Americas and the Antipodes to emigrants from all parts of Europe should be much greater than it was in the pre-war decade. In so far as any or all of these three factors fail, the incentive to migrate will be reduced.

A further factor to be considered is the prosperity of Europe, for, although history tends to show that migration is more powerfully affected by the pull of prosperity elsewhere than by the push of depression at home, the latter is not, of course, unimportant. A depression with much and prolonged unemployment in Europe would naturally tend to accelerate emigration (provided that conditions

elsewhere were better). Much may depend, too, on the policies adopted for bringing about a permanent rise in income levels in Eastern Europe. If capital is obtainable there for appropriate policies of agricultural improvement and for industrialisation, the resulting economic improvement may reduce the incentive to emigrate—the rapid rise in standards of living in Japan in the last half century has certainly been a major factor in rendering emigration from that country negligible. This is to be offset against the general effect of industrialisation (mentioned in the last paragraph) in raising the profitability of agriculture, and so the attractiveness of many overseas countries. Indeed, it is probable that, if the means of raising the standard of living at home are available, many Governments will be hostile to emigration (even though their countries are, technically, overpopulated), since nationalistic sentiment generally favours the development of a populous community, provided that very severe and evident disadvantages are not attached to it—and often even if they are. Will these means be available?

It is clear that the standard of living in practically any community can be raised by applying sufficient amounts of capital—always if no interest has to be paid out of the community as a result, and usually even if it has. If the Government is strong enough, it can raise the necessary capital at home, either by taxation (which does away with the subsequent necessity for paying interest at all) or by internal loans, the interest payment on which is only a matter of transfer within the community. If the Government is less strong, if it encounters exchange difficulties in obtaining the foreign machinery, etc., which is needed, or if the development is in the hands of people who are anxious simply to borrow in the cheapest market, regardless of whether it is internal or external (an eminently sensible policy in regard to any development with good economic prospects), then it is probable that the capital will be borrowed partly, at least, from abroad, in which case some net benefit will probably still be derived from it, because wages, etc., are likely to be raised as a result of the investment concerned even though the profits from it are not sufficient to pay the interest expected on the foreign loan. Thus, especially if the wealthier countries are prepared

to lend, but also even if they are not, there will probably be vigorous attempts by the Governments of European countries (especially the less developed ones in the south and east) to raise standards of living by the application of capital, and, in these circumstances, emigration may not be regarded very favourably by them.

It does not necessarily follow, however, that prosperity in the New World would not strongly attract emigrants from Europe, in spite of their rising standards of living. It must be remembered that the great emigrations from Western Europe in the last century took place in spite of rapidly rising standards of living here, and that one of the reasons why there has been so little emigration from Japan is that the entry of the Japanese into all the countries very much wealthier than their homeland was forbidden. In any case, it is clear that to obstruct emigration from an overpopulated country, no matter how rapidly its standard of living is being raised by internal development, is generally to sacrifice the possibility of raising that standard still faster, and that to apply capital in places where it is less productive simply because the people are there, when both it and the people concerned might be transferred to places where it (and they) would be more productive, is only a second-best policy.

So much for the economic factors which are likely to affect the attitudes of Governments and potential migrants in the countries of emigration. The corresponding factors which are likely to affect the attitudes of authorities in countries of immigration are even more important. Attention has also been called to some of the factors which have made for the drastic restriction of immigration in the United States and elsewhere, and it is clear that they consist largely of powerful sectional interests which will probably continue to have a strong influence on policy. The one thing which might be expected to have an appreciable effect in making the attitude to immigration in the decade or two after the war more favourable is success in maintaining fairly full employment in the countries concerned. Given this, the realisation that the natural growth of population was rapidly slowing down might well lead to a gradual rising of the immigration quotas in the United States (though probably not for quite a long time) and to a corresponding and perhaps earlier lifting of restrictions elsewhere.

Another main factor which might make increased immigration possible (chiefly in the British Dominions and Latin America)—and one which is probably essential if greater ease of immigration is to be at all long-lived—is the proper and intelligent regulation of national (or, better still, of world) development. In the past the British Dominions and Latin America have tended to take their immigrants in large gulps, each gulp being associated with the greatly increased production of some commodity for export. The digestion of each mouthful has led to a worsening of the country's terms of external trade, due to a glut of the commodity concerned, as a result of which the digestive capacity of the country has then been low for some considerable time. It is clear that, if immigrants were directed into all occupations in the right proportions, no serious dislocation of the country's internal or external economy need be caused; though the general level of activity would still be liable to be upset if adequate measures were not taken to steady it, and if the rate of immigration itself were not fairly steady. The ideal, then, is a steady rate of intake of immigrants, so distributed among occupations as to develop the economic structure of the country, and its external economic relations, on the lines which give the best *per capita* real income as the result of home production and foreign trade. The actual rate of intake would have to be governed by the rate at which capital became available, and was needed to bring about the extension of the community.

It is not suggested, of course, that it would be easy, or even possible, to realise this ideal at all fully, but it seems certain that the concept of the ideal itself has often been lacking in the past, and that the mere grasping of it should enable many of the worst mistakes to be avoided. The study of the general ratios between entries to different occupations which should be maintained to prevent violent dislocation, while at the same time promoting gradual transformation of the economic structure in the most desirable direction, is one of the most profitable that could be undertaken on behalf of countries of immigration—or, for that matter, countries with a high natural rate of population growth.

It seems, then, that migration has an enormous part

to play in the post-war world, if it is allowed to do so. Government regulation of economic life, which makes it easier in many ways to dispense with migration, need not, in fact, choke it. Indeed, the strangling of migration (as of trade) in the inter-war period was quite largely due to the fact that national policies of intervention were uncoordinated and marred by lack of either experience or sound doctrine; if they are more coordinated and directed on theoretically sound lines in the light of experience, there is no reason to suppose that they will not result in a considerable promotion and increase of beneficial movements of population, as well as of goods. To expel nature with a pitchfork may be very much worse than leaving her alone, but regulating her with instruments of precision is likely to be much better.

CHAPTER V

INDUSTRIAL EFFICIENCY AND NATIONAL ADVANTAGES

1. WHAT IS EFFICIENCY?

INTERNATIONAL comparisons of industrial efficiency have begun to attract a great deal of attention. Discussion of it, however, is still frequently clouded by misconceptions or by vagueness as to what is meant, or how "efficiency" should properly be measured, and it is therefore desirable to begin by considering these points.

The concept of efficiency—in its exact form—belongs to physical science. The efficiency of a piece of apparatus can be measured, quite unambiguously, as useful output per unit of input. Frequently, indeed, as with the thermal efficiency of a heat engine, it is possible to free the measurement of all physical dimensions by relating the output actually attained per unit of input to that which is theoretically possible under ideal conditions; but this is a refinement—for "efficiency" to be unambiguous and measurable it is necessary only that both input and output should be unambiguous and measurable.

These conditions are not realised in the process of production as the economist sees it. The engineer is interested only in the power-output of an engine on the one hand and in the fuel consumed on the other. The economist, concerned with the same engine, might be content to measure output in terms of power also, but the input, for him, would consist not only of fuel, but also of interest and amortisation on the capital sunk in it and of the labour, etc., involved in maintaining and operating it. These factors of production can all be measured separately, but only in different and non-commensurable units. There is thus no way of measuring input—in the sense in which it interests the economist—in physical terms by a single figure. The historical attempt to do so in terms of labour necessarily failed in face of the fact that neither the postponement of output in order to get more of it—which is

a very real part of the "input" wherever any but the most primitive methods of production are employed—nor the scarce natural resources which are equally part of the economic input, can be measured in terms of labour.

The only common measuring-rod which can be applied to all the factors of production is exchange value—generally money value. It is, moreover, not an entirely arbitrary measuring-rod; if those who purchase the factors of production may be supposed to do so in such a way as to maximise the utility obtainable in return for their expenditure on them, it follows—apart from certain reservations concerning the nature of the markets for factors and products—that small units of the various factors which cost the same in the market are of equal utility to their buyers. The money cost of any reasonably small parcel of factors used to obtain a product, no matter how the parcel is composed, has a claim (apart from the reservations just referred to) to be regarded as a proper measure of the social "input" involved in obtaining that product. In favourable circumstances it is a good measure of the utility which those factors might have created in an alternative use, and hence of the utility foregone in order to get the product under discussion.

Thus, cost per unit of output—or, rather, output per unit of cost—is the best available measure of efficiency in production. A superior efficiency in this sense may spring from many causes—from the use of better technical processes, from better lay-out of plant, from systems of management and remuneration which induce the labour force to work better, or which ensure fuller utilisation of the equipment; or from a geographical location which makes available productive factors of better quality or lower price.

In an important sense, this last-named cause—fortunate location in cases where the factors of production are imperfectly mobile—is just as much a source of efficiency as any other; society economises its resources just as much by mining for coal where it is easily got, or placing its flour-mills by the wharves where grain is unloaded, as by using machinery in its mines and factories or by working on a shift system. The imperfect mobility of the factors, however, and their consequent variation in price from

place to place, make it hard to give precision to a distinction which would be very useful—the distinction between efficiency which is an attribute of the industry and that which is an attribute of the economy as a whole. It would be convenient if the consequences of locational factors could be segregated under the latter head; one could measure efficiencies of corresponding industries or firms as the physical output per unit of cost, pricing the factors of production in a standard way—*e.g.*, at the average of the prices paid by the firms or industries compared. This does, indeed, present an interesting practical solution to the problem, but an element of arbitrariness remains; the geographical differences in relative factor prices bring about corresponding differences in the proportion in which the factors are combined; the combination which minimises cost in one country does not do so in another, and any single set of factor prices chosen for costing the products of industries in both countries must remain in some degree arbitrary. This is, of course, only a special case of the difficulty which arises with all index numbers—all attempts to compare differently composed collections of non-commensurable quantities.

If the attempt to abstract from locational differences is dropped, and industries are compared purely on a basis of physical output per unit of actual cost, other difficulties arise. It is true that this is a comparison of great practical importance, since it has immediate relevance to what will happen if there is competition between the industries. International—and interregional—comparisons of actual cost, however, may be very misleading, since the parities between the currencies circulating in the two places concerned, and the relation between the price levels ruling in them, may be governed by factors entirely remote from the industries which are being compared. One country may sell to the other principally a commodity which it produces at very much lower cost (relatively to other commodities) than is the case elsewhere. Thus, the external purchasing power of its currency will be unusually great in relation to its internal purchasing power over most commodities, and its costs in industries other than the principal exporting industry will appear very high, even though the quantities of factors used per unit of output in many of them may be no higher

—or even lower—than in other countries. Similarly, a tariff or quantitative restrictions on a country's imports may drastically alter the relative "efficiency" of its industries compared with those of other countries, as measured by output per unit of actual cost.

Thus, one is faced with a choice between imperfect alternatives. If the efficiencies of two industries turning out identical products in different places are compared on the basis of factors used per unit of output, priced at common prices, the "index-number difficulty" is encountered. If they are compared on the basis of actual costs per unit of output, considerations are introduced which are relevant to the question how world resources as a whole should be used in the given conditions, but irrelevant to the comparison of outputs per unit of input in the two industries considered alone. It is doubtless largely in order to avoid this dilemma that many people regard output per man-hour, or output per man-shift, as the simplest and most satisfacory measure of productive efficiency. There is, indeed, a well-established usage whereby "efficiency" is used to denote, not output per unit of total input, but output per unit of some particular factor—one speaks of the average or the marginal efficiency of labour or capital, for instance, meaning simply the average or the marginal productivity of those factors. This usage is a useful one; to use output per man-hour as a measure of the efficiency of the industry (as opposed to the efficiency of labour in the industry) is, however, highly dangerous. It is quite obvious that the man-hours taken into account are far from being the total input to which the output ought to be related. The man-hours which go to the manufacture of a piece of cloth from yarn are not only those employed in the weaving, dyeing, and finishing processes, but some portion of those that made the machines and buildings used in those processes. Moreover, besides the direct and indirect labour, there are other and non-commensurable factors to take into account; there is the postponement of consumption which occurred by virtue of the decision to build the textile factories in question instead of employing the resources for current purposes, and there is also the cost of using the land on which they are built, which is the foregoing of its use for

some other purpose such as agriculture or residential building. Some part of those factors too must be imputed to the piece of cloth concerned as a portion of the input required for its output. One cannot legitimately escape the dilemma involved in measuring efficiency simply by forgetting inconvenient parts of the input.

It has been assumed so far that the industries compared turn out identical products, so that there is no difficulty in comparing their outputs in physical terms. This condition rarely holds, especially where international comparisons are concerned. Corresponding industries in different countries may not produce identical goods at all, or, if they do, they produce many lines of goods in different proportions —their total outputs have different compositions. In these circumstances, output must be measured in value terms; the same dilemma therefore arises (though often in a less acute form) as with input.

Output can, of course, be measured simply as the selling value of the products—what is generally referred to as "gross output." For many purposes of comparison between corresponding firms or industries, this is satisfactory; it breaks down, however (as do any of the comparisons hitherto discussed), if the productive units compared take in their materials at different stages of fabrication. For this reason, the measure of output in value terms most usually adopted is "net output" or "value added in manufacture," which is the selling value of the product *minus* the cost of materials, fuel, and purchased power used. Strictly, however, this is still open to objection; it fails to exclude all contributions to the product not made by the firm or industry in question, since it includes what is paid (or put by to be paid) to other firms for the repair and renewal of plant, etc., for advertising, legal aid, insurance, postage, and various other purposes. If these are excluded, the result is "income originating in" the industry or firm concerned, which can properly be imputed to its labour, production-management, plant, and equipment. One of its great virtues is that it can be summed for quite different firms or industries, and that if summed over all the productive units in the economy, yields the gross national income—the value measure of the current output of goods and services in the economy as a whole.

The comparison of output and input, when both are measured in terms of actual market values, is, of course, nothing but the ordinary accounting operation to determine profit or loss—which are excellent clues to relative efficiencies in a single economy with mobile factors and perfect markets, but subject, again, to important reservations in international comparisons, owing to variations of both factor and finished product prices. Comparisons in terms of standardised (*e.g.*, average) factor and product prices might be interesting in some cases, but would, of course, come up against the "index-number problem" twice over.

It is more common, therefore, to relate output (in terms of either local market prices or some more conventional values, such as world market prices where these exist) to input measured in physical terms—*i.e.*, to the quantity of labour employed. What is really measured by this is, of course, the average efficiency of labour in value terms; not the efficiency of production. Nevertheless, when summed over the whole economy, it takes on a new significance. The receivers of income are, after all, not factors of production (in the most strict and abstract sense) but their owners; even if the aggregate volume of factors used cannot be measured unambiguously, the number of their owners (or of the owners and their dependants, *i.e.*, the total population) clearly can. There is no ambiguity in the concept of income per head of the total population; nor is there, essentially, any in that of average income per owner of productive factors, though in an economy in which productive and unproductive assets are so freely exchangeable against each other—in which war debt is a close substitute for industrial bonds—this latter concept has little significance. Average income per occupied person is, of course, the proper measure of the average productivity of labour—in the wide sense—in the economy as a whole, provided that any income from investments abroad is excluded.

There are thus two main distinctions which it is necessary to keep in mind in discussing efficiency. First, one must decide on the sense in which the word is used, whether it is intended to stand for output per unit input of all kinds or for output per unit of one factor only—the other factors used being ignored. Secondly (if particular

firms or industries rather than complete economies are concerned), it must be decided whether what is to be measured is something relating to those firms or industries considered *in vacuo*, or something relevant to the choice between them, as producers, in their actual setting. In the former case each factor entering into input, or each type of output, must be priced in the same way for both productive units; in the second the factors, or products, though physically similar, must be given their actual local prices. All the usual and simple comparisons to which the available data best lend themselves are comparisons of the efficiency of a single factor, generally labour. The second of the distinctions mentioned therefore more often arises in connection with the measurement of output than of input, and it is more usual to measure output in this case in physical or conventionalised value terms rather than in terms of actual market value. The reasons for these choices are partly bad and partly good; in what follows, however, it is necessary only to bear in mind the significance, and the limits of the significance, of the measurements which result from their having been made.

2. SOME COMPARISONS OF PRODUCTIVITY

With these considerations in mind, one may turn to some recent attempts to compare the productivities of labour in different countries, and attempt to account for the differences revealed. The subject is treated at some length by Mr. Colin Clark in the chapter of his book, *The Conditions of Economic Progress*, on "The Productivity of Secondary Industry," and a comparison of productivity in Great Britain, Germany, and the United States for years shortly before the war has been made by Mr. Rostas in the *Economic Journal* of April 1943. Mr. Rostas' results may be summarised first. Perhaps the most interesting of them are his comparisons of physical amounts of output per operative per annum in the three countries in various industries where outputs are susceptible of comparison in this way. For 25 industries the weighted average of German productivity exceeded that of British by 1 or 7 per cent. (according as weights appropriate to the German or to the British industrial structure were used), while United States productivity exceeded British by 129 or 138 per cent. (again according to the choice of weights). Mr. Rostas also compared the net values of output per occupied person in all the factory trades of the three countries as revealed by the British Census of Production of 1935, the German census of 1936, and the United States census of 1937. Taking as the appropriate exchange rates 17·08 Rm. and $4·94 to the £, he finds that German *per capita* productivity exceeded British by 11 per cent., while the United States productivity exceeded British by 125 per cent. The range of industries covered here is not the same as that covered by the direct comparison of physical outputs per operative, and the relative importance of the various industries in the three countries was not the same; both Germany and the United States had more, relative to Britain, of the industries in which their relative productivity was highest. All the evidence together seems to suggest, however, that British *per capita* productivity, industry for industry, was, on the average, perhaps slightly less than German, while the average *per capita* productivity in

manufacturing industry as a whole was appreciably less in Britain than in Germany. No doubt is left by it that British *per capita* output, both industry for industry (on the average) and in manufacturing as a whole, was less than half that in the United States.

The average number of hours actually worked per week were not the same in the three countries, so that the above comparisons cannot be taken as referring to productivity per man-hour. It seems that the average number of hours per week actually worked in Germany in 1936 was about 5 per cent. less, and in the U.S.A. in 1937 about 19 per cent. less than the average British working week of 1935. The comparison of productivities per man-hour is therefore less favourable to this country than is the comparison of annual *per capita* outputs.

Moreover, the general conclusion drawn from the comparisons is confirmed by earlier investigations. Mr. Clark calculated that average net output per operative in British manufacturing industry in 1936 (measured at United States prices) was about 48 per cent. of that in the United States manufacturing industry in 1935; his comparison did not extend to Germany, but his data make it appear that British productivity in 1930 was about 37 per cent. greater than in French industry but little more than a third of that in Canadian—differences which probably, however, owe more to the different industrial structures of the countries compared than to differences between corresponding industries in them.

The comparison of individual industries is, indeed, much more interesting than that of different countries' industrial systems taken as wholes. Mr. Rostas shows that German physical productivity per head in 1936 exceeded that of British by about 50 per cent. in coal mines and coke ovens, by 20 to 25 per cent. in cotton spinning, rayon, and silk, and by 10 to 20 per cent. in blast furnaces, steel smelting and rolling, machinery, rubber tyres, and soap; while it was below British by more than 50 per cent. in the beet sugar, preserved fruit and vegetable, and tobacco-manufacturing industries, by 20 to 25 per cent. in radio, cotton weaving, printing-ink manufacture, and brewing, and by almost 19 per cent. in margarine manufacturing also. In the remaining industries considered—

iron and steel products other than machinery, cement, motors, hosiery, and wheat milling—the productivities of labour in the two countries were about equal. Generally speaking, German superiority was more marked in the capital goods industries and British superiority in the consumers' goods industries—a fact which can hardly have been unconnected with the great recent development of German capital goods industries for re-armament purposes, and the contemporary expansion of British demand for consumers' goods. United States productivity was greater than British in all the industries compared; the greatest United States superiority (of more than 200 per cent.) lay, however, in blast furnaces and in the manufacture of radio sets, motor cars, and iron and steel goods other than machinery; United States superiority was less than 50 per cent., on the other hand, in cement making, cotton spinning and weaving, and in the jute, hosiery, and preserved fruit and vegetable industries.

It is clear that the sources of the great differences in productivity—both of differences between corresponding industries in different countries and of differences between different industries in each country—deserve much more study than can be given to them here, and more, indeed, than they have so far received from economists in general. A certain amount, however, can be usefully said even in a short space. It is perhaps the first set of differences—that between productivities in the corresponding industries in different countries—which is the more interesting and important, and which should therefore be discussed first.

Mr. Clark, in the chapter mentioned above, sets out the results of a number of investigations by himself and others concerning the sources of high industrial productivity and, especially, the high productivity prevailing in the United States.

The chief conclusion from these practical studies is that little or no significant correlation is to be observed, in general, between high output per head and large size either of the firm or of the industry, as measured either by employment or output. In the few cases where such a correlation appears it is simply the case that both productivity and size of the industry have increased in the course of time; there is no strong evidence to connect

the increase of the first with that of the second rather than with (say) technical progress independent of increases in scale. On this point Mr. Clark quotes Allyn Young to express his opinion: " . . . the mechanism of increasing returns is not to be discerned adequately by observing the effects of variations in the size of an individual firm or of a particular industry, for the progressive division and specialisation of industries is an essential part of the process by which increasing returns are realised." The great size of the tariff-free internal market of the United States was the factor which Young believed to be chiefly responsible for the high productivity of United States industry as a whole.

It is clear that there is a certain amount of empirical evidence for this view. If one considers the great industrial countries which carry on practically all branches of manufacture in not greatly different proportions—ignoring countries which, like Norway, specialise on a narrow range of industry in which they may have some special advantage—it is clear that there is a correlation between *per capita* productivity and size of the industrial economy as a whole. United States industrial employment before the war was nearly twice as great, and its net industrial output three or four times as great as British; German industry exceeded British by about one-seventh in employment and one-quarter in total net output; British industry exceeded French by between half and a third in employment, and had something like double its output. These differences in size are very closely correlated with the differences in output per head.

Empirical evidence of this kind, however, is very dangerous unless it is approached in a much more analytical spirit; to leave the matter at this stage is to risk the crudest of *post hoc* fallacies. The *immediate* source of United States superiority to Britain in labour productivity, industry for industry, is perfectly plain; United States industries are much more highly mechanised than British—the horse-power used per worker is twice as great in United States as in British factories, and the scanty evidence indicates that much the same is probably true of the value of plant and equipment employed. That, of course, is by no means the end of the matter; as Allyn Young said on this point:

" . . . this will not do, for, as every economist knows, the greater the degree in which labour is productive or scarce—the words have the same meaning—the greater is the relative economy of using it in such indirect or roundabout ways as are technically advantageous, even though such procedure calls for larger advances of capital than simpler methods do." In other words, to say that labour is highly productive because it works with a large mechanical equipment is no more significant than to say that it pays to give it a large mechanical equipment because it is scarce (or productive).

This in turn, however, is not the last word. It is not enough to contemplate the functional relation which exists at one time between the scarcity, productivity, and capital equipment of labour; one can get further only by considering the *process* by which the given situation came to be established. The historical source of the high industrial productivity of United States labour is well hinted at by Mr. Hitch in *America's Economic Strength*. American industry had, from the first, to compete with agriculture for its labour much more keenly than had European industry. Income statistics show a lower level for American agriculture than for British until the end of last century, but that is not the decisive point—in Britain and in Europe generally a rapidly increasing population was pressing upon the land, and enclosure movements were in some instances putting additional pressure on the countryman to migrate to the town. Entry into agriculture in Europe, indeed, was very difficult, in the sense that it could be achieved only by becoming an ill-paid labourer, by inheriting smaller and smaller shares of peasant holdings, or by a great capital outlay; in the United States, on the other hand, free or cheap land could be had until late in the century, and crops could be obtained from the virgin soil with all too little capital expenditure. American industry had to attract potentially independent farmers; European industry was fed by a stream of labour virtually forced off the land.

In these circumstances, it is clear that United States industry had to offer much higher wages than had European industry, and had to adopt the methods appropriate to a labour scarcity. Hence, it came about that American *per capita* industrial productivity was much higher than British

even before the American market or the American industrial economy was bigger than ours. American artisans' wages, indeed, were higher than British even in Colonial days. That the enormous scale of the home market was important in making possible the growth of mass production (which is a later development) in the United States cannot be doubted. It is true also that a good deal of natural wealth (coal, copper, and petroleum, for instance) is more readily available—can be got with less labour, quite irrespective of the equipment which that labour uses—in the United States than in Europe, which naturally contributes to the higher industrial output per head there. For both these reasons opportunities were plentiful, but it was probably of crucial importance that, from the beginning, industrial labour was scarce because of the strong pull of agriculture. It is not, of course, possible to state the relative importance of these factors with any precision; they were all necessary to produce the scarcity of industrial labour in relation to industrial opportunities which lies at the root of high *per capita* productivity.

The final element which was necessary to bring about the profitable employment of this dear labour was, of course, capital, and this was available principally because great natural opportunities were seen to exist, and because the average incomes were already high—for the capacity to develop great natural riches depends on the wealth which those riches have already created. In the first decade of this century, when industrial expansion was very rapid, some 14 per cent. of the United States national income was being saved—and more than this was being invested in the United States, for there was still a net importation of capital at the rate of about £10 million a year. In Britain, also, in the period of great industrial development, capital has been forthcoming from home savings; probably the proportion of national income saved was much the same as in the United States. By no means all this saving, however, went into the development of the home economy; the total amount invested in British industry and transport (excluding investments in land and dwelling-houses) between 1865 and 1914 was probably some £3,000 to £3,500 million, but about the same amount was added to our investments abroad in that period (about half of it in the Empire, about

a fifth in the United States, and another fifth in Latin America). There is no reason to believe that the capital invested abroad brought in smaller returns to the country than would have accrued had it been invested in home industry; there is no reason to complain of a misdirection of our savings in this respect. In 1913 it in fact brought in about 10 per cent. of the national income, a return of over 5 per cent. on our total foreign investments. The fact remains, however, that one of the reasons why British industry was not more lavishly equipped was that much British capital was invested abroad. We chose (as it were) to have our industrial workers producing rather smaller physical amounts per head, but buying cheaper imported goods with part of their output, and to have our capitalists' incomes supplied rather more by overseas labour and rather less by British labour, than would have been the case had we invested more at home and less overseas.

The much greater scarcity of labour relatively to both capital and investment opportunities in the U.S.A. as compared with Britain does not, however, explain the whole of the difference of *per capita* industrial productivity between the two countries. The fourth factor of production, technical knowledge, which economic theory so frequently ignores (largely because it is so difficult to take into account in a static analysis) is of immense importance in any review of how things have come to be as they are. One of the chief reasons why British industrial efficiency was rapidly overtaken by that, not only of the United States, but of Germany also in many branches of activity, is simply that these competitors came later into the field, and so had the advantages of later techniques. It has been made clear in the air war, for instance, how great may be the advantage of going later into large-scale production with better designs. It happened that, in many of the industries in which Britain secured her early primacy—textiles, iron, and steel—plant was peculiarly long-lived; it was a long time before it had paid for a sufficient part of its cost to make the installation even of very substantially improved patterns worth while, and when it was old the relatively low rate at which it was necessary (or customary) to charge depreciation on it went a long way towards offsetting the reduction of other costs which might have been obtained by substituting newer

plant for it. There is little doubt that foreign practice was very largely better than British in these older industries by the end of last century for this simple reason alone.

The importance of this technological time-lag has doubtless changed in the last forty years. It may be that the industries which have come into greater prominence in all the advanced countries in that period are ones in which the physical durability of equipment is less than it was in the older industries; certainly it is the case that, with the development of mass-production and accelerated progress in quality of products the plant has often to be changed in order to keep the product at all up to date, so that, with obsolescence high in any case, the opportunities for one plant to catch up to or get ahead of its rivals are more frequent than they used to be. Continuous effort is necessary now to maintain a lead which, earlier, might have been gained and held for quite a long time as a result mainly of good fortune in the timing of one's industrial growth. It has become a commonplace that industrial research is of vital importance for the maintenance of industrial efficiency. The way in which research has come to be so important for giving an industrial system a slight lead over its rivals at each of the frequent modifications or renewals of its plant is, however, probably less appreciated.

Perhaps a more fundamental reason for the technological lag of British industry behind its rivals relates not to the plant but to the personnel. That British practice was surpassed abroad towards the end of last century may be due partly to the operation of the tendency described in the old saying "clogs to clogs, three generations." The second and third generations of leaders of the older industries in Britain, whose energies were diverted towards establishing a higher social position (as opposed to a better financial position) for themselves, competed on unequal terms with the first, more single-minded, leaders of the corresponding German and American industries. More recently, this cause has not operated, because Britain has not had a temporal lead in the development of the newer industries; moreover, here, as in other countries, the effective technical direction of industry has been passing over rapidly from the entrepreneur to the salaried technician. Even under these new conditions, however, it seems that the United

Kingdom has remained at some relative disadvantage, probably for two reasons. In the first place, the higher direction of industry has still not been leavened nearly as much as in Germany and the United States by technical experts with an appreciation of the importance of research or of the character of the technical qualifications needed in the salaried staff. Secondly, the public service has tended to attract men of administrative ability who, in the United States, would certainly have gone into industry, and who, in Germany, would at least have been more likely to do so than was the case here—a result not only of the high tradition and competitive recruitment of the Civil Service in Britain, but also of the relatively low prestige of natural science and technical subjects in the British educational system. (It is noteworthy that British commerce has probably fared better than industry in this respect.)

The technological and organisational differences between British and United States industry, however, are only part of the wider differences between the two economies. The fact that output per head, or per man-hour, is very much greater in the United States in any particular industry is, on the face of it, proof only that the United States industry is technologically or organisationally different from the British—presumably more highly capitalised. "Income originating" per head is difficult to compare between corresponding industries—or between manufacturing industry taken as a whole—in the two countries for lack of adequate data. Mr. H. W. Arndt has shown how, in principle, the comparison should be made, has pointed out the paucity of data just mentioned, and has very tentatively estimated that, whereas "income originating" is about 75 per cent. of "value added by manufacture" in the United States, it may be as much as 83 per cent. of it here—our lower level of capital equipment, in particular, rendering depreciation, repairs charged to current account, etc., only perhaps half as great in relation to output as is the case in the United States. Thus, if that output which is necessary to maintain and replace the equipment of industry is excluded, the comparison between United Kingdom and United States productivities is somewhat more favourable than appears from a simple comparison of physical outputs per head, but the picture is not fundamentally altered—

the United States superiority with regard to "net income originating in manufacture," while certainly less than that with regard to net output per head (125 per cent. according to Mr. Rostas), appears still to be one of 100 per cent. or more.

The United States superiority in this respect—that is to say, primarily, its superiority in equipment—is not, of course, fully reflected in a superior standard of living. Mr. Clark calculates, by direct comparison of physical agricultural outputs valued at world prices, that net output per adult male engaged in agriculture was, in 1934-5, only some 39 per cent. higher in the United States than in the United Kingdom. Direct light on productivity in the "tertiary" industries is scanty—United States productivity was apparently several times as great as British in the movement of goods by rail if ton-miles per person employed is the criterion (this is largely a consequence of the longer average haul in the United States, and is somewhat misleading, since so much of the service performed by railways is in the provision of terminal facilities), but in retail distribution there seems little to choose, and it can be assumed that this is so, also, in regard to all personal and professional services, administration, and defence. Indeed, if the whole occupied populations in work in the two countries in the immediate pre-war years are compared and their very different occupational distributions taken into account, it appears that the average United States output of goods and services per head cannot have been as much as 50 per cent. greater than the corresponding British average. When account is taken, further, of the lower proportion of the total United States population that is "occupied" (*i.e.*, in or seeking gainful work) and the higher United States proportion of unemployment among the occupied population, this difference is further reduced to one of perhaps 25 to 30 per cent. When it is remembered that the United Kingdom obtained a much higher proportion of its total income from abroad than was the case with the United States, it becomes clear why, despite its great inferiority in manufacturing equipment, and therefore in the productivity of its industrial labour, it maintained an average standard of living little below the American.

Standard of living depends not only on the productivity

of labour in particular occupations, but on the proportion of the population which is productively occupied and on the proportion which—by specialising and engaging in external trade—it is possible to keep in the occupations in which their productivity (measured in value terms) is greatest. The United Kingdom gains (quite apart from its overseas investment income, now sadly reduced) by keeping a fairly high proportion of its population occupied and in work, and by keeping a very high proportion of its occupied population engaged in the production of manufactures which can be exchanged for relatively large quantities of primary products. That, however, clearly does not justify any abatement of the effort to raise net income produced per head in every branch of production to the highest possible level. While this is no doubt possible in all branches, it is in manufacture that the scope for it is probably greatest, and the high relative importance of manufacture here would make the reward of any such improvement particularly rich. Industry produced little short of half our national income in the mid-1930's; if the production of that income per industrial worker had been up to the United States standard, therefore, our real income per head of the total population —though it would probably have risen by considerably less than a half owing to consequential changes in occupational structure and the terms of trade—would very probably have been the highest in the world.

There is, however, a more urgent aspect of the matter. The high degree of specialisation on manufacturing industry which still keeps the British standard of living so high relatively to that even of countries where income produced per head in industry is higher than here, is itself a function of our efficiency in producing exports at low cost. Competitive costs in exporting industries cannot indefinitely be maintained in the face of growing technical superiority abroad and of a well-maintained standard of living at home. To fall further behind foreign practice in the exporting industries must, therefore, mean some sacrifice of the advantages of specialisation. To stand still (or not to advance fast enough) in this respect might thus mean not merely a relative, but an absolute fall in the standard of living of the British people.

3. OLD INDUSTRIES—COAL AND COTTON

The way in which the greater age of British as compared with United States or German industry contributes to the inferior productivity of labour in it may be illustrated by reference to the two British industries which probably suffer most in this respect.

Coal and cotton share an almost symbolic place in British economic history; together with wrought iron (which lost its supremacy to steel sixty or seventy years ago) they were the greatest of the industries in which, in the middle of last century, the United Kingdom led the world. They were thus staple exporting industries; in 1860 exports of cotton yarn and manufactures amounted to £52 million, or over 38 per cent. of all British exports; in 1910 they amounted to nearly £105 million. or almost 25 per cent. of the total, while coal exports were valued at a further £38 million, or over 8½ per cent. of it. By 1938, however, cotton exports were down to £50 million, or 10½ per cent. of the total, while coal exports were some £37 million, or less than 8 per cent. of it. In total output, too, a decline had set in. In 1900 the United Kingdom possessed 42 million cotton spindles, or over 40 per cent. of the world total; her greatest absolute number (57 million) was reached in the years 1925-28, though her share of the world total had then fallen to about 35 per cent.; by 1938 the number had fallen to less than 37 million, or a quarter of the world total. Her consumption of raw cotton in 1860 had been probably nearly half the world's total consumption; it reached a maximum level averaging about 900,000 tons annually in the five years before 1914, which was, however, probably little more than a fifth of total world consumption. By 1936-8 it was down to 640,000 tons, or probably less than a tenth of the world total. Similarly, British coal production reached a peak of 292 million tons in 1913; it was then 24 per cent. of the world total (the United Kingdom had accounted for nearly 40 per cent. of world output in 1890, the first year for which a world total is available); but in 1936-8 had sunk to 232 million tons, or less than 21 per cent. of world output. Thus, after

starting in the mid-nineteenth century with very large proportions of the world's total productive capacity, and reaching their maxima both of absolute output and absolute importance as exporters shortly before the war of 1914-18, these two British industries have declined alike in output, exports, and relative importance in the world.

That some such changes as these were likely to take place as the rest of the world overtook the great British lead in industrialisation, exploiting resources which were, in the aggregate, vastly greater than those of the United Kingdom, is obvious; so obvious that there has been all too little tendency to look further in order to see if other factors were at work also. It is now perfectly plain that other factors were at work—that since 1913 the United Kingdom has been surpassed by other countries not only in bulk of output, but also in productive efficiency in the industries concerned. In 1913 output per man-shift in British coal mines was one of the highest in Europe (it was slightly exceeded only in the Upper Silesian field), though it was even then less than a third of the figure achieved in the bituminous coal mines of the United States, where natural conditions are very much superior. By 1938 output per man-shift in the United Kingdom was only 63 per cent. of that prevailing in Upper Silesia, 71 per cent. of that of the Netherlands, 75 per cent. of that of the Ruhr, and 81 per cent. of that in Czechoslovakia, besides being little more than a quarter of that in the United States. In fact, between 1913 and 1938 British output per man-shift had increased by only 13 per cent., or less than in any other major coal-producing area—the increase elsewhere had ranged from 19 per cent. in France and 36 per cent. in the United States to 60 per cent. in Upper Silesia, 64 per cent. in the Ruhr, and 101 per cent. in the Netherlands.

In the cotton industry the story was similar. The Platt Report expresses the opinion that British practice and output per man-hour changed little in the thirty years before the war; in the United States, on the other hand, output of finished cloth per man-hour (in all processes) increased between 1910 and 1936 by about 50 per cent. for most varieties of product, and by much more for some. Output per man-hour in the American industry as a whole exceeds that in the British by somewhat more than this

proportion (it was from 22 to 100 per cent. above it in spinning, five to ten times as great as British in winding and beaming, and twice or three times as great in weaving), but it seems that in 1910 the discrepancy between productivities of labour in the two countries cannot have been very striking, especially as the American standards of quality appear to be slightly lower than the British. Thus, as in coal-mining, it is progress elsewhere in the last thirty years, while British productivity has made little headway, which accounts for the present substantial British inferiority.

A comparison with United States industry is not, of course, always the most relevant. While productive efficiency in the United States cotton textile industry is probably the highest in the world, it is not, in any important degree, a competitor of British industry, because of the high American wage rates, and the fact that they bulk larger in total productive cost in the cotton textile industry than in many others. It is rather the efficiency of the corresponding industry in other countries—Japan, Brazil, India, and many others—which is of direct significance to the United Kingdom. There is evidence that in many of these countries where cotton textile industries have grown up in recent years output per man-hour is higher than in Lancashire, even though lower than in the United States. In any case, Lancashire, with wage rates higher than in most of these countries, would have to surpass them considerably in output per man-hour in order to compete successfully with them, and this it certainly has not done.

What are the reasons for the technical progress abroad and the (comparative) stagnation in the United Kingdom in these two important industries in the last thirty years? Some of them arise from the mere fact that the British industries concerned are older than their competitors, and that the latter have had the advantage of far more rapidly-expanding home markets. The greater age of the British coal-mining industry, for instance, is one of the main reasons for the larger number of independent mines here as compared with abroad—coal-mining was widely developed here long before the technique of large-scale mining had been evolved. It was established, too, long before general opinion favoured national ownership of minerals which, had it prevailed from the start, would have facilitated a

more rational development. Moreover, both in coal-mining and cotton, the age of the industry is partly responsible for traditional rights and practices, both on the side of management and on that of labour, which have lost their original usefulness and now obstruct progress. The greater age of the physical equipment in the British industries is another important factor. In coal-mining the whole lay-out of the mines is affected by their higher average age in this country; in cotton manufacture the fact that, for instance, 42 per cent. of the looms in Lancashire in 1930 were over thirty years old is clearly due in part to the age of the industry as a whole. Abroad, in countries where the home demand for cotton textiles and coal has been expanding in the last thirty years as a result of industrialisation, the average age of equipment is naturally lower than in the United Kingdom, where the great industrialisation came much earlier and internal demand for such basic commodities as cotton textiles and coal has been stationary or falling for a generation or more.

To possess an up-to-date technique in an industry the demand for whose products in the (more or less sheltered) home market is expanding, it is necessary only to install modern plants and adopt modern practices as capacity is extended; in a country where home demand is falling, or is expanding only slowly, on the other hand, it is necessary to scrap plant which is still mechanically efficient and to change established practices in existing works—a far more difficult matter. The financial aspect is important, also; an industry whose markets are expanding is generally a prosperous one, because its existing capacity tends to be fairly fully used and its overhead costs small in relation to its turnover; an industry faced with a stagnating or declining demand is likely to be burdened with excess capacity and high overhead costs, and consequently to have a much smaller profit margin and poorer general prospects, both of which discourage expensive schemes of modernisation. Finally, the industry which suffers from the disadvantages above enumerated (because its fortunes in its more sheltered markets are depressed) will, in all but the short run, find itself unable to compete with success in its less sheltered markets. As so often in economic matters, there is thus an element of instability inherent

in the situation; the industry which is expanding already is the better able to expand (and to improve its techniques) further.

Such are the handicaps under which the older British industries labour as compared with foreign industries which started later and have been able to count, in the last generation, on a more buoyant demand in their home markets. Their influence is apparent in the changes which have taken place, here and abroad, in the last thirty years. In the British cotton industry, as mentioned before, little technical change has taken place. In the United States, on the other hand, great changes have occurred, one of the most important of which is the replacement of the non-automatic by the automatic loom. In 1914 nearly 70 per cent. of the looms in the United States were of the former type, in 1939 only 5 per cent., whereas in the United Kingdom looms are still nearly all non-automatic and (as mentioned above) are largely old. American use of high-speed machinery in other departments of the cotton textile industry is also largely a development of recent years, has involved heavy capital expenditure, and has been facilitated by the expansion of the American home market, the modernity and spaciousness of the newer mills, and the comparative absence of prejudice and established practices such as abound when the industry is older and the labour force already long in being. In particular, the possibility of three-shift working in the United States (in contrast with single-shift working here) has been an essential condition of the lavish expenditure there on new plant, which must be run as continuously as is practicable in order to keep overheads low in relation to output. Established tradition (coupled, perhaps, with the fact that the labour force is more largely composed of women here) and the existence of a greater amount of excess capacity in the British industry are doubtless among the main reasons militating against imitation. The structure of the industry, which is also largely due to its greater age, has contributed further difficulties, since it has hindered both a far greater standardisation of the product such as obtains in the United States (and favours mechanisation), and the close adjustment of yarn quality to the peculiar requirements of automatic weaving.

In coal-mining British technique has not stood still during the last thirty years as it has in the cotton textile industry; the percentage of the total coal output which was mechanically cut rose from 8 in 1913 to 61 in 1939; the percentage mechanically conveyed at the face (which was very small in 1913) had risen to 58 per cent. by 1939; the percentage mechanically conveyed in the gate-roads had risen from a negligible figure to 40. Nevertheless, output per man-shift made only the relatively small increase of 13 per cent. mentioned earlier. The reasons for this are doubtless complex, but one, which emerges very clearly from the Reid Report, is the great inefficiency of haulage between the face (or the gate conveyors where they exist) and the shaft bottom. Haulage accounts for a quarter of all the underground labour employed in the United Kingdom; the tonnage of coal got per haulage and loading worker is only a fifth of the corresponding figure for the Netherlands, and a tenth of that for the United States. This state of affairs is due in part, no doubt, to the distance of the faces from the shaft bottoms, but it is certainly due even more to the antiquated methods of underground transport used here, which in turn are attributable partly to the fact that they have been in existence longer (on the average) than those abroad, partly to the winding and undulating nature of the roads, built to follow the seams (in contrast to the Continental roads, driven straight through the rock to meet the steeply-inclined seams which prevail there), and partly, like technical backwardness generally, to the lack of funds wherewith to finance improvements in the industry's unprosperous last twenty years.

The nature of the improvements made abroad in recent years throws further light on the matter. In the Ruhr, for instance, though mechanisation made further progress between 1925 and the war, it was already so far advanced that this does not go far to explain the great increase (86 per cent.) in output per man-shift worked underground; indeed, the major part of this improvement seems to have been due to a drastic concentration of output into a smaller number of working places, a concentration which was made possible partly by the efficiency of the main underground haulage systems already in existence. A great capital expenditure was, nevertheless, made (largely

with the help of foreign loans) in order to improve the equipment of the industry in a large number of relatively minor respects. In the Netherlands the mines are new, and have been planned on a large scale in such a way as to facilitate an especially concentrated and productive method of working. Thus, in both the Ruhr and the Netherlands fields—fields which enjoy no marked natural advantage over those of the United Kingdom—progress has been largely a matter of the concentrated working of a limited number of faces in mines laid out on a large scale, and with haulage systems adapted to the economical handling of large outputs. The smaller size, diffused ownership, and antiquated haulage systems of the British mines have been obstacles to the adoption of similar methods—to say nothing of the lack of funds referred to already. That productive efficiency here has lagged behind that in Upper Silesia and the United States is partly due to the same causes, and to the adoption of mechanical loading in the latter country, but the natural conditions here are in any case far more adverse than there—thinner and deeper seams, weaker roofs, more gas, and more water; so that some inferiority as compared with their results is to be expected.

Thus, a very large part of the inferior productive efficiency of the two British industries under discussion, as compared with foreign industries which do not enjoy any natural advantage over them, is to be explained in terms of the greater age of the British industries, and of the fact that the home market for their products has ceased—or nearly ceased—to expand in the last generation. That, however, is by no means the last word on the matter. In the first place, there are important elements in the disadvantage under which the British industries labour which do not arise—at all directly, at least—from the historical circumstance just mentioned. One of these elements is the lack of facilities for training the labour force and for recruiting either managerial or technical skill in the two British industries as compared with their foreign counterparts. Both the Reports mentioned here draw attention to this; British mine workers do not receive as systematic and thorough a preliminary training as is given in Germany or the Netherlands; there is, as the Reid Report says,

"a serious dearth of mining engineers who possess the knowledge and experience necessary to undertake the far-reaching schemes of reorganisation which are necessary"; American mill managers, according to the Platt Report, are younger and more willing (and free) to experiment than their British counterparts; they often find their way into their positions by offering their services to mills during the College vacations—a possibility which hardly exists in the United Kingdom. These disadvantages of British industry are important, since their effect is cumulative, but they are relatively easy to remove.

In the second place, the disadvantages which arise from the greater age of British industry, though heavy, are by no means impossible to remedy. The Reid Report gives summaries of a number of schemes of reorganisation worked out by various collieries which, if they are correct in their expectations, and representative of what can be done on a wider scale, suggest that it should be possible to attain an output of 250 million tons (which is somewhat higher than the pre-war annual output) with a labour force less than half that on the books of the collieries to-day, and at a capital cost in the region of £100 million. Such a reorganisation would bring British output per man-shift somewhat above the levels reached in continental Europe, though it would still be under half of that reached in the United States. Similarly, the recommendations of the Platt Committee, which amount essentially to re-equipment, improved co-ordination between successive processes, greater standardisation of product, and improved facilities for the training of management, would certainly achieve a striking result if the capital cost of carrying them out could be borne (there is no indication of its magnitude) and if all parties agreed to the necessary reorganisation and alteration of established practices.

In cotton, as in coal, the changes which are necessary if output per man-hour is to be raised from its present low level would doubtless reduce the total labour requirements of the industry; it is hardly to be expected that the increases in home and foreign demand consequent upon cheaper production would, in either of these industries, be sufficient to keep as many hands employed in them with (say) twice their pre-war output as were employed in them

in 1939. The possibility of carrying out the improvements smoothly therefore depends very largely upon success in maintaining a high level of activity in the economy as a whole, and in facilitating the movement of labour from (or labour which would otherwise go into) the two industries concerned into alternative occupations.

When considering what this implies, one must bear certain further facts in mind. Both coal and cotton have lost a very large part of their former labour forces in the past generation. The number employed in coal-mining fell from 1,214,000 to 790,000 between 1924 and 1938; the numbers in the cotton industry fell from 573,000 to under 400,000 in the same period. The cotton industry was already having difficulty in finding recruits before the war, and the same has notoriously been true of the coal industry of late. Coal-mining is, of course, an inherently unattractive occupation, and both the industries concerned were (before the war) among the worst paid in the economy —a result, of course, of their failure to improve their productive efficiency *pari passu* with advance elsewhere. The average mineworker's earnings in a full week in 1939 amounted to some 63s., which was markedly less than the average weekly time rate received by, for instance, lorry drivers, dock labourers, or bricklayers; the average earning for a full week in the cotton industry (all classes of operative) was probably less than 36s., which was below, for instance, the minimum time rate for women in the boot and shoe industry.

With such low earnings, the labour force would inevitably continue to contract in any conditions of general national prosperity, with alternative employment at all freely available. Wage rates in coal-mining have risen much more than the average of all wage rates since 1939, but have been enabled to do so only by an increase in the price of coal which in ordinary circumstances would render the exportation of coal virtually impossible and severely cripple the competitive power of many coal-using industries. Earnings in the cotton industry have similarly risen rather more than the general average but are still relatively low, so that it is extremely hard in conditions of full employment to augment the industry's labour supply. In short, then, earnings much higher than the low *per capita* output of

labour in these two essential industries justifies are essential if their labour supply is not to wither away—and wither away fairly rapidly in view of the rather high average ages of the workers now in them. Such earnings can be sustained only by heavy subsidisation, in one form or another, or by a great increase in output per man-hour.

The low level of wages has, of course, been one of the factors limiting mechanisation. Here, again, an element of instability enters, for when an industry lags behind technically and its markets decline, the existence of surplus labour keeps wages low and this in turn reduces the incentive to mechanise, so that the technical lag increases. This has happened for a generation in both the industries here discussed; after a certain point, however, the slow transfer and retirement of the labour force restores, at least, one of the most potent spurs to technical reorganisation—a shortage of labour—provided that the shrinkage of the market does not continue at too rapid a rate. It seems likely that the British coal and cotton industries have reached that point. The whole history of these two industries in the last generation constitutes a most important chapter in the story of British transition from world industrial hegemony to the position of one industrial country among many. What happens in the next chapter will be of crucial importance, not only for those industries themselves, but, as a portent, for the whole economic future of the United Kingdom.

4. NEW INDUSTRIES—SYNTHETIC RUBBER AND PLASTICS

From these old industries in which, so far as the United Kingdom is concerned, a cycle of growth and contraction seems to have been almost completed, it may be interesting to turn to two new ones, in which the United Kingdom has not conspicuously taken the lead, and to consider how the natural advantages for carrying them on appear to be distributed between the industrial countries of the world. First, however, it is necessary to give some attention to the history and technology of the industries themselves, which have not yet had time to become familiar to most students of economics.

(i) Synthetic Rubber

In the first place, it must be noted that there is no such thing as "synthetic rubber" in the literal sense—the precise chemical structure of natural rubber is not known, and no substance has been synthesised which is identical with it in physical properties. It is known, however, that the peculiar properties of rubber, especially its elasticity and resilience when suitably vulcanised, are due to the fact that its molecules consist of immensely long chains, the individual links of which are fairly simple. It has been known for over eighty years that one of the relatively simple substances into which rubber can be broken down—isoprene, the precise structure of which was determined some twenty years later—tends to become viscous on standing, and it was subsequently found possible to reconvert it into an elastic, rubber-like substance. In the first decade of the present century, it was discovered that other substances, chemically related to isoprene, may likewise be converted into rubber-like solids, and in 1910 the Russian chemist Lebedev showed this to be possible with butadiene—the compound of which isoprene is a simple derivative, and from which a great deal of the subsequent development has come. In the same year the English chemists Matthews and Strange showed that

the polymerisation of butadiene (*i.e.*, the joining together of its molecules into very large ones which constitute the elastic solid) is strongly promoted by sodium—hence the process which was started commercially in Germany and Russia ten years ago, and from which the German name *Buna* comes (*i.e.*, from the initial letters of *bu*tadiene and *na*trium).

During the war of 1914-18 the German shortage of natural rubber led the Bayer Company, which had been active in the earlier research, to set up a plant at Leverkeusen in which a total of over 2,000 tons of synthetic rubber was actually produced for use—an output of about 300 tons per month being finally attained. The substance polymerised to yield this "rubber" was not butadiene, but its derivative dimethyl butadiene, obtained ultimately from acetone. The products were of poor quality and the process was exceedingly slow—polymerisation was brought about by heating for three or six months—but it no doubt filled a need. After the war, however, it was not worth while carrying on production—not even the high rubber prices of 1925, which touched 6s. a pound, made it so, though they probably helped to intensify research—and a further combination of technical advance and practical stimuli was required to restart synthetic manufacture.

The stimuli were of two kinds—the demand for substances which, though like rubber in most ways, had some special properties fitting them for special uses, and the urgent desire to achieve self-sufficiency in an important war material. The commercial motive operated in the United States, where the motor and petroleum industries, in particular, developed demands for special materials resistant to oils and other solvents. Two groups of these, both first placed on the market in 1931, deserve mention here. The first, the thiokol group, is very different in chemical composition from natural rubber, and is the outcome of a different line of research from that which gave rise to the butadiene and similar processes. Thiokol is produced from ethylene (present in the natural gas which is abundant in many oil-bearing districts, and derivable also from alcohol) and sodium polysulphide, and combines certain rubber-like physical properties with a remarkable resistance to air, water, sunlight, mineral

oils, and most other solvents, so that it is extensively used for petrol pipes, paint sprayers, special packings, etc. German firms produced at about the same time a number of products of the thiokol type called perdurens; a similar substance is believed to be manufactured in Russia, and another has been manufactured in the United Kingdom. The second group of products, the neoprenes, has these qualities in a smaller degree, but adds to them elastic properties similar to those of natural rubber and greater resistance to burning, and is especially suitable for heavy-duty tyres, though it is inferior to natural rubber for use on good roads. Neoprene is produced by polymerising a simple derivative of butadiene — chloroprene, which is derived in practice from acetylene. Russia has subsequently produced a substance of the neoprene type.

The motive of self-sufficiency operated in Germany and the U.S.S.R. and, subsequently, in Japan, Italy, Poland, and other countries. There, the object was different from that which operated in the United States; it was desired to produce as cheaply as possible with local materials a substance capable of taking the place of rubber in its more general rather than its special uses—and the most general use of rubber is, of course, for tyres. The large-scale manufacture of a butadiene product (by the use of sodium) was announced in the U.S.S.R. in 1933; that of buna by a similar process in Germany was announced in the following year.

Methods of manufacture have changed since then. In Germany, particularly, the use of sodium to promote polymerisation was abandoned a few years later for polymerisation in emulsion, a method now used in the production of many synthetic rubbers, to produce a latex like that obtained from rubber trees, from which the solid "rubber" is subsequently made to coagulate. The nature of the staple product used as a general substitute for rubber in Germany has also changed. In place of the original bunas made by polymerising butadiene alone (products known as buna 85 and buna 115, from their molecular weights, which were 85,000 and 115,000 respectively), buna-S and buna-SS have been introduced. The change consists in polymerising a certain amount of styrene (which by itself can be polymerised into a non-elastic resin) along with the

butadiene. The products are little more resistant to oils, etc., than natural rubber, but they are particularly suitable for tyre-treads, and, even if used for the whole of the tyre, give it (according to the Baruch Committee's findings) a useful life 90 per cent. as long as that of a natural rubber tyre. They are more difficult to work than natural rubber, and it was not until an extra process was developed for making them more plastic before mounting and vulcanising that they could be used on a large scale.

One other type of "synthetic rubber," out of the many developed in the last decade, which may perhaps be mentioned here, is that produced by the polymerisation of isobutylene, which is available in very large quantities in natural gas, but available from other sources also. Products have been manufactured from it in Germany, Britain, and the United States in recent years—mostly taking advantage of its special heat-resisting and solvent-resisting properties, for, as a tyre material, it has been stated to possess only half the life of natural rubber.

The present importance of these products in the world is, of course, very great. The maximum German production attained during the war is stated to have been 110,000 tons a year; Russian output, chiefly of the two buna-like products S.K.A. and S.K.B., was 60,000 tons per annum before the outbreak of war. The United States programme, however, overshadows these outputs, as well as the much smaller ones of Italy and Japan. An output rate of not much less than a million tons a year was finally achieved, and the world capacity for producing synthetic materials of this kind must be more or less equal to pre-war natural rubber production.

The long-term significance of this depends on whether synthetic production continues on anything like its war-time scale in the future, and this, in turn, depends on two factors—costs and policies, both of which are exceedingly hard to assess. On the side of costs, one can at least say that capital charges on account of plant are a very important item. The capital cost of the American programme was $700 million, which works out at rather over 30 cents per pound of product per annum. A British estimate of what it would cost to make 200,000 tons of synthetic rubber per year in this country put the capital cost at about £24

million, or a little over a shilling per pound of product per annum. What annual charge this capital liability is likely to impose is a matter of conjecture, in the absence of very special knowledge. In an industry where technical change is so rapid, entrepreneurs must count on having to replace large parts of the plant within no more than five years, though other parts may not easily be rendered obsolete, and may have long physical lives. Probably it would be reasonable to expect the whole capital investment to pay for itself, on the average, within something between five and ten years, which means an annual charge for depreciation, obsolescence, and interest of 4 to 8 cents per pound of rubber produced according to the American figures quoted above, and 1½d. to 3d. according to the British estimate.

The cost of operation is very largely that of producing the butadiene or other substance for polymerisation. There are three main sources from which these substances are obtained—alcohol, acetylene, and petroleum (or the natural gases which frequently go with it). Alcohol was formerly used in Russia, where the material was obtained by the fermentation of potatoes, but its use there seems to have declined; it was drawn upon in the United States under the war programme, however. The commercial promise of processes starting from alcohol naturally depends on the price of the alcohol, and vegetable sources do not, save in exceptional circumstances, appear capable of providing it cheaply enough. Where great quantities of ethylene can be cheaply obtained, as from coke-oven gas and natural gases, alcohol can be produced from it at low cost, and can be used as the starting-point in the production of cheap butadiene.

Acetylene may also be used as a source of alcohol, but for the purpose of producing butadiene it is better to use it more directly, by converting it straight into acetaldehyde, into which alcohol itself has to be converted, in any case, if it is used for this purpose. Acetylene is important also as the chief material in the manufacture of chloroprene, and hence of the neoprenes, and the cost at which it can be obtained is therefore an important factor in determining the commercial importance of at least two of the main synthetic rubber processes, besides that of several of the less important. Acetylene is obtained, of course, by the

action of water on calcium carbide, which in turn is produced by heating coke and quicklime together at very high temperatures in an electric furnace. The cost of the electricity used in this process forms a high proportion of the cost of making any synthetic rubber of which acetylene is the main raw material, for the production of a pound of buna by the German method is stated to require about 18 kilowatt-hours of electrical energy, most of which is used in carbide manufacture. Unless electricity can be obtained at the very cheap rates made possible by abundance of accessible water power, therefore, that part of the cost of synthetic rubber attributable to power alone is likely to be as great as the minimum cost at which plantation rubber could normally be produced before the war (about 4d. per pound). Indeed, at present British prices, the coal for producing this amount of electrical energy would alone cost almost this sum ; it must be remembered also, however, that the war has increased the cost of producing natural rubber also.

Petroleum and natural gas provide materials which constitute the starting-points for the manufacture of many synthetic rubbers, and which are already beyond the stage which has to be reached with the expenditure of so much electrical energy in the carbide-acetylene processes. As mentioned above, the ethylene, which can be easily obtained from natural gas by dehydrogenation, and which is produced as a by-product in the " cracking " of the heavier oils to yield motor spirit, may be easily converted to alcohol, and thence, by way of acetaldehyde and the aldol condensation, to butadiene. It is also the chief raw material of the thiokols. Moreover, isobutylene, which is produced in great quantities in some of the " cracking " processes, may be polymerised directly to yield the polyisobutylenes, or " butyl rubbers " referred to above. It is clear, therefore, that the use of petroleum and natural gases gives by far the best promise of cheap synthetic rubbers, since the raw materials it yields are cheap, plentiful, and require relatively little power to convert them into the substances needed for polymerisation.

The relative costs of different synthetic rubbers made by different processes are difficult to compare directly. In August 1941 the American prices (in cents per pound)

of natural rubber and some of the synthetic substitutes were as follows:

Natural Rubber	23
Thiokol-F	45
Vistenex (a polyisobutylene)	45
Buna-S	60
Neoprene-GN	65
Perbunan	70

It is noteworthy that the cheapest of the synthetics were the two which are produced most directly from petroleum by-products, that buna-S, which is derived less directly, was more expensive, and that neoprene, which starts from acetylene, was dearer still. All these prices, however, were profoundly affected by the increase in the scale of manufacture. Statements of the cost of production of buna-S are clouded by two facts—costs have varied greatly between the plants operating with petroleum by-products and those using grain alcohol, and, secondly, the estimates given are frequently under suspicion of excluding capital costs to some extent. It seems clear, at least, that until late in the war the average total cost in all plants was over 30 cents a pound. In the most efficient plants, however, prime cost appears to have fallen to little more than 10 cents, and it is clear that the official selling price of 18½ cents covered total costs in these plants with a little to spare. It is believed that the United States possesses an annual capacity of between 300,000 and 500,000 tons of this low-cost buna-S—*i.e.*, between a third and a half of its total buna-S capacity can operate at prices which bring unaided competition with natural rubber within sight.

Is it only within sight, or actually within reach? Buna-S is inferior to natural rubber for most purposes, including the most important purpose of all—motor-tyre manufacture. Natural rubber may therefore expect to enjoy a premium; the fact that the United States has purchased Malayan rubber at 20½ cents f.o.b. since the war is hardly significant, as this occurred at a time of scarcity and at a time when much of the United States output was still being produced at a much higher cost than this; but it is not unlikely that, apart from a political decision to maintain a large synthetic capacity for security or other reasons, such purchases will continue. What

seems certain is that buna-S will begin to compete very strongly with natural rubber in many uses if the price should rise very markedly above this level. In any case, quite apart from the relatively small output of such synthetics as neoprene, which are superior to natural rubber for a limited range of uses, it is clear that buna-S will continue to play a very large part—it is most unlikely that the low-cost United States plant just referred to will be allowed to close down, even if the competition of natural rubber should prove very formidable—and thus that, failing an enormous increase in demand, the scope for the natural product will be somewhat restricted. Some of synthetic rubber's wartime gains are, indeed, likely to be maintained; whether, on purely economic grounds, the substitution will go further, is a matter to which this discussion must return.

First, however, it will be convenient to give some account of the second of the new industries under examination here—one to which, both in its techniques and in the nature of the raw materials from which it starts, the synthetic rubber industry is closely akin.

(ii) Plastics

In the last few years a very great deal of publicity has been given in this country, and still more in the United States, to the achievements and prospects of the plastics industry; and the prognostications made in some quarters (not generally very responsible ones) have carried the implication that plastics are expected to transform the world economy in the not distant future as steel transformed it in the later nineteenth century. To enquire thoroughly into the implications of these new materials and the new techniques of using them would require much space and much technical knowledge; but, short of such a thorough enquiry, it is still possible to throw a good deal of light on the subject by the use of fairly common knowledge and common sense.

How one should define plastics is a vexed question; the most generally recognised boundaries of this class of materials are not strictly related to any set of chemical or physical properties. The plastics (as the term is ordinarily

used) are non-metallic and, in the chemical sense, organic substances capable of being moulded under heat and pressure, extruded, or, in some instances, simply cast, into forms which remain fairly rigid in use. The " synthetic rubbers " just discussed are generally placed in a class apart, and the manufacture of the hard-vulcanised moulded products of natural rubber is generally credited to the separate rubber industry also. Moreover, the artificial textile fibres, though chemically similar to materials generally classified as " plastics," are usually considered separately—which is practically convenient, since they go as raw materials to the established textile industries, where they have made, and will doubtless continue to make, an enormously important place for themselves, demanding separate study.

Within the limits so set, the plastics industry is neither very new nor very large. The output of plastics is published only for the United States, where it was about 270,000 (long) tons in 1942, the value of the manufactured products being variously estimated from $400 million upwards. World output may well be about twice this, but even so, it is equal only to perhaps a quarter (by weight) of the world's current aluminium production and a quarter of one per cent. of the world's steel production. As to its age, the celluloid industry dates from the 1870's, and the use of bitumen, shellac, and even casein plastics is by no means new. Nevertheless, the industry has shown a very remarkable recent growth, its output having doubled between 1935 and 1939, and again between 1939 and 1942; and even more striking than this growth of output was the emergence of new materials in the last ten years.

The Development of Plastics

The history of plastics so far may be divided conveniently into four parts. Up to 1909 only celluloid—nitrocellulose, generally derived from cotton linters—had attained first-class importance, replacing glass, horn, ivory, and vulcanised rubber in a number of uses, but, more notably, supplying, through its combination of flexibility and transparency and the ease with which hollow objects could be made of it, a number of uses (*e.g.*, photographic films) in which it had no close rival. In contrast with

celluloid's versatility, shellac found a great single use in gramophone records, and the bitumen plastics attained importance only in the electrical industry. In the early years of this century, too, the manufacture of casein plastics from milk was being developed, but these, while they competed with celluloid in certain fancy goods trades, also lacked its transparency and flexibility.

In 1909 occurred probably the most important event in the history of plastics so far—the development of the first phenol-formaldehyde resin by the Belgian-American Leo Baekeland. The product was a true synthetic resin, not occurring in nature, but producible by the interaction of two simple substances obtainable from inorganic sources. Bakelite is still the most widely used of all the plastics. It (and its near relatives) are thermo-setting resins. The immediate product of the reaction between phenol (or some related substance) and formaldehyde is a fusible resin which, on further treatment by heat and pressure in a mould, is changed to a hard infusible and non-inflammable substance. The fusible resin can therefore be mixed, while liquid, with any suitable " filler " such as wood flour or asbestos, and reground when cold to a moulding powder, which is then pressed in heated moulds into almost any form, the filler contributing any of a number of physical properties to the product; it can also be used to impregnate wood, paper, or fabric, which can then be built up into laminated structures, hardened by pressure and heat, and subsequently, if necessary, machined. These properties enabled the phenol-formaldehyde resins to gain ground rapidly in the second phase of the history of plastics, which lasted until the late 1920's, for, besides making excellent electrical fittings, ash-trays, etc., they gave promise of a wider range of usefulness, in conjunction with other materials, in the industrial field. Although they dominated development in this second phase, however, displacing bitumen, porcelain, and metal in certain uses, they probably did not greatly effect the use of celluloid, which still increased in usefulness as the use of photographic materials developed, and also found a wide use in a number of lacquers and finishes, which have since come to provide one of its main outlets.

A third phase may be said to have begun in the late

1920's with the invention of a number of new resins, two of which may be said to have competed with celluloid and one with bakelite. The first two were, respectively, the alkyd resins, introduced in 1926, and cellulose acetate, which appeared in the following year. The alkyd resins, made from phthallic or maleic anhydride and glycerine, have found their chief use as the basis of paints and finishes, which in recent years have largely replaced the earlier cellulose finishes made from celluloid. Cellulose acetate, on the other hand, has competed with celluloid in those uses in which its transparency and flexibility were important and its inflammability a disadvantage. It has been used for " non-flam " photographic film, transparent packages, safety glass, etc., and its capacity for taking any colour lent it also to decorative uses wherever its susceptibility to damage through prolonged exposure to water was not a great disadvantage. The new competitor of bakelite was urea-formaldehyde resin, a not dissimilar thermo-setting substance, which had the advantage of being transparent (instead of opaque and brown, as the phenol-formaldehyde resins are), and therefore, if mixed with white fillers, such as shredded paper or wood flour, capable of taking any colours. It shares most of the properties of the phenol-formaldehyde group, such as suitability for impregnation of wood, paper, and fabric, but is much dearer and somewhat less resistant to heat, so that, generally speaking, it has displaced them only in those fields where its appearance is an advantage. It has also conquered others which they had not touched. Picnic sets, lamp shades, radio cabinets, bottle closures, buttons, and numerous fancy goods came to be made of it.

The developments of the late 1920's, however, were not all against the phenol-formaldehyde resins. It was found that the latter, without fillings, could be cast in moulds and cured by prolonged treatment with heat alone, without pressure, the products being transparent, translucent, or opaque, according to the size of the incorporated globules of water which are released in curing. Thus products of any colour and various degrees of transparency and translucency could be produced from phenolic resins.

The later part of this phase, however, brought a development which worked in the opposite direction.

From about 1934 a new technique was being developed, specially suited to the mass production of small mouldings from "thermo-plastic" resins, *i.e.*, those which, like cellulose acetate, are moulded at high temperatures without undergoing any chemical change to render them infusible, as the thermo-setting resins do. This technique, known as injection moulding, consisted simply in forcing the heat-softened moulding powder at high pressure into cool moulds, where it solidified at once. The speed of the process, being much greater than the compression moulding of thermo-setting resings, which require something like ten minutes in the mould to complete their "cure," tended to offset the much higher cost of thermo-plastic materials as compared with their rivals, and enabled cellulose acetate and, later, still more expensive thermo-plastic substances to compete even in uses for which the phenol and urea resins were in every way adequate.

The fourth phase in the history of the industry, which began in the middle 1930's, has been one of very great progress along all lines. In the first place, new thermo-plastics have appeared at an astonishing rate; secondly, the injection-moulding process had been applied to them and to the older thermo-plastics on an ever-increasing scale, and, thirdly, the techniques of casting the phenolic thermo-setting resins, and of making reinforced and laminated materials from them suitable for the most diverse uses, have been pushed ahead with great energy. The great accession of new materials was the fruit, largely, of the fundamental research carried on in the field of polymerisation—*i.e.*, the propensity of the molecules of some simple organic substances, when suitably treated, to coalesce into very large molecules. It was a remarkable programme of research in this field, carried out in the years 1928-37 by W. H. Carothers for du Pont de Nemours & Co., which resulted in the development both of neoprene (the most satisfactory, as regards physical properties, of all the artificial substitutes for rubber) and of nylon: the first wholly synthetic substance used to produce a textile fibre, and one which may also do service within the limits of the plastics industry as just defined.

The first of the new thermo-plastics produced in this period (about 1935) were the acrylic resins—mostly based

on polymerised methyl methacrylate, produced from ethylene by way of ethylene chlorhydrin and acrylic acid. (The ethylene may be obtained either from coke-oven gas, from petroleum cracking plants, natural gas, or alcohol.) The outstanding property of these resins is their transparency—greater than that of the best optical glass—which, together with the fact that they do not shatter, makes them excellent for windscreens and the gun turrets of aircraft, in which they found their chief wartime use. Their optical use is limited by the ease with which they are scratched. They are also expensive, and, for purposes in which slightly less remarkable transparency and a tendency to cloud on prolonged exposure to sunlight are not disqualifications, a cheaper group of resins—the polystyrenes—has been available since 1937. These resins, produced from ethylene and benzene, are constituents of buna-S; they are little more expensive than cellulose acetate, and have been used in Germany, where pure cellulose was scarce, for some of the purposes for which cellulose acetate is used here. Cellulose acetate has also had to face new competition in the cellulose ethers (first marketed in 1935), which resist moisture better, and, more recently, in cellulose acetate butyrate (a co-polymer of cellulose acetate and cellulose butyrate); the polyethylenes are another recently-developed group which may compete strongly with the established thermo-plastics. Since 1942, however, the cellulose ethers, or derivatives of them, seem to have found a new field of usefulness in the making of tools and dies.

In the same period, still more new thermo-plastics based ultimately on acetylene or on ethylene were being developed — polyvinyl chlorides, acetates, and butyrates which, according to the degree of polymerisation, can be obtained as rubber substitutes or hard mouldings—transparent or in any colours. Polyvinyl butyral, which appeared in 1937, came into almost universal use as the toughening centre layer of safety glass within the next two years. A related substance is the newer vinylidene chloride (marketed in 1939), which is remarkable for its high tensile strength, fitting it for use as cordage, and also for properties which enabled it to be substituted for copper piping in some applications where high temperatures are not encountered. In contrast to these generally expensive new materials,

there has appeared, since 1937, a thermo-setting material cheaper than any plastic hitherto marketed—lignin, the natural adhesive from wood, which may prove to be economically important.

The recent history of the thermo-setting resins is also interesting. Melamine-formaldehyde resins, for example, developed first in Switzerland, have shown some sign of competing with the urea-formaldehyde plastics, and a development which may be very important is the production of a cheap thermo-setting resin already used for tractor seats by the incorporation of soya-bean protein in phenol-formaldehyde resins. New substances have also been produced of which there is not yet much information. For instance, the development of a transparent, abrasion-resisting thermo-setting resin, curable at relatively low pressures, was announced in the United States in 1942; and, indeed, the flood of new resins (though mostly of the thermo-plastic type) is very much greater than this short summary can indicate. Perhaps the chief developments of recent years affecting the thermo-setting resins, however, have been in the field of technique rather than that of materials. The use of phenol-formaldehyde, reinforced with strong fabric, to build up solid blocks out of which serviceable, light, and silent-running gear-wheels can be machined, the use of similar techniques for making heavy-duty bearings which can be run with only water for lubrication, and the manufacture of panels from resin-impregnated paper or resin-bonded plywood were pre-war developments; more recently, especially in the United States, great efforts have been made to find methods of "curing" large aircraft components built up from wood and impregnated with phenolic resins; use has been made, for instance, of short radio waves to bring about the homogeneous curing of thick resin-impregnated parts held under pressure. The pursuit of the wholly "plastic" (*i.e.*, resin-impregnated wooden) aeroplane by various methods has, indeed, occupied much space in the United States press at one period; while no very spectacular result was achieved in this field, the revived and highly successful use of wooden construction (in the Mosquito bomber, for instance) certainly owes much to the new adhesives based on synthetic resins.

The Achievement and Promise of Plastics

Looking at this history, one sees that plastics have three main sources of competitive strength:

(i) their suitability as material for mass-produced small objects not required to resist unusual conditions such as heat or great mechanical stress;

(ii) their lightness as compared with metals or glass, their generally good electrical insulating qualities, and the beauty of many of them; and

(iii) the great range of specialised qualities which they offer—*e.g.*, the optical qualities of the acrylic resins, the perfect adaptation of polyvinyl butyral to its use in safety glass, the mechanical qualities of the reinforced formaldehyde resins, the acid-resisting qualities of many plastics, and so on.

Some of their limitations are implicit in these qualities. Plastics have not yet been developed which are as suitable for bearing all-round stresses as is steel. Some plastics have high tensile strengths, but their compression strengths are lower and their shear strengths generally smaller still, in comparison with those of the industrial metals. Their lightness redeems them to some extent (they are about a fifth of the weight of steel and about half that of aluminium), and where bulk does not matter, a synthetic resin can sometimes be substituted for steel, or even for one of the light metals, with an improvement in both strength and lightness—hence their important prospective applications to the frames of aircraft and, perhaps, to motor bodies. Moreover, the technique of manufacture which has achieved the greatest economic success—injection moulding—is applicable, as yet, only to quite small objects, and compression moulding and lamination, though capable of producing bigger objects, are generally slower and more difficult than the making of corresponding products from sheet metal; while the mechanical properties of phenolic castings are still such as to limit their scope.

Perhaps the chief limitation of the synthetic resins, however, is their high cost. The phenol-formaldehyde resins cost between 8d. and 1s. 5d. per pound (a price range within which both aluminium and magnesium also

usually fall), whereas sheet steel costs only about 1½d. for the same weight. The urea-formaldehyde resins cost nearly twice as much as these, and nearly all the thermoplastics cost more still. The only synthetic resins that are really cheap, indeed, are lignin (which costs only 3d. per pound) and the new soya-bean phenol-formaldehyde plastics. This costliness as compared with other structural materials does not matter when the resin is used for the sake of some very special property, aesthetic or physical, or when the cost of the material is small in comparison with the cost of manufacture—provided that the cost of manufacturing the product concerned from resin compares favourably with that of manufacturing it from rival materials. Otherwise, however, it constitutes an important limitation.

Taking all these advantages and disadvantages into account, one can see the reasons for what has happened with regard to the plastics; they have fairly completely conquered only the worlds of electrical fittings, instrument panels, ash trays, small containers, etc., and since it so happens that many of these worlds were coming into existence at the same time as plastics (owing to the rise of the electrical, radio, motor, aircraft, and cosmetics industries, and of proprietary branded goods), they have not displaced any other materials from a previous major use. Elsewhere, their progress has had the nature of infiltration rather than complete capture; they have achieved it because of the high degree of their adaptability mostly to subsidiary purposes. This does not mean, of course, that they can never accomplish a revolutionary advance into the established fields of other materials. A hard-surfaced plastic may at any time be discovered, for instance, capable of replacing safety glass or optical glass; the phenolic resins, in conjunction with wood and suitable fillers, may already have opened the way for a very large displacement of the light metals in aircraft construction; the saving of weight and power may justify the use of relatively expensive plastic materials instead of pressed steel for motor bodies; the advantages of noiselessness and lightness may enable plastics to replace steel in the gear-wheels and frames of numerous small portable machines, such as sewing-machines. These, and many other similar possibilities, one can foresee, and some of them are almost certain to become actual in the

fairly near future; but how many of them will do so, and what the consequent effect on consumption of plastics and other materials may be, one cannot say. Moreover, the whole field of more far-reaching possibilities—the invention of plastics with both the cheapness and the quality to rival steel, timber, glass, or pottery in more than a fairly small fraction of their uses, for instance—is hardly a profitable one for speculation; such possibilities cannot be excluded, but it is impossible to say whether the technical goals concerned can be reached at all, and, still more, how soon.

If, however, one cannot say whether plastics present a serious menace to the older structural materials, one can say, at least, that they are likely to prove serious rivals to the new light metals—and that the new light metals, on the other hand, are likely to complete strongly with them at some points. Wherever the chief advantage of plastics over steel lies in their lightness, and strength also is required, aluminium and magnesium and their alloys will meet them on fairly equal terms as regards physical properties and cost of materials, and the result of the competition will probably depend on manufacturing technique, together with such imponderables as the attractive appearance which plastics can generally be given. There is certainly a considerable field to be divided between the light metals and plastics as they exist to-day (though that field probably does not cover a very large proportion of the dominion of the older materials), but how it will be divided between them, and how rapidly its total area will be extended by the developments of another decade or generation it is futile to guess without very full technical knowledge—and the fullest of such knowledge would probably help little in this regard.

(iii) Synthetic Rubber and Plastics—Sources and National Advantages

This brief review may serve to indicate the scope which, on present knowledge, the synthetic rubber and plastics industries appear to possess for further development, and the sources from which they are at present derived. It also shows how rapid has been the advance of technique in these fields in recent years, and how uncertain,

as a consequence, is even the nature of the products which will be of importance in them (say) ten years hence. In spite of this, however, there is a reasonable probability that the products of to-morrow will be developed from the same main stems as those of to-day—sufficient probability, at all events, to render a discussion based on that supposition worth while.

Synthetic rubber, as has been explained, has so far been produced on a large scale from three main sources—petroleum by-products, alcohol, and acetylene derived from calcium carbide and hence from coal. The ethylene of coke-oven gas is a further possible source, but probably not a sufficiently plentiful one for large-scale production. The sources of plastics are similar; petroleum by-products, alcohol, carbide, and coke-oven gas are among the main ones, but there are also others—the methyl alcohol, acetic acid, and acetone derived from the destructive distillation of wood, the lignin produced in wood pulping, the residual protein of soya beans and other oil-bearing seeds.

For synthetic rubber production, grain alcohol has proved to be a considerably more expensive source than petroleum; the Russian transition from potato alcohol to petroleum for this purpose is also significant—it is likely that natural starches and sugars will, in general, be too valuable as foodstuffs or feedingstuffs to be among the most economical sources of synthetic rubber or plastics. The extreme cheapness of the lignin and soya-bean plastics, moreover, probably means that agricultural countries will do best to specialise on them, or on related products rather different from those which are produced most readily from petroleum or coal. Such a differentiation of function is not likely to be very clear-cut, but the tendency towards it is perhaps worth noting.

Coal, destructively distilled in coke ovens or gasworks, yields phenol and (indirectly) formaldehyde for manufacture of the phenolic resins, benzene, which is one of the materials of styrene, and a certain amount of ethylene, which is the other material for the production of styrene and the main material also for the polyethylenes and the acrylic resins, and can be used as the source of the polyvinyls. Coal—or rather, coke—is used, along with limestone, to produce calcium carbide, from which comes

acetylene, the most direct source of the polyvinyl and similar resins and, if necessary, of ethylene and its derivatives. It is also used to produce water-gas, the hydrogen of which is used in the production of ammonia by the Haber process, ammonia in turn being used (together with carbon dioxide) to produce urea, and also in the manufacture of substances of the nylon type.

Coal is therefore almost a "universal provider" of the basic materials for many of the plastics and the chief synthetic rubbers, and countries with good coal supplies and—equally important—with ready access to markets for all the by-products of coal distillation, possess some of the chief elements of competitive power in the industries concerned. The same, however, may be said of countries with abundant supplies of petroleum and natural gas. These possess, in particular, an extremely cheap source of ethylene and related substances. How the cost of these substances derived from petroleum compares with their cost if derived from coke-oven gas it is hard to say; it would depend, in any case, on numerous circumstances, such as the demand for other petroleum and coke-oven by-products; but there is, at least, a strong presumption that plastics produced fairly directly from ethylene from either of these sources will be considerably cheaper than similar plastics produced, ultimately, from acetylene, the production of which requires great quantities of electric energy. Petroleum and natural gas can also be made to yield, less directly, most of the other hydrocarbons used at present in the production of plastics, and it is not unlikely that some of the heavier constituents of petroleum, with long chains of carbon atoms in their molecules, will be used before long as more direct sources of substances which can be made to polymerise to yield resins.

It is therefore clear that either of the industries under discussion can readily be set up in any of the advanced industrial countries of the world. Most such countries have good coal supplies, with coal distillation industries and markets for their by-products. All of them use (even if they do not produce) large quantities of petroleum products. The refining of the petroleum—in which the materials for these industries are produced—can as well be done at the port of discharge as at the source; there is little difference

in bulk or in ease of transport between crude oil and its distilled products, and, if the country concerned is dependent on imports in any case, little strategic advantage in importing the necessary supplies in refined form. For countries which are suffering from persistently adverse balances of payments, moreover (as many of the old industrial countries are likely to suffer on account of changes in the structure of the world economy, or, perhaps more temporarily, as a result of the war), there is likely to be a tendency to save foreign exchange by purchasing their liquid fuel supplies in crude form—unless the difficulties are so acute as to justify recourse to the still very expensive home production of substitutes by synthesis or hydrogenation. Countries with cheap coal, or with less cheap coal and cheap electric energy derived from some other source (convenient hydro-electric sites at present, or perhaps atomic energy in the not very distant future), can, moreover, base either plastics or synthetic rubber industries on carbide. It is to be noted, moreover, that the industries concerned have very low labour costs and very high capital costs; the comparative advantage in them is likely to belong, therefore, to the countries with dear labour and cheap capital. The conditions of their existence, in short, are fulfilled best by the great industrial countries, and fairly well by all of these.

The balance of advantage among such countries goes, of course, to those with cheap coal and cheap petroleum (or natural gas). It is easy to see from these simple considerations that the United States possesses advantages of the first order and the United Kingdom has considerable inferior ones—her coal is relatively dear, she has no natural gas, and her petroleum, even if she refined it at home (which is at present done to only a small extent), would have borne the cost of transport. These are absolute disadvantages under which the United Kingdom labours for natural reasons; they must not, however, be taken as indicating that the industries concerned come low in order of *comparative* advantage in this country. As has been shown, the older industrial countries labour under even greater disadvantages in many other branches of manufacture, as compared with the United States, than are necessarily involved in these new branches of production; the fact that these greater disadvantages are largely matters

of man-made equipment rather than natural endowment makes little difference, save in the very long run. New industries—especially those involving very elaborate techniques—tend to be equipped similarly, save for variations introduced solely to suit local conditions, in different countries. There is little room here for differences in equipment corresponding to gaps of a generation or more in technical progress, and perpetuated by inertia and by imperfections in the supply of capital and enterprise, such as are common in the older industries. With the older industries bulking so large in its economy, the United Kingdom (like other older industrial countries) will find its comparative advantage in the new industries improved by the very fact that they are new, and do not bear the accumulated burden of age.

A further general point is relevant to the probable distribution of these new industries. Since their techniques are outstandingly new, complicated, and rapidly developing to greater extents than is general over the range of industry as a whole, they must be regarded as being, in an unusual degree, experimental laboratories and schools for technicians. In the language of classical economics, their social products are greater than their private products to an unusual extent, because of the contribution which their operation makes to the funds of knowledge and skill. This constitutes an argument for their establishment, even where the cost of their products appears slightly higher than that of imported substitutes; it is an argument which is likely to be seized upon with somewhat excessive zeal in countries which are still a little self-conscious about the process of industrialisation, and will doubtless be given its due weight in others also.

All these considerations suggest that the industries under discussion—or some branches of them—will tend to develop in all economically advanced countries, and that the margins of national advantage, though perceptible, will be less marked, and certainly less effective in differentiating the national industrial structures in this field, than were those in many of the older industries. The differentiation is likely, indeed, to be more between processes than between products over a wide range of the plastics industry, apart, perhaps, from the distinction mentioned earlier between the products founded on mineral hydrocarbons and those

founded on lignin or vegetable proteins. One further distinction, however, is likely to prove important. Many of the " synthetic rubbers " differ from the synthetic resins in having a formidable natural competitor, which, indeed, they still face on a footing of qualitative inferiority in the most important uses. Their production has, moreover, already been pushed much further than it would have been under peacetime economic impulses, so that there is little inducement to expand their output in the near future, provided that the international trade system functions reasonably well. What expansion there is—unless it is produced by a new cult of autarky—is likely to be on the oilfields, where advantages are comparable to those which the lowest-cost United States producers enjoy to-day. This, however, does not apply to the more expensive " synthetic rubbers " which excel the natural product in special uses; they, like many synthetic resins, are likely to be produced in most advanced countries.

A great many circumstances—especially the wider diffusion of capital and technical knowledge over the world—conspire to make the whole pattern of development of these new industries radically different from that which was followed by the older ones before the last quarter of the nineteenth century. There is no longer any question of one country obtaining a long lead (though the United States may in fact retain a lead in the manufacture of buna-S for a considerable time), and the United Kingdom starts in these fields without pre-eminent advantages, though with fair ones. The British problem of achieving efficiency in these industries will not be similar to that which has confronted her for a generation or more in the old ones—the problem of writing off the past and securing a fresh start—it will be the problem of securing a mode of development which is vigorous and competitive with the best foreign practice, and of avoiding the torpor which has overcome some sheltered industries even in their youth.

CHAPTER VI

STUDIES OF INTERNATIONAL TRADE

1. THE GREAT INDUSTRIAL EXPORTERS

THE development of the whole pattern of international trade is dominated by the world-wide progress of industrialisation, which has already long since broken the almost monopolistic position of the United Kingdom as "the workshop of the world," and as an exporter of finished manufactures in a class by herself. Nevertheless, it is still true that world trade in finished manufactures is dominated by a relatively small number of countries—sufficiently small for their respective characteristics as exporters and their respective fortunes to be a convenient (as it is, of course, an extremely important) subject for study. This section seeks to further this study, particular attention being paid to the oldest member of the group—the United Kingdom.

In the first place, which are the great exporting countries? In 1937 there were only nine countries (U.S.A., United Kingdom, Germany, Japan, Canada, France, Belgium-Luxemburg, Argentina, and India, in that order) which were each responsible for more than 3 per cent. of total world exports; collectively they accounted for 54·6 per cent. of the total. Of those nine countries, however, the first three were outstanding, being collectively responsible for nearly a third of the world total (the United States with 13·06 per cent. of it, the United Kingdom with 10·22 per cent., and Germany with 9·41 per cent.). Moreover, these three great exporting countries were of paramount importance in world markets in another sense—one or other of them was in 1937 the chief single supplier of 54 out of the 66 countries whose import statistics are given in the League of Nations' annual *International Trade Statistics*; the United States was the principal supplier of 22, and Germany and the United Kingdom each of 16 countries, no other exporter being the principal supplier of more than three.

The nature and location of an exporting country's markets are, of course, largely determined by the nature of the products which it produces with the greatest efficiency, but it is also true that the direction of its specialisation (and hence in some degree the direction in which it is most efficient) depends on the markets to which it happens to have the best access—for any reasons, including those of politics, geography, or personal and institutional connection. In other words, comparative advantage determines the distribution of export trade in so far as the market resembles the "perfect market" of theoretical economics, but "imperfections" of the market not only modify the pattern of trade but, in so doing, alter comparative advantages where these are based on anything but immovable natural resources. In seeking to explain the nature of a country's export markets, therefore, it is probably most helpful to begin by considering the composition of its exports, but it must be borne in mind that this composition is not a "given" factor from which the rest follows—the relation between the nature of exports and the location of markets is, like so many connections in economics, really one of reciprocity rather than of causality.

The differences in the composition of the exports of the three biggest exporting countries are in some degree visible from the broad headings of the Brussels classification; the percentage composition of their exports (including re-exports) in 1937 arranged under these heads was as follows:

	Live Animals, Food and Drink.	Raw Materials and Semi-Manufactures.	Finished Manufactures.	Total.
U.K.	6·8	18·3	74·8	100
U.S.A.	7·8	42·0	49·9	100
Germany	1·3	16·5	82·1	100
World Total ...	22·4	38·1	39·5	100

The outstanding feature of this comparison is the similarity of British and German exports, in that they consisted so largely of finished manufactures, in contrast with United States exports, such a high proportion of which still consisted of raw materials and semi-finished products. The contrast was markedly greater eight years earlier,

however; in 1929 14 per cent. of United States exports had consisted of food and drink, 41 per cent. of raw and semi-manufactured materials, and only 45 per cent. of finished manufactures. In Germany, at that date, raw materials and semi-finished products (mainly the latter) had accounted for nearly 22 per cent. of the total, against only 16 per cent. in the United Kingdom. Thus, over the eight years concerned, United States exports, and, in a smaller degree, those of Germany, were coming to consist more of finished manufactures, while those of the United Kingdom were not notably changed in this direction (there was, indeed, a slight shift in the opposite direction here, though probably not a significant one).

When one comes to examine the goods exported by these three countries in greater detail, further great differences are apparent. Consider first the foods and foodstuffs; German exports of these were negligible, British exports in these classes consisted as to more than half of beverages (mainly spirits), with manufactured tobacco and fish also of some importance, while the United States exports were chiefly unmanufactured tobacco, cereals (which had been much more important a few years earlier) and fruit. A comparison of certain kinds of industrial exports is made in Table XVI. It would be difficult to make a comprehensive comparison of the exports of the three countries, since, while the United Kingdom and the United States supplied data to the League of Nations in the form specified in the latter's "Minimum List," Germany did not. It is thought, however, that a reasonable degree of comparability has been achieved in the groups selected.

From this table both the main differences in the percentage composition of each country's industrial exports and the relative strengths of the three competitors in the world market for various classes of goods can be seen. The high dependence of the United Kingdom on textile exports (which still constituted over a quarter of her export total), the overwhelming reliance of Germany on chemicals, fuel, steel, and machinery exports (collectively over 70 per cent. of her total), for instance, are specially noticeable. It is most interesting, however, to run through the items of the Table and to seek to account for the relative competitive strengths of the three countries with respect to each.

In chemicals Germany had a long lead, the remains of a still longer one before 1914, based largely on the early excellence of German technical education and the official encouragement of applied science. Her lead in dyestuffs and pharmaceutical products was especially great. The United Kingdom's lead in textiles, on the other hand, is (if United States exports of raw cotton fibres are excluded)

TABLE XVI.

Selected Industrial Exports, 1937 (Million £).

(Percentage of the country's total exports in parenthesis.)

	U.K.	U.S.A.	Germany.
Chemicals, etc.	27·6 (5·3%)	28·2 (4·2%)	68·0 (14·4%)
Of which—			
Pharmaceutical Products	3·4	3·7	11·2
Dyes and Dyestuffs ...	1·7	1·6	11·8
Other Colours, Paints, etc.	4·1	4·4	4·8
Textiles	132·9 (25·5%)	90·6 (13·5%)	38·1 (8·0%)
Of which—			
Fibres	16·4	78·7	0·7
Yarns	28·4	1·4	8·2
Piece Goods, etc. ...	88·1	10·8	29·2
Fuel	49·5 (9·5%)	92·5 (13·8%)	58·3 (10·2%)
Glass and Pottery	6·0 (1·2%)	3·5 (0·5%)	13·5 (2·9%)
Iron and Steel	38·4 (7·4%)	58·2 (8·7%)	37·0 (7·8%)
Non-ferrous Metals ...	14·4 (2·8%)	22·6 (3·4%)	9·8 (2·1%)
Metal Manufactures (excl. Machinery)	22·4 (4·3%)	20·1 (3·0%)	54·6 (11·6%)
Machinery and Vehicles ...	97·8 (18·8%)	182·4 (27·2%)	114·5 (24·1%)
Of which—			
Electrical Machinery and Apparatus	19·0	23·6	25·0
Ships, Vehicles, Aircraft	38·0	89·8	28·2
Machine Tools ...	2·1	12·2	16·7
Prime Movers and Boilers	7·3	3·2	5·3
Textiles and Leather Working Machinery	6·0	3·2	10·9
Total	521	670	473

enormous. This, again, is a relic—a relic of the vastly greater lead which she attained in the mid-nineteenth century by virtue of her early start in this branch of manufacture. Her chief competitor in this instance, before the war was, of course, not Germany or the United States, but Japan, whose textile exports, however (excluding fibres in both cases), were little more than half as great as the British. More important than the competition of other exporters in bringing about the fall of British textile sales, indeed, was the growth abroad of industries serving primarily their home markets. Fuel exports, on the other hand, are primarily a matter of natural advantage; the United

Kingdom, with its coalfields near to tidewater and its cheap outward shipping freights due to the small bulk of its other main exports, still led the world in coal exports in 1937 (though its trade had declined by a third since 1929 and German exports almost equalled its total, excluding bunker coal). The United States was a much smaller coal exporter, partly, no doubt, because the greater bulk of her exports as a whole in relation to that of her imports did not make for specially cheap freights on exported coal; but her exports of petroleum products, which do not compete with other commodities for cargo space, were not subject to this handicap. In contrast to these cases where natural advantage was paramount, the German lead in glass and pottery exports must be ascribed largely to long-standing traditions of craftsmanship.

With regard to exports of iron, steel, and non-ferrous metals, natural advantage is again in the forefront; the United States, with its great reserves of coal, iron ore, and copper, naturally took the lead; the United Kingdom's exports of non-ferrous metals rested less securely on advantages connected with the possession of coal and with long-standing commercial connections with the distant sources of the ores. In the export markets for metal goods other than machinery Germany had a decisive lead over both her main competitors combined; this was probably traceable largely to the great re-equipment, rationalisation, and official encouragement of the German metal and metal-working industries in the interwar years, and to the cheapness of raw steel in the home market, maintained by official price limitation in the Nazi period. In the varied range of engineering products national lines of specialisation, traceable in a large measure to historical rather than to current economic factors, again play a great part. In regard to electrical machinery and apparatus the three great competitors were of not dissimilar strengths; all three had vigorously built up these relative new industries which (in the beginning, at least) were largely ancillary to, and drew upon the same resources as, other branches present in all advanced industrial systems. In the field of vehicle and ship building, however, a much higher degree of international specialisation is visible. In the motor vehicle trade the United States' lead was unchallenged, partly

because the enormous size of her home market had led to the early development of mass-production, partly because mass-production is more favoured by the relative prices of factors of production in the United States than by those obtaining elsewhere. The United Kingdom had lost the great lead in ship building for foreign account which she acquired in the late nineteenth century by virtue of the large British demand for ships, and the proximity of some British centres of heavy industry to the slipways; in 1937 Germany, largely by subsidies, far exceeded her in new tonnage exported; Britain, however, was well ahead of the United States in this respect, and also dominated the world market for second-hand ships.

The machine-tool market was dominated jointly by Germany and the United States; the latter's advantage in having far the largest home market in the world no doubt counts for much here; it gives her a large and varied fund of skill and experience in this industry, where the products are so highly individualised. The German home market, too, in the later 1930's, was very large, partly as a result of re-armament, but the preponderance of the German industry, as compared with the British, in export markets must also be attributed in part to sheer specialisation and vigour in this branch of German engineering. Past experience and specialisation have no doubt favoured the United Kingdom in the world market for prime movers and boilers, in which she leads. In the market for textile machinery, however, she has lost to Germany what was once a predominant position; largely (as has in some degree been the case with other kinds of machinery) because some of the chief importing countries in the 1930's were among those to which Germany was able to increase her exports by specially heavy purchases of imports coupled with bilateral techniques of payment.

The geographical distribution of the chief exporting countries' markets is related jointly to the directions of specialisation sketched above, to geographical considerations, and to political factors. In fact, the export markets of all three of the great exporters under discussion are world-wide. The United States sent no more than a sixth of its exports to any one country, and there were nineteen countries to each of which it sent more than 1 per cent.

of them; the United Kingdom and Germany had even more widely-dispersed trade connections. Nevertheless, there was some sign of a systematic geographical influence in the patterns of the three great exporters' markets.

TABLE XVII.

Geographical Distribution of Export Markets of the U.K., U.S.A., and Germany, 1935 (% of total exports).

DESTINATION.	U.K.	U.S.A.	Germany.
North Africa	2·5	0·9	1·3
South Africa	8·8	2·3	1·0
Other Africa	4·2	1·0	0·7
Northern N. America	5·3	14·4	0·5
U.S.A.	5·5	[—]	4·0
Latin America: Mineral-Producing	1·7	5·8	2·5
,, ,, Tropical Agricultural	3·5	8·2	4·3
,, ,, Non-Tropical Agricultural ...	4·0	2·4	2·6
India, Burma, Ceylon	9·8	1·4	2·7
S.E. Asia	2·8	3·2	1·3
Japan, Korea, Formosa	1·0	8·9	2·0
China and other Continental Asia	4·0	2·8	3·4
U.S.S.R.	0·8	1·1	0·9
Continental Europe: Industrial	18·9	19·2	[43·3]
,, ,, Non-Industrial; Western and Northern	8·9	3·8	10·8
,, ,, ,, ,, Eastern ...	3·1	1·9	9·0
Non-Continental Europe	[5·0]	19·2	9·1
Oceania	10·3	3·2	0·7
Total	100	100	100

Note.—Germany and U.K., Special Trade; U.S.A., General Trade.

Table XVII shows the distribution in 1935 of the export trade of the three countries concerned by geographical areas, calculated from the League of Nations study, *The Network of World Trade*. The most striking feature of the Table is the concentration of over 70 per cent. of German exports on European markets—mostly those of countries classified by the League of Nations as "industrial." This, of course, accords well with the nature of German exports, briefly discussed above; the specialisation on machinery (especially machine tools), and the importance of coal exports and dyestuffs were partly the causes, partly the effects, of the high degree in which German trade was directed to industrial markets; Germany's geographical position, almost surrounded by neighbours in fairly advanced stages of industrialisation, has, however, also clearly played its part in bringing about this direction of specialisation and trade. Among the less highly industrialised countries of Europe,

German exports were directed almost as much to the eastern and south-eastern groups as to the western and northern—the much greater total buying power of the latter notwithstanding. Her dominant position in East European markets is brought out by Table XVIII, which shows the proportions of their total imports which each of the geographical regions distinguished drew from each of the three big exporting countries. Here, again, geography doubtless played an important part; the eastern countries were far nearer to Germany than to either of the other great industrial exporters; the western and northern countries were practically as near to the United Kingdom. Moreover, the volume of trade in the opposite direction is always an important factor; Germany made it so by the bilateral techniques of payment which she employed, and the United Kingdom did so (in her relations with the Baltic and Scandinavian countries) by the trade agreements of 1933. Even in the absence of bilateral clearings or any special use of bargaining power, however, the fact that channels of credit, personal connections, and movements of shipping are fostered by a movement of trade in one direction tends to foster a movement in the reverse direction. Thus, the facts that Germany deliberately bought heavily from South-Eastern Europe and that the United Kingdom found her nearest sources of timber and many foodstuffs in North-Western Europe were in themselves of some importance in directing German and British exports.

In the British case, however, the concentration of export markets in certain overseas countries is even more noteworthy than that in the less industrialised countries of Northern and Western Europe. (The proportion taken by the industrial parts of the Continent, though the highest taken by any of the areas here distinguished, is not remarkable in view of the enormous purchasing power and the proximity of the markets concerned.) The extent to which British exports found markets in Africa, the temperate States of Latin America, India, Burma, Ceylon, and Oceania obviously requires explanation—the need is brought out even more strongly in Table XVIII, which shows how high a proportion of their imports some of the areas just named took from the United Kingdom. The obvious explanation is that large parts of the regions

concerned (except temperate Latin America) were parts of the British Empire, and were thus bound to the United Kingdom by ties of political and personal connection, as well as by fiscal preference.

This explanation doubtless accounts for an important part of the fact. The Dominions, India, and Burma together took about a third of all their imports from the United Kingdom; the Colonies, Protectorates, and Mandates together took about a quarter of theirs—percentages which are significantly higher than the corresponding ones for (say) temperate Latin America and tropical Latin America respectively. The contribution of fiscal preference to this result cannot be very great; the proportions of their imports which the Empire countries took from the United

TABLE XVIII.

Percentages of the Imports of Various Geographical Regions drawn from the U.K., U.S.A., and Germany, 1935.

IMPORTING AREA.	Percentages from: U.K.	U.S.A.	Germany.
North Africa	8·9	4·0	3·7
South Africa	48·0	16·2	4·9
Other Africa	26·8	7·6	3·7
Northern N. America	21·7	55·7	1·9
U.S.A.	7·6	[—]	3·8
Latin America: Mineral-Producing	9·2	34·2	10·4
,, ,, Tropical Agricultural	14·8	35·6	14·4
,, ,, Non-Tropical Agricultural ...	23·6	14·1	8·5
India, Burma, Ceylon	36·6	5·9	7·5
S.E. Asia	10·4	11·9	3·6
Japan, Korea, Formosa	3·3	31·8	4·9
China and other Continental Asia	10·6	10·8	7·6
U.S.S.R.	17·6	11·9	9·1
Continental Europe: Industrial	7·8	7·7	[12·4]
,, ,, Non-Industrial; Western and Northern	23·8	10·0	18·2
,, ,, ,, ,, Eastern ...	11·6	7·2	22·0
Non-Continental Europe	[3·8]	11·3	4·2
Oceania	44·0	15·2	2·9
World	12·1	11·8	8·6

Kingdom before the increases of preference agreed to at Ottawa were not sufficiently below the post-Ottawa proportions to warrant such a view. Nor is political jurisdiction in itself decisive; some of the former German colonies under British mandate continued until 1939 to trade overwhelmingly with Germany. In some degree this imperfection in the world market for industrial exports is due to personal, sentimental, and linguistic bonds, either tying Empire

purchasers to United Kingdom sellers directly, or bringing about similar results indirectly, by ensuring that much of the capital and enterprise in the Overseas Empire came from the United Kingdom. It must not be forgotten, however, that, in the absence of such "imperfections" due to political or linguistic ties, the markets of the Dominions would still probably have been as dependent on United Kingdom sources of supply as are those of temperate Latin America—a very high and striking degree of dependence. For, while it is no doubt true that these regions which in fact buy so much from the United Kingdom could buy similar goods from either of the other two great industrial exporters, it is certain that there is no equally accessible substitute for the United Kingdom as, overwhelmingly, the largest single market for their foodstuffs; and, as was mentioned above, factors which favour trade in one direction frequently favour trade in the opposite direction too, even in the absence of attempts to promote the bilateral balancing of trade by State policy or bargaining.

The dominance of the United States in the markets of Canada, Japan, and the tropical and mineral-producing parts of Latin America was, indeed, at least as great as that of the United Kingdom in its most favourable markets. Geographical position clearly has something to do with this; so (in Latin America and Canada, at least) have United States capital investments. The stimulating effect of trade in the opposite direction is, again, an obvious factor, especially with Japan and Latin America, which find the chief outlet for their raw material exports in the United States market. This same factor may be responsible for the slight lead which United States exporters have over those of the United Kingdom in the markets of South-Eastern Asia, despite the British advantage derived from fiscal preferences in some of the most important of those markets.

Such, very briefly, is the distribution of the markets of the three chief exporters. It remains to glance at the relative course of their respective total exports and industrial exports over the last few decades. Table XIX shows the total exports of the three in 1913, 1929, and 1937, valued in each case at 1913 prices.

TABLE XIX.

Total Exports valued at 1913 Prices (Million £).

	1913	1929	1937
U.K.	525	470	392
U.S.A.	499	783	625
Germany	505	464	318
Total of the above	1529	1717	1335
Total of above as % of World Total ...	37·9	32·8	26·4

This shows strikingly the differences between the fortunes of the three countries concerned. British and German exports showed falling trends over the whole period, British falling somewhat more than German between 1913 and 1929, and German much more than British between 1929 and 1937. United States exports showed an enormous increase between 1913 and 1929 (they undoubtedly displaced the United Kingdom and Germany from certain markets); their fall between the latter year and 1937 was marked, but left them still well above the 1913 level in volume. The decline of the total exports of these three countries as a percentage of world exports is also noteworthy; it is clearly a result of the rapid economic development of the rest of the world. For the present purpose, however, it is more useful to trace the course of exports of finished manufactures. For Germany and the United States, price indices are available which enable these to be calculated at 1913 prices; for the United Kingdom the only available index refers to all exports, but, since mainly or wholly manufactured goods constitute three-quarters of the total, little error is likely to be involved in applying it to them. Table XX shows the result.

The trends of the manufactured exports of the three countries are similar to those of their total exports, except that the increase in United States manufactures over the whole period is considerably steeper; in 1937 they were still well over twice as great (by volume) as they had been in 1913. It was, of course, in this category of exports that the United States captured markets from its two chief competitors between 1913 and 1929; it appears to have displaced them little, if at all, further between then and 1937. The United Kingdom's share of the total finished manufactured exports of the "big three" fell steeply

between 1913 and 1929 (from 46·5 to 34·7 per cent.); it increased very slightly between 1929 and 1937, and, since the total for the "big three" remained roughly constant in relation to the world total, it would appear that the United Kingdom held her own among the exporters of finished manufactures over this later period as a whole.

TABLE XX.

Exports of Finished Manufactures valued at 1913 Prices (Million £).

	1913	1929	1937
U.K.	417	377	309
U.S.A.	148	398	327
Germany	332	313	236
Total of the above	897	1088	872
World total	1530*	2010*	1650*
Three big exporters as % of World Total	59%	54%	53%

* The world total of exports of finished manufactures for 1913 is taken from the League of Nations *Industrialization and Foreign Trade*; the 1929 total is obtained on the assumption that it bore the same relation to the "big three's" total as this source shows for 1930; and that for 1937 is based on a similar calculation from the League's 1936-8 average.

The reasons for the different courses taken by the three national volumes of manufactured exports are, clearly, complex. The great expansion of United States exports was largely due simply to the economic development and, particularly, the further industrialisation of the United States; it was powerfully assisted, however, by the growing demand for motor vehicles, in which the United States led the world. The great decline in German manufactured exports was largely attributable, first, to the war of 1914-18, and, secondly, to the collapse of Central European credit, the disequilibrium of the Reichsmark, and the policy of autarky coming successively after 1929. The decline in British exports of this class was due partly to United States competition in the period up to 1929 (as indeed was that of German exports too), but probably more notably to the industrialisation of other overseas countries, particularly as it reduced their demand for British textiles.

One aspect of the changes in national fortunes in the export markets, however, deserves further mention—namely, the changes in the prices of the manufactured goods offered for sale by the three great exporting countries. The basic data are as follows:

TABLE XXI.

Prices of Finished Manufactures exported in sterling at Current Rates of Exchange (1913=100).

	1913	1929	1937
U.K.*	100	155	133
U.S.A.	100	122	93
Germany	100	154	166

* Prices of all exports (mainly finished manufactures).

It is plain that these prices show a high negative correlation with the corresponding volumes of goods sold. The much greater increase of British and German as compared with United States export prices between 1913 and 1929 corresponds with a fall in the volume of their exports and a rise in that of United States exports; the very high price of German exports in 1937 (actually higher than in 1929) corresponds to a very great fall in their volume, while the falls in British and United States export prices between 1929 and 1937 correspond to much smaller declines in quantities exported. No very great reliance should be placed on these index numbers, which are subject to numerous qualifications, but the correspondences just described are nevertheless very striking. The maintenance of German export prices was partly deliberate—an attempt to secure favourable terms of trade at the expense of some sacrifice in regard to volume—and also perhaps partly illusory, since subsidies and special exchange provisions of various kinds are presumably not taken into account in the official price index. It is certainly true, however, that United States exports consisted to a far greater extent than did British of the products of industries in which there was a high rate of technical progress.

Even a glance at Table XVI makes this clear. The greatest British predominance was still in textiles, technical progress in the production of which has been much slower than in other fields during the last century (if the development of synthetic fibre industries is left out of account). On the other hand, chemicals in which Germany was pre-eminent and motor cars in which the United States had so big a lead were emphatically the products of industries in which technical progress has been very rapid. Similarly, progress in connection with petroleum had been faster

than that connected with coal. The United Kingdom was thus apparently losing her advantages as an exporter in relation to the United States (and, in some degree, in relation to Germany too, though political factors partly masked that aspect of the matter) because her specialities did not lie in the most rapid current of technical advance, and were not, therefore, being progressively substituted for other goods in the way which is to be expected of the products of progressive industries. This fact naturally implied, also, a lower average rate of increase in productivity in British industry than in German or American, other things being equal.

More generally, moreover, the United Kingdom's established specialities were not the commodities for which world demand was increasing most rapidly. The German Enquête-Ausschuss *Der Deutsche Aussenhandel unter der Einwirkung Weltwirtschaftlicher Strukturwandlungen*, quoted by Professor Stanley in the I.L.O. report on World Economic Development, clearly shows this. Well over half of a sample covering 80 per cent. of British exports in 1929 consisted of commodities the total world trade in which had increased by less than 75 per cent. (in current gold value) between 1913 and 1929; little more than a twentieth consisted of goods world trade in which had risen by over 150 per cent. Of a corresponding sample of United States exports, four-fifths was made up of commodities world trade in which it had increased by more than 75 per cent., and a third of goods in which it had increased by more than 150 per cent. The composition of German exports was intermediate, in this respect, between those of British and American, but rather nearer, on the whole, to the former. This difference of distribution between classes of goods for which world demand was increasing at different paces would probably by itself have made the gold value of United States exports increase at a percentage rate about a third as great again as that at which British exports were increasing, and perhaps a quarter as fast again as the rate of increase of German exports. In fact, British and German total exports both increased in value by about a third between 1913 and 1929, while United States exports more than doubled. That German exports did not rise more than British is doubtless accounted for

by the territorial changes and other factors arising out of the war of 1914-18; that United States exports so greatly outdistanced them both requires more to explain it than the fact of United States specialisation on the particular goods for which world demand rose fastest. United States exporters, in fact, must have increased their proportionate share of the world markets for many products.

In part, this again arose out of the war of 1914-18, during the earlier part of which the United States had particularly favourable opportunities for establishing new connections in what had formerly been British and (still more) German markets. This was particularly so in Latin America, where, afterwards, the United States position was reinforced as a result of the heavy lending which the war and other factors had made possible. That, however, is clearly not the end of the story. There can be little doubt that the superior productive efficiency of the United States as compared with the United Kingdom and Germany enabled American goods to oust their rivals in foreign trade. Whether United States productive efficiency in the exporting industries increased faster than British and German during the period 1913-29 is a relevant question here, but not the only relevant one. The answer to it is, in any case, probably in the affirmative; the United States had far smaller arrears of obsolescence resulting from the war than had her two great industrial rivals. Since her economy, from its rapid expansion in the past, was geared to a higher proportionate rate of capital accumulation than theirs (and was kept active by an optimistic spirit during this time), the proportionate extent to which plant was modernised or newly created in the years 1913-29 was much greater there than in the United Kingdom, and even than in Germany, despite the latter's heavy foreign borrowing in the last five years of the period.

Even if United States relative efficiency in the exporting manufacturing industries had not increased, however, similar consequences would have flowed from the mere fact that those industries were increasing rapidly in size relatively to the economy as a whole. However efficient these industries had been in earlier times (and United States manufacturing industry had long shown much higher outputs per person occupied in it than had European, and had been of re-

markably high productivity in comparison with the traditional United States exporters of agricultural produce), it was unlikely to capture foreign markets on a large scale until its own vast and rapidly growing home market was satisfied. It was only in the present century that United States manufacturing capacity had begun to overtake United States demand for manufactures to any appreciable extent. Thus, the increase in the United States share of world markets for particular goods depended not only on the efficiency of United States industry, but on the timing of its growth. This, of course, is always so—the same could have been said of the successful German competition against British goods a decade or two earlier, or the successful Japanese competition against them a decade later.

The combined effects of the special factors arising from the war of 1914-18 and of the expansion and increased competitive power of United States industry are, in any case, clear, and could be illustrated from events in the world markets for many particular commodities. Two important illustrations, however, will suffice. In 1913 the United States was responsible for less than a third of the combined machinery exports (electrical and non-electrical together) of the three great industrial exporting nations; in 1929, for 45 per cent. of that total. In 1910 United States vehicle exports were less than British; in 1929, they were over four times as great as British.

After 1929 these factors apparently operated less strongly (or were partly offset by others) in so far as they affected British exports as compared with those of the United States or Germany. As was observed above, the British share of the total manufactured exports of the "big three" (measured at constant prices) rose slightly between 1929 and 1937; this, however, was due to the remarkably heavy fall in German exports, which followed the collapse of German credit, the subsequent overvaluation of the Reichsmark, with the attendant payment difficulties, and, finally, the cult of autarky. British and United States manufactured exports both declined in volume by about 18 per cent. between 1929 and 1937; German declined by 25 per cent. In current sterling value, United States manufactured exports (owing to their heavier price fall) declined by nearly 37 per cent., British by about 29 per

cent., and German (owing to the maintenance of their price) by only some 20 per cent. In value terms also, therefore, British wholly or mainly manufactured exports roughly retained their relative position, constituting 36 or 37 per cent. of the total of similar exports of the "big three," between 1929 and 1937, whereas between 1913 and 1929 their share had fallen from 41 to 37 per cent. The failure of United States manufactured exports to maintain their volume better than British over this period, despite a greater fall in unit price, and their consequent decline relatively to British in total money value, is to be attributed largely to two factors—the cessation of United States foreign lending, which had stimulated the country's exports so greatly in the 1920's, and the depression of the United States' principal markets in the Western Hemisphere, which contrasted unfavourably with the prosperity (in 1937) of such important British markets as Australia, New Zealand, and South Africa.

Nevertheless, it is clear that the adverse factors described above as influencing the course of British exports between 1913 and 1929 had their counterparts in the succeeding eight years. It was still true in 1937 that the United Kingdom's exports consisted less of the things for which there was a rapidly expanding world market, and in regard to which technical progress was rapid, than did those of the United States or (probably) of Germany. The great absolute and relative fall in textiles, iron, and steel among British exports, however, and the increased part taken by (for instance) vehicles, electrical machinery, and chemicals, had diminished the British disadvantage on this score. The same changes in the structure of British exports had also diminished the extent to which they consisted of the products of industries with relatively slow rates of technical advance. Moreover, since some parts of British industry were developing in the 1930's while United States industry was stagnant, there can be little doubt that the United Kingdom was recovering some ground in regard to productive efficiency; this (along with the greater prosperity of mainly British as compared with mainly United States markets mentioned above) may have accounted for the fact that United Kingdom exports of vehicles and machinery (including electrical machinery) showed a much better

trend than did similar United States exports between 1929 and 1937. German exports of machinery showed a better trend than did British, and competed successfully with British exports as well as with American in (for instance) Latin America. Germany was developing her capital goods industries at this time considerably faster than the United Kingdom, and her productive efficiency in these branches of manufacture was probably rising faster than here; though, as pointed out above, German success in particular markets was dependent on the use of bargaining power and on subsidies of various kinds as well as on efficiency in manufacture. It is noteworthy, however, that German success did not extend to vehicles, the manufacture of which (in civilian types) was undergoing a much less vigorous development.

All three of the chief exporting countries were faced with severe competition from outside their own ranks. For the most part, this competition came from protected producers within the markets where they sought to sell, but there was also growing competition from new industrial exporting countries, despite the fairly constant proportionate share of the "big three" together in the world total of exports. Both of these varieties of new competition, however, hit the three great industrial exporters unequally; among the industries growing up to serve their home markets the textile industry was everywhere prominent, and textiles (largely Japanese) were probably the most important of the new manufactured exports which were arising to compete with those of the "big three." Hence the fact that the United Kingdom was still far more dependent on textile exports than was either of the other great industrial exporters exposed her to particularly severe pressure. This pressure decreased, of course, in proportion as it succeeded in reducing the importance of the goods concerned among British exports, but it remained a depressing factor in British economic life right up to the war.

This brief survey of some of the factors affecting the place of the United Kingdom's exports relatively to those of her chief competitors, and in the world generally, shows something of the mechanism of the decline in this country's share of the world's total exports of finished manufactures.

In 1872 she was probably responsible for little short of two-thirds of the world total (at current values), by 1913 for less than one-third, by 1929 for probably a little over 21 per cent., and in 1937 for perhaps 1 per cent. less than this. The relative fall has certainly been slowing down, especially in the 1930's, though for this (as has been observed) special and presumably non-permanent factors, such as stagnation in the United States and autarky in Germany, were largely responsible. Something much greater than a continuation of the pre-war curve—which would at best give us a constant share of a world total which may not increase sufficiently for our purpose and was falling in the pre-war decade—is clearly necessary, however, if British exports are to achieve anything like the increase which has been authoritatively set up as a target. The foregoing discussion may at any rate serve to show the general nature of some of the changes needed if any such large increase is to occur. British exporters lost their pre-eminent position for four main reasons; because greater technical progress took place in branches of production with which they were not concerned than in those with which they were; because world demand for (and world trade in) the kinds of goods they produced increased less than for those exported by their competitors; because, in particular lines of production, their rivals increased their productive efficiency until they had comparative cost advantages; and because these rivals had greater productive resources which they eventually exploited. Something must be done about these four aspects of the situation (or such of them as it is practicable to influence) if any drastic improvement in the relative position of British exports is to occur.

In conclusion, they may be glanced at in turn. In the first two matters, a great deal can be done. The British industrial system, being the first to arise, and possessing, like others, a certain degree of rigidity, has long been more adapted than the newer industrial economies to satisfying the demands which were increasing yesterday, in contrast with those that are increasing to-day. Generally speaking, too, the new industries were those in which technical progress was rapid. Although new industries arose here, they were overshadowed both in the economic

structure and in the export lists by the older ones, so that newer competitors whose exports consisted mainly of the newer products could show a more rapid expansion. To some extent this is inevitable, but much can be done to mitigate it by promoting a rapid adjustment of the economic structure to changes in world demand and in technique—in making the new industries develop rapidly here.

The third matter is again one about which much can be done. It was inevitable, because of the forms of their resources, that some of our competitors should possess a comparative advantage over us in respect of many of our exports when they reached particular stages of economic development, but in many cases their advantage was gained because the British industries concerned had fallen behind them in technical excellence. To guard against this, the need is to adapt not only the economic structure, but also the technical equipment of each exporting industry to the latest advances in technique as quickly as possible. The fourth matter—the smallness of British resources in relation to those of all her potential competitors together—is one about which little can be done. Certainly, the industrial development of other countries cannot be held up for the convenience of British exporters; nor is it at all certain that it will be to their net disadvantage, provided that they are sufficiently adaptable; though it is clear that, if they adhere to their traditional branches of production, they will suffer more than their counterparts in the other old industrial countries.

The essence of all the remedial measures just mentioned is, clearly, adaptability, technical excellence, and rapidity of economic development. How, in terms of political, educational, and industrial institutions, the necessary adaptability and technical excellence can be achieved cannot be discussed here. With regard to rapidity of development, however, a final moral can be drawn from the experience outlined in this section. An essential condition of the constant modernisation of equipment and the launching of enterprise in new fields is a high level of economic activity. If prospects are poor and profits low—as in the United Kingdom in the 1920's, or the United States in the 1930's—development stagnates and both plant and the general economic structure grow obsolete. That a high level of

activity is an essential condition of modernisation and advance does not, however, mean that it is also a sufficient condition. Indeed, in times of easy profits, technique and management may lag through sheer indolence. The classical economist would reply that active competition is the best spur to efficiency and progress, and that there is no reason why this spur should lose its sharpness in conditions of constant high activity—that profits need not be easy even when they are high in the aggregate. This, like many other portions of classical economic doctrine has, however, failed to find favour in some quarters as an account of what is desirable, and industrial combination in its many forms has certainly destroyed its accuracy as an account of what really happens. In these circumstances—since depression makes re-equipment and progress impossible, and if boom does not efficiently promote their realisation—what new factor is required to produce the changes on which the necessary expansion of British exports depends?

2. SOME ASPECTS OF THE PATTERN OF WORLD TRADE

The actual pattern of international transactions in the world is a subject which offers an enormous and largely untouched field for systematic study—a very surprisingly untouched field in view of the obvious importance of the questions involved and of the fact that statistics of international trade—despite many difficulties of international comparability—have long been among the most complete and coherent of all numerical economic data. The purpose of this section is to present some approaches to the study of it; this may be done in two parts—first, some attention will be given to the measurement and the explanation of the very different extents to which different countries depend on international trade, and then some aspects of the world trade pattern, or parts of it, will be examined. The second part of this enquiry is to be taken as an experiment in technique and its numerical results as illustrations of what might be done by more extensive investigations, rather than as an analysis of even the main structure of the vast web of international commerce. There should not, however, be any need to apologise for it on that account.

(i) Degrees of Dependence on International Trade

In current discussions the question often occurs how far a particular area or country is economically self-sufficient or, on the contrary, dependent on international commerce, and considerable confusion is caused both by the failure to formulate the question with sufficient precision and by the lack of a suitable measure of the degree of self-sufficiency even when the concept is fairly clear. There are obviously two completely different forms in which the question may arise: (*a*) How far does the country (or other area) actually depend upon trade which passes across its boundaries? and (*b*) How difficult would it be for the country or area to make itself independent of all such trade?

The first of these questions is clearly the easier to answer, but even so, the answer is rarely put into a satis-

factory numerical form. It seems that the only completely satisfactory measure of the actual degree of dependence of a country, for instance, upon international trade would be the proportion of the total goods and services consumed within it which comes from abroad. The actual evaluation of this in any given case would present various difficulties; a reasonable approximation to it, however, may be obtained by calculating the proportion which the value of merchandise imports bears to the country's total national income. Clearly, this is unsatisfactory in so far as services of various kinds are imported, and in so far as merchandise imported is re-exported. The latter difficulty is not entirely removed by considering "retained" imports only, since these may be re-exported after manufacture. With these qualifications, however (which could be dispensed with to some extent in many cases), it may be maintained that the ratio of retained imports to total income affords a reasonably good measure of the actual degree of dependence of an area upon the outside world.

The second of the above questions—that of the difficulty or ease with which an area could become entirely self-sufficient—is far more difficult to answer. It is extremely important to realise in this connection that there are relatively few countries in the world which could not support their present populations at some standard of life or other without intercourse with the outside world. Britain is possibly one of the exceptions, and even here it is not certain that we could not maintain our population at all without international trade. It is certain, however, that the standard of living supportable under these conditions would be extremely low. Other countries, such as France or Germany, could clearly become self-sufficient at a level considerably lower than their customary peacetime standard of living, but not nearly so far below it as in our case. The United States could achieve self-sufficiency at a standard of life not far below its customary one.

There must, of course, be some relation between the degree of peacetime dependence upon international trade and the sacrifice in standard of living which would be necessary for complete self-sufficiency. The relation, however, is very far from being a rigid one. Some countries, such as Great Britain, which are almost or quite incapable

of achieving self-sufficiency at all, because their imports include essential commodities (such as foodstuffs) which they could produce at home only with the greatest difficulty, nevertheless import a smaller proportion of their total consumption than do other countries whose imports consist largely of things which they could produce without great difficulty, or which are essential only to the maintenance of a high standard of living. In examining the ratio of imports to national incomes for various areas, therefore, we shall be throwing a certain amount of light upon the difficulty or ease of attaining self-sufficiency in those areas, but this amount of light would have to be supplemented by a study of the nature of the imports and the capacity of the area for producing substitutes.

The following Table shows the percentage which retained merchandise imports in 1929 bore to national income over the decade 1925-34 in various countries.

TABLE XXII.

Ratio of Retained Merchandise Imports, 1929, to Average Net National Income, 1925-34.

	Per cent.		Per cent.
Belgium	48·7	Greece	18·8
Norway	47·7	France	18·3
South Africa	47·2	Germany	18·2
Denmark	45·6	Netherlands India	17·1
Netherlands	42·1	Argentina	16·4
Finland	37·3	Lithuania	16·3
Eire	35·4	Hungary	15·5
New Zealand	33·7	Portugal	13·4
Austria	28·4	Japan	12·3
Latvia	28·1	Rumania	12·0
Australia	27·8	Bulgaria	11·5
Sweden	27·6	Poland	10·2
Switzerland	26·9	Yugoslavia	9·9
Canada	25·6	United States	6·6
United Kingdom	24·7	India	6·1
Estonia	23·3	China	3·6
Czechoslovakia	22·0	U.S.S.R.	2·6
Italy	21·4		

It is extremely difficult to disentangle all the influences which go to determine the percentages here shown. Certain main principles, however, stand out fairly clearly. The countries which were most dependent upon international trade—Belgium, Denmark, the Netherlands, South Africa, Norway—were small and fairly wealthy countries, though particular factors, such as gold production, were obviously

important in particular cases. The countries least dependent upon international trade form an oddly assorted collection—the United States, the U.S.S.R., India, and China. Their common feature is their great size, which is clearly the chief factor making for their relatively high degree of self-sufficiency, since the group contains both the richest and the poorest of countries. Among countries of approximately the same economic importance, as measured either by population or by national income, however, there is generally a fairly marked tendency for those with the highest incomes per head to be also the ones most dependent upon international trade. It may be added that, even if no account is taken of size, the correlation between income per head and dependence upon international trade is positive, and, though small, is just large enough to be technically significant.

It may be of interest to add figures for groups of countries, especially those which are associated together for purposes of trade policy or are interesting for other reasons. The percentage ratios of imports from the outside world to total national incomes in the year 1937 for certain of these groups were roughly as follows:

	Per cent.		Per cent.
British Empire ...	8·0	Continental Europe	5·8
Sterling Bloc ...	9·5	Western Hemisphere	3·6

This raises an historical question. If it is true that higher incomes per head, generally speaking, tend to go with a high degree of dependence upon international trade, is it possible to trace an increasing dependence upon such trade in the development of a country which has gradually built up a high standard of living? Unfortunately, the matter is again far from simple. The United States, for instance, appears to have become less (though not steadily less) dependent upon international trade from about 1860 till the decade before the 1914 war. This corresponds, no doubt, to the growth of manufacturing industry and of population, decreasing the exportable agricultural surplus and the degree of dependence upon imported manufactures at the same time. The post-1919 decade, however, was marked by a considerably increased dependence upon imports, due probably in part to the increasing capacity of the country for exporting industrial goods, and perhaps also to the development of particular manufactures which

demanded imported raw materials, such as rubber. Since 1929, of course, reliance upon international trade has decreased in the United States, as practically everywhere else. World trade as a percentage of world income shrank from about 11 or 12 per cent. in 1929 to probably less than 10 per cent. in 1937.

Our own reliance upon foreign trade has been relatively high for a long time. It seems likely that at the end of the seventeenth century our imports amounted in current value to about a fifth of national income, and roughly the same was probably true in 1800 and in 1850. In the decade following this last date, however, trade expanded much faster than income, and throughout the whole period from 1860 to 1929 the ratio of imports to national income did not deviate far from 30 per cent. In 1937 (a peak year) it was only 17·5 per cent.

Japan affords an interesting illustration of the course of events during a process of rapid industrialisation. In 1904 imports were as much as 32 per cent. of national income; this ratio fell to 24 per cent. in 1914 and 21 per cent. in 1925, and in 1936 was below 20 per cent. She is therefore becoming less dependent upon international trade —a course opposite to that which our development took at a comparable step in our industrialisation. The reason is probably that Japan's early industrialisation, unlike ours, was financed largely by borrowing abroad, so that imports in the early part of this century were remarkably high. They had, indeed, increased ten-fold in twenty years. In the 1880's, before industrialisation was seriously begun, the ratio of imports to national income was probably only 2 or 3 per cent.

There the question of reliance on external trade may be left for the time being. It is clear, however, that it would repay further study.

(ii) Some Reflections on Trade Patterns

Before looking at the actual pattern of trade-flow, it is perhaps worth while to consider some of the logical and general considerations which limit the form which the pattern of trade between a number of countries can take. That there are purely logical limitations is obvious—A's

imports from B, for instance, are identical with B's exports to A (it being assumed that a consistent method of measurement is adopted). There are also more purely economic limitations arising, for instance, from the impossibility of a permanent excess of a country's payments abroad over its receipts from abroad when it is not prepared to acquiesce in continuous borrowing. These limitations leave, of course, an indefinite number of ways in which the detailed economic (and other) factors can cause a given trade total to be distributed between various international channels, but they exclude a further indefinite number of arrangements as impossible. If the total imports and the total exports of each of a number of countries are given, it is not possible, for instance, to fix all the sub-totals of imports of one country from another (or of exports of one country to another). Conversely, if all these sub-totals are thought of as being fixed by some economic and other conditions, it is obvious that every country's totals of exports and imports is thereby fixed.

These facts may appear trivial, but in dealing with anything so complicated as a multilateral trade system it is as well to be aware of all the underlying algebraical necessities. Some of the traps which this may help one to avoid are, indeed, far from obvious at first glance. In order to test the extent to which various countries are complementary to each other, for instance, one might well compare the distribution of each country's exports between destinations with a distribution of them in proportion to the total imports which the various destinations concerned obtain from all sources—this distribution being chosen as a perfectly "neutral" one which might result if geographical and economic conditions favoured trade between all pairs of countries equally. It is perhaps not obvious at first sight that this "world of reference" is logically impossible, save in the special case where all countries' trade totals are alike—yet, except in this case, it can easily be shown that the proposed "neutral" distribution makes A's imports from B differ from B's exports to A. Or, again, one might make use of a "world of reference" in which the trade between each pair of countries was proportionate to the product of their national incomes, and then, in order to take account of the fact

that different countries trade to very different extents in relation to their incomes, one might insert various factors of proportionality. It can be shown that the equality of each country's total imports with its total exports demands, in fact, that these factors should be the same for all countries. Thus, devices which are of great service for partial analyses of portions of the trading system can be used for the whole system either only in special cases or not at all.

For partial or regional studies, however, these limitations matter a good deal less, and one may use—with due care—any instrument of analysis that comes to hand. It is obviously a matter of great interest to examine the extent to which a given country's imports or exports are concentrated in particular channels. The percentages of its imports which come from particular countries, or the percentages of its exports which go to particular countries, are, for many purposes, the most relevant data, showing the relative extents of its dependence on various external sources and markets. For some purposes, however, it may be more important to know what may be called the relative "intensities" of its trade relations with different countries. The main reason why Britain sells more to—or buys more from—the United States than to Costa Rica, for instance, is a difference in the size of the markets which those countries offer for imports (or the amounts of goods they can provide for export); a difference which is too obvious to be interesting, and the effects of which it is desirable to eliminate in order to get some measuring rod of the relative extents to which trade reveals complementarity between the British economy, on the one hand, and those of the other two countries, respectively, on the other.

The simplest way of doing this is to compare the actual division of British exports between various channels with the division which would result if we exported to the various countries concerned in proportion to their total external purchases of goods. Similarly, one could compare the composition of our imports, by sources, with that which would result if we imported from countries in proportion to their total exports. This is done for a number of countries in Table XXIII, in columns 3 and 6 of which an index is computed expressing the comparison as a series of percentages.

TABLE XXIII.

Index of "Intensity" of U.K. Trade with Certain Countries, 1938.

Country.	1 % of total U.K. imports from country concerned.	2 Total exports of country concerned as % of total for all countries (except U.K.).	3 Index of "Intensity" of U.K. import trade with country concerned.*	4 % of total U.K. exports to country concerned.	5 Total imports of country concerned as % of total for all countries (except U.K.).	6 Index of "Intensity" of U.K. export trade with country concerned.†
S. Africa	1·7	0·82	208	7·6	2·40	317
Australia	7·8	2·64	295	7·3	2·54	290
N. Zealand	5·1	1·13	450	3·7	1·06	349
Canada	8·5	4·30	198	4·4	6·82	65
U.S.A.	12·8	18·2	70	5·4	10·72	56
Argentina	4·2	2·23	189	3·7	2·17	175
India	5·4	2·82	192	6·4	2·28	280
Denmark	4·1	1·70	241	3·1	1·73	179
Germany	3·3	11·0	38	5·0	10·90	46
France	2·6	4·46	58	4·4	6·50	69
Japan	1·1	3·86	29	0·4	3·68	11
U.S.S.R.	2·1	1·31	160	3·3	1·31	252

* *I.e.*, column 1 divided by column 2 expressed as a percentage.
† *I.e.*, column 4 divided by column 5 expressed as a percentage.

The Table shows that the Dominions supplied much more than their "share" of British imports—twice as much in the cases of Canada and South Africa, three times in that of Australia, and more than four times in that of New Zealand. How far this is due to natural complementarity and how far to the ties of language, old association, and fiscal preference cannot, of course, be determined with any precision; but it is interesting to note that Argentina and Denmark—which had no fiscal preference or political ties to help them in the British market (though Denmark has, of course, the advantage of proximity) also supplied about twice their "share." The much greater reliance of the United Kingdom on distant New Zealand than on Denmark (in relation to the respective total exports of those countries) is very striking, but even that should not be used as evidence of the force of preference and old association without making allowance for the fact that our imports from New Zealand are quite largely meat and wool, of which we are abnormally large importers, and in which Denmark does not compete on any great scale. India also supplied about twice its "share" of United Kingdom imports, and the U.S.S.R. was not far behind. It is striking, but not surprising, that the countries listed

which supply markedly less than their "share" of our imports are the industrial ones—Japan, Germany, France, and U.S.A.

On the export side the picture is broadly similar, with the rather striking exception provided by Canada, which took much less than her "share" of United Kingdom exports—the reason, of course, being that she took part in one of the most notable "triangular" systems of international payments, and acted as one of the major channels for the transfer to the United Kingdom of interest, not only on her own debts, but on those of the United States as well. South Africa, India, and the U.S.S.R. were the chief countries (among those listed) whose intake of British exports exceeded their "share" more than did the amount which they supplied of British imports.

This method of analysis works quite well if the object is to analyse the trade of a single country, such as the United Kingdom, for a world is conceivable in which this country imports from various other countries in proportion to their respective total exports, and exports to them in proportion to their respective total imports; and a comparison of the distribution of British trade in the real world with that in this imaginary world is therefore intelligible. If, however, a more extensive analysis of world trade patterns is desired, one comes up against the logical and other limitations discussed above. The only conceivable world in which each country's exports to each other one were proportionate to those other countries' respective total imports, and in which, at the same time, each country's imports from each other one were proportionate to those other countries' respective total exports, would be a world in which all countries had the same trade totals. In other words, if we wish to extend the analysis, it is necessary to stop taking the various countries' trade totals for granted; and, moreover, the imaginary world with which the real world is to be compared becomes so completely unlike it that the comparison ceases to be at all interesting.

For any wider analysis, therefore, a new approach has to be tried; and the one which most readily suggests itself is one that relates the trade between any one country and any other to the national incomes of both—thus giving up

the attempt to take the relation of each country's external trade to its national income as something for separate consideration, apart from the matters of trade distribution which are under discussion. If there were no special factors making for greater or less complementarity between one pair of countries than between another, or for a higher total dependence on external trade (in relation to income) in one country than in another, then the trade (in either direction) between any pair of countries would presumably be proportionate to the product of their national incomes—a country would trade with another in proportion both to its own and to its trading partner's total production and consumption of goods and services. To compare the distribution of trade in an imaginary world where this is the case with its distribution in the real world is therefore to throw light on all the factors of complementarity, competitiveness, and greater or smaller tendency to draw national requirements from abroad, which are in fact at work. The result is interesting, just as any analysis which eliminates a major factor governing actual events is interesting —because it enables the remaining factors to be better seen.

Table XXIV shows the result of applying this analysis to the trade between ten chosen countries in the year 1928 (a date selected chiefly because the necessary national income estimates are more easily available for years round about it than for later or earlier ones). The United Kingdom and the United States are chosen for their intrinsic importance, Germany and Belgium are added chiefly because they are a pair of neighbouring highly industrialised countries, Australia and New Zealand as a pair of neighbouring wealthy agricultural countries, India partly for its intrinsic importance, partly to represent poor tropical countries, and Poland, Rumania, and Hungary as neighbouring poor European peasant countries. The object of the selection is to throw light on the " intensities " of the trade relations of economies of various types both with similar and with different ones.

The blank spaces in the Table are due to absence of easily available data about the trade between the pairs of countries concerned, where it is very small. It is plain that no very simple conclusion can be drawn from it ; the effects of natural complementarity (evident in the relations between

Australia and New Zealand and the United Kingdom, for instance) are very clear, but so are those of proximity (as witness the relations between Hungary, Rumania, and Poland), and of sheer size, as affecting the the extent to which the countries concerned are dependent on external trade as a whole (as the very low values obtained for all the trade relations of the United States show). It may be possible to make some allowance for some of these factors in order to isolate the remaining ones—in particular to eliminate the effects of the different degrees of dependence on external trade just referred to.

TABLE XXIV.

Trade between Various Countries as Percentage of that suggested by the Products of their National Incomes.*

Countries of Provenance.	Countries of Destination: U.K.	U.S.A.	Germany.	Belgium.	Australia.	N.Z.	India.	Hungary.	Rumania.	Poland
U.K.		51	102	490	1040	1350	284	49	117	115
U.S.A.	117		74	138	208	152	14	21	22	48
Germany	76	32		580	91	40	41	360	332	316
Belgium	930	109	542		177	240	380	162	38	228
Australia	730	37	299	800		1970	234	—	—	65
N. Zealand	2130	70	64	—	1066		—	—	—	—
India	161	32	102	140	168	119		31	10	46
Hungary	17	3	150	54	—	—	—		1040	261
Rumania	48	1	289	234	—	—	—	1780		175
Poland	81	31	255	191	—	—	—	415	173	

* *i.e.*, Percentage Ratio = Trade between two countries concerned as percentage of that between all countries listed. / Product of national incomes of countries concerned as percentage of sum of corresponding products for all pairs of countries listed.

The factor which it is easiest to eliminate is that which results from the very widely differing relations between the various countries' trade totals and their national incomes, relations which (as was pointed out above) vary largely with the size of the country, small countries being much more dependent on external trade than large ones are. This factor can be eliminated by comparing the actual distribution of trade with that suggested, not by the products of the national incomes of the countries concerned, but by the products of their trade totals. To do this is not precisely to take the trade totals of the various countries for granted and to compare their actual distribution between the various possible channels with some imaginary regular distribution;

as mentioned above, it is a matter of simple algebra to show that only in the special case where all countries' trade totals are the same are they consistent with the proportionality of trade between each pair of countries to the product of those countries' trade totals. Nevertheless, though the imaginary world with which the real world is compared here is not one in which national trade totals are the same as in the real world, the discrepancy is not too great, unless the actual trade totals of the countries chosen both differ very widely from each other and also, in some individual cases, constitute high proportions of the total trade between all the countries concerned. The trade total assigned to a small country in the imaginary "world of reference" is greater than its actual total; that assigned to a large country is smaller; but the discrepancy is very much less than that between the actual national trade totals and those assigned to the same countries in the "world of reference" in which trade is distributed in relation to national incomes alone.

In Table XXV, below, the trade in 1928 between various countries (the same as were chosen for study before) is compared, in the form of percentages, with that which would have flowed in the same channels if it had been distributed in proportion to the products of the trade totals (with the whole world) of the countries concerned. Complementarity and proximity are, obviously, the only important factors which cause the figures in this Table to differ greatly from 100.

TABLE XXV.

Trade between Certain Countries in 1928 in Relation to the Products of their Respective Trade Totals with the Whole World.*

From \ To	U.K.	U.S.A.	Germany.	Belgium.	Australia.	N.Z.	India.	Hungary.	Rumania.	Poland
U.K.		50·5	45·0	155·0	290·0	308·0	331·0	22·6	66·6	71·0
U.S.A.	115·0		95·0	127·0	163·0	103·0	42·0	27·2	32·0	101·0
Germany	57·7	40·0		238·0	31·3	11·7	62·0	217·0	240·0	284·0
Belgium	292·0	100·0	220·0		43·6	50·0	333·0	66·5	200·0	156·0
Australia	194·0	29·0	100·3	197·0		37·0	70·0	—	—	33·4
N. Zealand	488·0	47·5	18·7	—	200·0		—	—	—	—
India	187·0	100·0	153·0	152·0	154·0	96·0		52·6	20·0	114·0
Hungary	8·0	4·4	90·5	22·2	—	—	—		720·0	243·0
Rumania	27·8	26·3	210·0	122·0	—	—	—	1200·0		200·0
Poland	50·5	6·4	228·0	125·0	—	—	—	386·0	200·0	

* *i.e.*, Percentage Ratio = { Trade between two countries concerned as percentage of that (in one direction) between all countries listed. / Product of trade total of two countries concerned as percentage of sum of corresponding products for all pairs of countries listed. }

The highest figures obtained relate to the trade between Rumania and Hungary, where proximity is clearly the main factor responsible; the trade of both these countries with Poland was also very large in relation to what it would have been if the external trade totals of the countries concerned were the only determinants of it. The exports of Germany to these three countries were also very heavy, and so (in the case of Rumania and Poland) was the trade in the opposite direction—an obvious effect of complementarity and proximity combined. The effect of proximity is to be seen also in the high degree in which the trade, both of the United Kingdom and of Germany, was directed towards Belgium, but the part played here by complementarity—of the kind which can well exist between highly industrialised countries—was probably considerable, for the amount of trade between Germany and the United Kingdom (where the degree of proximity was not much less than that between the United Kingdom and Belgium) was notably low. Still heavier, however, was the concentration of trade in certain channels due to sheer complementarity between the economies concerned, the distance between them being great. The most striking case of complementarity of this kind is that between the United Kingdom and New Zealand, but the United Kingdom and Australia, and India and Belgium are also examples of it. It must be remembered when considering the distances that separate some of these highly complementary countries, however, that *ocean* distances are of small account, as barriers to trade, in comparison with distances over land; all points on the seaboard of the world are, in some sense, in reasonably close proximity to each other, and it may well cost less to bring goods to Britain or Belgium from the other side of the world than to bring the same goods from some point in (say) Eastern Europe.

At the other end of the scale—where economies are competitive rather than complementary—the trade between the countries concerned may be so small that the value of it is not recorded in the League of Nations statistics from which the Tables in this section are compiled. It is plain, however, that the trade relations between Hungary and Rumania, on the one hand, and the U.S.A. on the other, indicate competitiveness rather than complementarity,

as, indeed, do those of Germany and the United Kingdom. As interesting, however, as the cases where complementarity or competitiveness between two countries is brought out by the magnitude of the trade between them in both directions are those cases where a heavily "one-sided" relation exists—cases such as the United Kingdom and the U.S.A., Australia and New Zealand, Hungary and Germany, India and Germany, and others. It is hardly worth while to give closer attention to these scattered instances, however; more can be gained by applying the same technique to large economies or groups of fairly similar economies—a task which the tables prepared by the League of Nations in *The Network of World Trade* fortunately render comparatively easy.

Table XXVI below shows the trade, in millions of dollars, between six large economies or groups in 1938, as given by important statistics. The British Isles (with which Iceland, the Faroes, and Spitsbergen are included, though without making the description seriously misleading from an economic point of view), the United States, and the nine chief industrial countries of Continental Europe (France, Belgium, the Netherlands, Sweden, Germany, Austria, Switzerland, Italy, and Czechoslovakia) are chosen as constituting the three chief industrial areas of the world; the overseas temperate agricultural countries (Canada, Australia, New Zealand, Argentina, Uruguay, and Paraguay) form a fourth group, while the mainly agricultural countries of Continental Europe form a fifth, and the tropical agricultural countries (those of Latin America and Africa, as well as India, Ceylon, and South-East Asia) a sixth.

TABLE XXVI.

Trade between Certain Areas in 1938 (Million Dollars).

From \ To	British Isles.	U.S.A.	Industrial Continental Europe.	Overseas Temperate Agricultural Countries.	Non-Industrial Europe.	Tropical Countries.
British Isles	—	110	480	570	320	510
U.S.A.	570	—	700	690	190	520
Ind. Europe	760	370	—	300	1150	720
Overseas Tem. Ag.	1130	360	570	—	70	80
Non-Ind. Europe	530	130	1080	40	—	60
Tropical	600	770	970	300	100	—

Table XXVII shows the trade figures of Table XXVI expressed as percentages of the total trade between the areas concerned—those in the top right-hand half of the Table as percentages of the trade in one direction; those in the bottom left-hand half as percentages of that in the other direction. In order to see what the distribution of trade between the areas concerned would be if it was dictated solely by the relative sizes of their trade totals it is necessary to calculate the products of the trade totals (totals of trade with the other areas concerned) of each pair of countries or groups in question, and to express each of these products as a percentage of the sum of all of them. The actual percentages of total trade which are concentrated in the various channels can then be expressed

TABLE XXVII.

Trade between Certain Areas in 1938 as Percentages of Total Trade between these Areas (in the appropriate direction).

From \ To	British Isles.	U.S.A.	Industrial Continental Europe.	Overseas Temperate Agricultural Countries.	Non-Industrial Europe.	Tropical Countries.
British Isles	—	1·70	7·42	8·82	4·95	7·89
U.S.A.	6·89	—	10·81	10·68	2·94	8·04
Ind. Europe	9·18	4·47	—	4·64	17·80	11·12
Overseas Tem. Ag.	13·65	4·35	6·89	—	1·11	1·24
Non-Ind. Europe	6·40	1·57	13·05	0·48	—	0·93
Tropical	7·25	9·30	11·72	3·62	1·21	—

as percentages of those which would be concentrated there in the imaginary "world of reference" so conjured up. The result of this operation is shown in Table XXVIII.

The largest of the figures in this Table relates to non-industrial Europe's exports to industrial Europe, a case where complementarity and proximity are both at work; though it is noteworthy that the trade in the opposite direction is considerably smaller—partly owing to the current German policy of accumulating passive trade balances with the eastern countries. The next highest figure relates to Britain's imports from the temperate overseas countries, and here the trade in the opposite direction is very much smaller; Britain has to import her foodstuffs from the countries which produce them, but there is no corresponding necessity for them to take

manufactures from her rather than (as they largely do) from the United States—moreover, the discrepancy reflects the transfer to Britain of interest on a large part of her overseas investments. The United States' heavy exports to the overseas temperate countries, also, are not balanced by any equally large trade in the opposite direction. The United States is herself a competitor in the sale of the products of temperate agriculture, and her imports from countries whose principal exports are such products therefore naturally fall short of the large quantities of manufactures which she can sell to them—especially in view of the fact that the kinds of manufactures which they need are mostly the same as those she produces for her own use. That the United States' trade with tropical countries is so much larger—in relation to the trade totals of the parties involved—than is that of Britain, or even than that of industrial Continental Europe, is easily to be accounted for—tropical products are a relatively small part of the large range of foreign products on which Britain is dependent, a larger proportion of the somewhat smaller range of products which industrial Europe (with its nearer approach to self-sufficiency in temperate agricultural products) imports, and a still smaller proportion of the relatively narrow range of imports of the United States, with its much lower population density and abundance of natural resources of nearly all kinds except those occurring in tropical areas.

TABLE XXVIII.

Trade between Various Areas in 1938 in relation to the Products of their Respective Trade Totals with all the Areas concerned.

From \ To	British Isles.	U.S.A.	Industrial Continental Europe.	Overseas Temperate Agricultural Countries.	Non-Industrial Europe.	Tropical Countries.
British Isles	—	24·5	66·3	137·2	86·4	109·0
U.S.A.	99·5	—	122·4	190·0	63·5	140·0
Ind. Europe	82·0	50·7	—	56·5	254·0	120·5
Overseas Tem. Ag.	212·5	85·4	84·0	—	26·3	23·3
Non-Ind. Europe	111·7	34·9	186·0	11·4	—	19·7
Tropical	100·2	161·7	126·9	68·0	25·6	—

The smallest figure in the Table is that relating to two obviously competitive areas: non-industrial Europe and the temperate overseas agricultural countries. The

trade between these two groups is small in both directions, though non-industrial Europe's imports from the overseas temperate countries are more than twice the trade in the opposite direction—a result mainly of the fact that the overseas countries produce wool and certain minerals with which non-industrial Europe does not compete. Next in order of smallness (in relation, of course, to the relevant trade totals) comes the trade—much the same in both directions—between the tropical countries and non-industrial Europe. The smallness of this trade was essentially due to the fact that both the groups concerned were mostly poor; tropical countries tend to satisfy their needs for non-industrial goods with tropical produce (it is noteworthy that the tropical countries' imports from the overseas temperate agricultural countries were also very low); the European agricultural countries, on the other hand, though they consume some tropical fruits, coffee, cocoa, and vegetable oils, cannot afford very much of these luxuries; nor do they use as much jute (for sacks) as the overseas temperate agricultural countries, where most of the produce of the soil is marketed, not consumed on the farm. Moreover, South-Eastern Europe, for instance, was increasingly producing vegetable oils on its own account.

The trade between the overseas temperate and the tropical agricultural countries is interesting to compare with that between the latter and non-industrial Europe. It has just been remarked that the tropical countries imported very little from the temperate agricultural; the trade in the opposite direction, however, was much heavier—and much heavier than that from the tropics to non-industrial Europe—because the overseas temperate countries are rich, and so consume relatively large quantities of tropical fruits, tea, coffee, cocoa, and vegetable oils (they use imported cattle cake in some cases also), and, since most of their products are marketed, they use great quantities of sacking. Moreover, the Australian importation of mineral oils from South-East Asia is included in the import figures in question.

Industrial Europe's trade with the overseas temperate countries was much greater, but still fell markedly short of proportionality to the trade totals of the two groups concerned, not because of any lack of natural comple-

mentarity between them, but because industrial Europe had access to competing agricultural supplies from the neighbouring non-industrial countries, Germany in particular having made special efforts to divert her trade to them. The situation of 1928, when Germany was still trading much more heavily with the United States and the British Dominions, would probably have presented a somewhat different picture in this respect. Britain's trade with non-industrial Europe—in both directions—was not far from proportionality to the trade totals of the areas concerned. Britain's balance with these countries was passive; in some degree they exported to this country and imported from the Continental industrial countries, just as the overseas temperate countries exported to Britain and industrial Europe and imported from the United States. It is noteworthy that British Imperial Preference and the heavy British investment in the overseas world did not cause her to concentrate on trade with the overseas countries to the exclusion of agricultural Europe nearly as much as industrial Europe concentrated on trade with its agricultural neighbours to the exclusion of overseas trade. The reason is largely geographical; Britain is a neighbour only of the north-western non-industrial countries of Europe, with which she did a very large part of her total European trade; the industrial countries of Central Europe, on the other hand, are neighbours both of the north-western and of the eastern and southern non-industrial European areas. The fact is, however, none the less interesting.

The trade between the three great industrial areas was, in general, on a larger scale, in relation to the relevant trade totals, than that between the non-industrial countries, though very markedly less than that between the industrial and the non-industrial areas. The exports of the United States to industrial Europe and, in a smaller degree, to Britain, are represented by the highest figures in this part of the Table, and it must be remembered that they were by no means wholly exports of industrial produce, since the United States was still a considerable exporter of foodstuffs and raw materials. This is emphasised by the fact that the trade in the opposite direction was notably small. The trade of Britain with industrial Europe was fairly high in both directions (though Britain's balance was markedly passive here, since part of her receipts on account of invisible

exports to the overseas world were still transferred to her by this indirect channel).

In general, it seems that the method of analysis here used is of considerable service in showing the anatomy of world trade. The essence of its usefulness is that, while it does not conceal the nature of the trade balance between any pair of countries, it shows at a glance how far the flow of goods between them in either direction exceeds or falls short of what it would be in a world where complementarity or competitiveness, distance or proximity, and State diversion of trade into or out of the channel concerned were no greater between that pair of countries than between any other pair. In the application just made it serves to emphasise two things—that the complementarity between industralised countries is generally higher than that between agricultural ones, though much less than that between industrial and non-industrial areas; and that so long as some countries' exportable resources or products are many-sided while their requirements from abroad are relatively narrow in variety and geographical origin, and so long as other countries' exportable products are highly specialised and their requirements from abroad varied, the pattern of trade which best satisfies human needs will be one which excludes the bilateral balancing of trade, or even total payments, between many pairs of countries.

CHAPTER VII

THE ECONOMIC IMPACT OF ATOMIC ENERGY

1. THE NATURE OF ATOMIC POWER-STATIONS

IT has become a commonplace that the release of atomic energy (or, more strictly, nuclear energy) by the agency and for the purposes of man ushered in a new age. There can, indeed, be no disputing that a new factor of immense importance was introduced into international affairs, and into any assessment of the future of civilisation, with the explosion of the first atomic bomb. Because military considerations are present in so many decisions of policy, whether in the political or the economic field, it is therefore safe to say that the atomic bomb will in many ways modify the economic life, as well as the political future, of the world. It is not, however, with this that the present chapter is concerned; its starting-point is not the explosion of the first atomic bomb, but the moment on December 2, 1942, when a graphite-uranium pile in Chicago gave rise to the first self-sustaining nuclear reaction ever produced by human agency—producing energy by the fission of uranium nuclei at the small initial rate of half a watt.

From that small beginning, under the pressure of wartime need, the production of energy by the atomic pile has already been vastly expanded. The plant subsequently built at Hanford, on the Columbia River, released energy by this means at a rate amounting to many thousands of kilowatts, probably equivalent to the output of several large power stations—not, however, for the energy's sake, but for the sake of obtaining plutonium, an element of atomic number 94, not found in nature, as a war-head material for atomic bombs. At present, indeed, the technical problem of obtaining usable mechanical energy from the atomic pile has not been solved; means have yet to be found of operating a pile at the high temperatures required for the economical conversion of heat into mechanical work. Once

that problem has been solved, however, an entirely new source of useful energy will be available to mankind.

It is not hard to foresee the most probable general pattern of energy generation from this new source in the early part of the "atomic age." Atomic piles are fairly massive objects; the Chicago pile, which it was never considered safe to work at a rate or more than 200 watts, contained about six tons of uranium metal alone. A pile with plutonium as its working substance might be much smaller, but round any pile very heavy concrete defences have to be set up to protect their surroundings from dangerous radiations, and precautions have to be taken, similarly, to guard against radiations from the steam or other working material, which would be activated by the pile. In short, an atomic power source, working on anything like the principles so far adumbrated, is bound to be a heavily built affair, operated largely by remote control, and probably placed for safety at a considerable distance from human habitations. This means that such sources are likely in the foreseeable future to take the form of large central power stations distributing their energy electrically.

The second economically important characteristic of this new source of power is, of course, the exceedingly small bulk of material actually used up in its production. In the conversion of uranium into plutonium, some 24 million kilowatt hours (*i.e.*, about 32 million horse-power hours) of heat energy are produced per kilogramme of plutonium produced—a striking contrast with the 6 kilowatt hours or so of heat energy produced in the burning of a kilogramme of coal. However difficult it may be to extract uranium from its ores, and however massive the actual apparatus for the release of atomic energy may be, it is certain that there is virtually no economic bond tying the production of the energy to the source of the ore, as present-day power stations are tied to the sources (or the convenient unloading points) of their fuels. Political restrictions may, in fact, render uranium and other fissionable materials accessible only to those countries in whose territories they occur, but, so far as purely economic factors are concerned, it is clear that the "fuel" for this new type of power station could be brought half-way round the world by air-

liner without any noticeable increase in the cost of the energy developed from it. The chief locational tie on atomic energy plants may well be that which is already so important for coal-fired power stations—the need for a large supply of cooling water—though the development of gas turbines may remove this tie also.

Thus, if and when the atomic pile becomes an economic source of energy, it will be possible to release the power-using industries from the economic bonds which at present bind them to the coalfields and the sites at which water power can be conveniently used. In order to see what this means, however, it is necessary to consider the extent to which these present locational factors are, in fact, restrictive.

2. THE IMPACT ON THE LOCATION OF POPULATION AND INDUSTRY

In the first place, it is clear that they are not restrictive of industrial location in any completely rigid way, since the distances to which energy can be carried electrically from the coalfield or the water turbine are already considerable. Transmission up to 300 miles, or even further, from the point of generation is not too expensive under modern conditions, while coal can be carried, economically, over many hundreds of miles from the coalfield to the power station, provided that most of the distance can be covered by water, using fairly large vessels. It is therefore only the interiors of the great continental areas—or those parts of them that lie some hundreds of miles from either a coalfield or a good source of water power—that are outside the potential reach of reasonably cheap power under present technical conditions.

The chief obstacle to bringing power electrically to any point in a very high proportion—perhaps in the greater part—of the earth's land surface under present conditions is a matter rather of demand than of supply. The great centres of population, and therefore of industry and of demand, are not very mobile in anything but the very long run, and a great many of the power-using activities of mankind, for reasons of demand, labour supply, or transport, are either inseparably tied to these centres or are more economically carried out in or near them than at a distance.

Moreover, the great centres of population are, in general, accessible to supplies of mineral fuels, even if they are not actually based on deposits of them. The civilisation of the West is essentially a coalfield civilisation ; the centres of population that are not actually on or very near to coalfields are commercial centres whose chief *raison d'être* is their accessibility. The populations of Asia and even of Eastern Europe, being less dependent on mineral fuels, bear less marked locational relation to them ; nevertheless, since they subsist largely by the cultivation of river valleys and coastal plains, they are for the most part to be found in areas which could be served fairly inexpensively (given the demand) by electrically-conveyed energy from waterside power stations using coal or oil.

Thus, given the existing distribution of population in the world, it is certainly not the case that any large portion of mankind is out of reach of a potential supply of energy derived from the ordinary mineral fuels. The further question which at once arises is : How far has the location of these fuels been responsible for shaping the pattern of population distribution itself ? So far as the economically well-developed countries are concerned, it has obviously been important ; that issue has been prejudged in the remark just made that this is a coalfield civilisation. With technical factors as they are now (atomic energy not yet having effectively intervened), the coalfields and oilfields, and the districts with good water-power sites, have a comparative advantage in the industries which use much energy. The actual distribution of industrial population probably, in fact, gives an exaggerated impression of the locational importance of coal, because it depends necessarily on the technical conditions of yesterday rather than of to-day ; electrical transmission of energy, besides oil and water power, have not had time to exert anything like their full potential effect on the picture. Besides the rise of industry based on water power in coalless regions like Switzerland, Italy, and Scandinavia, and on oil and natural gas in Texas and elsewhere, the last generation has seen a shift of many branches of manufacture from the coalfields towards commercial centres such as London, Paris and Berlin, for which high-tension transmission is largely responsible.

Nevertheless, if technical knowledge were to stand still for a generation or two, so that the pattern of development could catch up with it, there would still, in all probability, be a strong tendency for the biggest power-using industries (the metallurgical and electro-chemical groups), and even for the biggest agglomerations of all industries, to be found within a few hundred miles of the coalfields, the big oil-fields, and the big water-power sites. Thus, the fact that none of the big centres of population is out of reach of potential supplies of fairly cheap power under present technical conditions must be viewed in the light of the further fact that those technical conditions make power considerably cheaper in some places than in others, so that the economic advantages of a particular territorial division of function between those activities which use much power (relatively to other factors) and those which use relatively little is very marked.

The advent of a source of power which is not tied to particular parts of the world's surface—of a fuel which is, by present standards, virtually without weight and transport costs—might therefore be expected to have two main consequences on the location of industry as we know it to-day. In the first place, it would diminish the differences between power costs in different places, and so reduce the advantage of particular locations for those industries which use most and least power in proportion to other factors of production. How much it would reduce these differences would depend, of course, on how competitive it was with existing sources of power—if atomic energy proved to be cheaper than energy from any other source, it might reduce the local cost differences very much indeed; otherwise its effect in this direction would naturally be more limited.

Secondly, the advent of such a new power source would remove one of the limitations which now prevent the development of power-using industry in those relatively few well-inhabited areas and those larger uninhabited areas to which it is technically impossible to supply reasonably cheap power from present sources. It would therefore make it easier to colonise and industrialise the remote and waste spaces of the world. Whether this would be important, however, depends on what the other limitations on the economic development of these areas are. In the short

run, as has been suggested already, the main limiting factor in most of the places concerned is, in fact, absence of population, or, even where the population is present, of those cultural and political factors which make modern economic organisation possible.

In the longer run, in which population may be supposed to be reasonably mobile, the main limitation is certainly climatic. The empty belt which stretches across the Old World from the Sahara to the Gobi is empty because it is arid—the same is true of the Australian interior. The presence of some rare and valuable mineral in a desert makes it economical to maintain small communities there in order to extract it, but the cost of irrigation or of bringing in the necessities of life in great quantities is so high under anything like present conditions that the possibility of bringing power to them as cheaply as it can be obtained on (say) the world's great developed coalfields would not in itself serve to open any large part of them up. Whether the availability of power at a much lower cost than any so far encountered would greatly alter the picture is a different question, which must be examined later.

The sub-arctic and arctic regions in the north of both the Old and the New Worlds are empty because they produce relatively little food (though the limit of cultivation is steadily being pushed northwards), and because the cost of the buildings, the heating, and the imported supplies necessary to maintain the physical conditions of an advanced standard of living are high there. It is only where they are unusually productive (as where, locally, they possess exceptionally valuable mineral resources or are of importance for communications, as are the settlements connected with the Soviet Arctic Sea Route) that they can be expected to draw in population from more clement regions. Here, again, power at ordinary prices (as opposed to power at prices far lower than anything hitherto experienced) cannot be expected to make much difference to the course of development. As for the undeveloped tropical regions of Africa and South America, it can hardly be said that lack of power resources is among the obstacles to their development, for they possess the largest water-power potential in the world.

Thus, if one surveys the empty spaces of the world, it becomes apparent that remoteness from existing power resources (where they are remote from them) has been only one of the reasons for their failure to develop, and that its removal would not, by itself, do very much to promote their development. It may well be, of course, that the planned development of some remote or inhospitable areas for strategic reasons will be facilitated by the availability of atomic energy at prices comparable with those now paid for power in the more favoured regions; it is possible also that it may greatly facilitate the planting in such regions of the relatively small settlements that are required for the exploitation of their special resources. So far as purely economic considerations go, however, it is unlikely that a new source of energy, distinguished by its independence of any particular geographical location, but not much cheaper than industrial power in the more favoured places to-day, would greatly alter the broad distribution of population and economic activity about the world.

3. THE EFFECTS OF CHEAPER FUEL

The discussion so far has been on two assumptions—first, that atomic energy will not be much cheaper than that from, at any rate, the best existing sources, and that an indefinite amount of power will continue to be available from the existing sources at no more than present costs. Both of these obviously require examination. How dear, in the first place, is atomic energy likely to be? That is a question which it is impossible to answer with any precision on the basis of the published information, and to which only highly conjectural answers could, in all probability, be given even on the basis of all that is known in the best-informed quarters. Certain commonplace considerations, however, throw a good deal of light on it. In the first place, it must be remembered that the atomic pile is simply a substitute for the furnace of an ordinary coal- or oil-fuelled power plant; there is no reason to suppose that any of the costs of producing power other than those of providing heat will be different in an atomic power station from what they are in a coal-fired one. Now,

in the United Kingdom before the war, the cost of electrical energy to the consumer was apparently made up, on the average, roughly as follows :

Cost of Fuel	14 per cent.
Power-station Wages, etc.	3 ,,
Transmission and Management, Repairs, Maintenance, Local Rates, etc.	32 ,,
Depreciation, Reserves and Capital Outlay ...	28 ,,
Interest and Dividends	23 ,,

The cost of fuel was thus only a seventh of total cost—at post-war prices it may perhaps be in the neighbourhood of a fifth. This, of course, refers to all the electrical energy sold ; in cases where it is generated for industrial use on the spot, most of the cost of distribution and transmission is saved, including the capital cost associated with those functions which, to judge by the purposes for which money was borrowed by electricity undertakings in the United Kingdom before the war, may be about half the total capital cost. Thus, in this case of specially generated industrial power, the cost of fuel may before the war have been as much as a quarter of total cost, and might be as much as a third of it at post-war prices.

It seems therefore that, even if the atomic pile could provide heat virtually without cost, the average cost of electrical energy to the consumer would be reduced only by perhaps a fifth on the average, and by a third in special cases where the energy is used in bulk at or near the point of generation. Indeed, if the comparison is with the best coal-fired generating plant, the saving would be less, for the best plant in the United Kingdom before the war used less than two-thirds of the general average amount of coal per unit of energy produced. Thus, even at post-war coal prices, the saving in cost afforded by a virtually free source of heat, in comparison with the best coal-fired plant, would probably be less than a seventh on the average and a fifth or a quarter in the special case where costs of transmission and distribution were negligible.

The effects of these reductions in cost of energy on costs of production and standards of living would be smaller still—so long as the amount of energy used did not greatly increase. Even in the United States, where far more power is used in manufacture (relatively to the amount of labour and materials) than is the case here, cost of energy

constitutes less than 3 per cent. of the total cost of all manufactures taken together. In mining, energy accounts for a much bigger proportion of the total cost—it may even be as great as a third of it—but there are few manufacturing industries in which the proportion exceeds a tenth. In transport, power is a relatively more important factor than in manufacture: locomotive running expenses on the British railways before the war, however (not all of which are costs of energy), were less than a quarter of total expenses of working—excluding any allowance for interest on or repayment of capital. As for the direct household use of energy, total personal expenditure on light and fuel of all kinds in the United Kingdom is now, and was before the war, less than 5 per cent. of total personal expenditure on goods and services.

That the utmost saving in average costs must be small does not mean, however, that a virtually costless source of heat for generating electricity would have no important economic consequences. What governs the decision to use more energy is not the reduction in the average cost per unit, but the reduction in the cost of additional units. The extra cost of producing an extra unit of electrical energy—at hours when the plant is not loaded to capacity at least—is very little more than the cost of the coal burned in generating it, and undertakings therefore find it worth while to sell extra units (outside peak hours) at any price they will fetch, so long as it is in excess of this coal cost—a cost which, with modern plant and at present British coal prices, is perhaps in the neighbourhood of a fifth of a penny. If, therefore, there were a virtually free source of heat, the marginal cost of energy to all but the peak-hour consumers might fall to very near zero—the proportionate reduction in the price to them might be very great indeed.

Moreover, to quote the small proportion which energy costs constitute of the total costs of goods and services as evidence that a cheapening of energy would be unimportant is largely to miss the point. It may be that, if energy became cheaper, it would be substituted for other factors of production on an enormous scale, thereby transforming the whole technical process of production. When rubber cost several shillings a pound, its importance in the world economy was negligible, but when it cost only a few pence

a pound, its importance became very great. It is a great mistake to argue as if the proportions in which the factors of production are used are independent of their relative prices.

Thus, the next question of importance is: To what extent would a virtually costless source of heat, rendering the marginal cost of energy almost zero in certain circumstances, cause the production and consumption of energy to expand? This is harder to answer than the previous questions; again, however, certain clues to the answer are readily available. Consideration both of supply and of demand enter into it. On the demand side, the question is, How far would the use of energy expand with reduction in its price? and there the evidence is scanty. There are, however, certain useful pointers. The various main factors of production—including mechanical energy—have very different relative prices, and are used in very different proportions in different countries. The United States, for instance, possessed before the war perhaps 40 to 50 per cent. more capital equipment and used perhaps 80 per cent. more mechanical energy per occupied person than was the case here; France used perhaps 40 per cent. less both of capital and of energy per occupied person than the United Kingdom; in Japan, probably only something like a quarter of the energy and a still smaller proportion of the capital were used. These differences in proportions of the factors used corresponded roughly to differences in relative price. In the United States, labour was probably almost three times as dear, relatively to either capital or power, as it was here; in France it was cheaper than the other two factors mentioned by perhaps 40 to 60 per cent., while in Japan it was cheaper by an even greater margin. Thus, in considering what would happen in this country if power became cheaper, one may learn much from the experience of the United States, where it is cheaper already—relatively to labour at least. Energy costs only a third as great as the present ones, in relation to labour costs, might be expected to produce something much more like the industrial methods of the United States than we have seen hitherto.

It is most important to remember, however, that extra use of power goes with extra use of capital. The international

comparisons just quoted illustrate the positive correlation between the two, which is indeed clear from more general considerations. There may be industrial processes (particularly electro-chemical ones), using much power, which employ, directly, a less expensive plant than alternatives demanding less power; but this cannot greatly affect the issue in a large, varied economy. In such an economy, considered as a whole, it can be taken for granted that cheaper power promotes the substitution of power-using machinery for labour. That being so, the supply (and the cost) of capital is likely to be one of the main factors limiting the greater use of power. A great cheapening of power in the United Kingdom would not produce precisely the kind of industrial development that has taken place in the United States (quite apart from all matters connected with the different sizes of the two national markets, etc.), for American industry employs, roughly speaking, twice as much capital as British, besides employing twice as much power per man, and, in relation to labour, capital is much dearer here than it is there. Even free power would be far from causing an indefinite expansion of the use of power, because the extra equipment required would not be free. There would still be very definite limits to the amount of its resources which the community could afford to invest in the extra equipment, without which extra power could not be used.

It seems, therefore, that the extension of the demand for power consequent upon a reduction in the cost of it, such as a free source of heat might bring about, would be moderate rather than sensational. This conclusion is reinforced by considerations relating to the conditions of supply of energy. It has been pointed out above that a costless source of heat would probably make extra units of electrical energy available at negligible cost to those users, at least, who consumed it mainly outside peak hours. The total amount of almost free energy that could be supplied would, however, necessarily be limited. On any calculation of the amount of resources that should be put into any given form of production in the social interest, it emerges that, broadly speaking, that scale of output is best at which total costs would just be covered if each unit of output could be sold separately at the highest price it

would fetch in the market. In practice it is, of course, not possible to sell units of output in this way; total revenue from their sale is therefore less than it would be if such perfect discrimination were possible. The output in the power industry under commercial conditions is, for this reason if for no other, rather less than the optimum. Even if it were the optimum, however, the condition stated would impose fairly severe limitations. It would allow the installation only of that amount of generating plant on which the capital, maintenance, and working costs could be met out of revenue on the assumption of perfect discrimination in pricing. The free units, even if there were no working costs at all, would be limited to those which the plant could produce by working to peak capacity in between the hours in which there was a peak load for which customers were prepared to pay. The production of an extra unit is not, in general, socially justifiable if it involves extra costs greater than the price someone is prepared to pay for it (or, perhaps, than someone would be prepared to pay for it if personal incomes were equally distributed). Even if generating plant could be run without cost (which, of course, is an ideal state that cannot be achieved), the extension of output beyond the capacity of the existing plant is bound to involve extra costs in the shape of capital charges on extra plant. The long-run equilibrium price of energy developed with the help of any plant at all—plant not being a free good, even if heat becomes so—cannot really be reduced to zero save for a limited number of units generated at non-peak hours.

4. EXISTING POWER-SOURCES AND FUTURE DEMAND

The comparison has been, so far, with the present position; it may be more relevant to make a comparison with the position as it might have been expected to become had atomic energy not come in sight. Two considerations have to be faced in this connection; in the first place, it may be that, failing the industrial application of atomic energy, we face a prospect of increasing power costs even with consumption of power at its present level; secondly, it may be that the cost of power from existing sources will

rise as world population and the world supply of power-using equipment increase.

The weight of these considerations can be judged only in the light of a general survey of the world's existing sources of energy. It is customary to divide these into two groups—the exhaustible and the inexhaustible. The former comprises, of course, all the mineral fuels which are the main source of power used at present. The latter, strictly, consists of the earth's receipts of solar energy, which is available for human use mostly in the form of foodstuffs, vegetable sources of power (such as grain or potato alcohol), and the energy of air and water set in motion by the sun. For practical purposes, also, one can include the energy of the tides in this class, though that is derived from the kinetic energy of the earth's rotation (an enormous but, in principle, exhaustible stock of energy) in conjunction with the gravitational pulls of the sun and moon. How large are these sources?

The stock of coal and lignite in the world, known or believed to exist at reasonably accessible depths, exceeds five million million tons—enough to last, at present rates of extraction, for more than three thousand years. Known petroleum reserves constitute only something like a score of years' output at present rates, but discovery is constantly going on, and it is impossible to make any useful estimate of how long the world's total reserves might last—though it does not seem likely that they are anything like as great in relation to the rate of extraction as is the case with coal. Inevitably, however, it is the most accessible and easily-worked deposits that are being exhausted first; moreover, the chief coal-producing countries have now reached a crisis in their mining industries which makes it hard to predict what the future costs of coal in them will be. In the United Kingdom, the coal industry has fallen behind in its technical equipment, and has for a generation or more been able to employ labour at less than the long-term equilibrium price, because of its decreasing total demand for labour and the existence of heavy general unemployment. In the United States, where technical equipment is the most advanced in the world, wages in coal-mining have also been lower, relatively to those in other industries, than is likely to be the case in the future, since general unemployment

has prevented adjustment to the new situation which arose when a large supply of immigrant labour from poor countries ceased to be available for that and other unpleasant and ill-paid occupations. If fuller employment is maintained in these and other coal-producing countries in the future, coal-mining wages—and, probably, costs—are likely to stand higher relatively to those in other industries than has been the case hitherto.

On the other hand, the efficiency of electrical power generation from mineral fuels has been increasing very rapidly; it has doubled in less than a generation, and, as mentioned above, the best plant in the advanced countries is more than fifty per cent. more efficient than the average plant here; so that a further rapid improvement in the course of the next twenty years is certain. Thus, while a rise in coal prices (relatively to other prices) may cause the cost of electrical energy to stand higher in relation to that of other commodities in the immediate future than before the war, it seems likely that a fall will set in and continue for at least a decade or two. Any secular rise in the price of electrical energy due to increased costs of mineral fuels is not likely to set in for some time yet.

When one looks at the prospective long-run increase in demand for energy, however, the ultimate probability of such a rise in its cost becomes very great. Of mineral fuels the world is at present using less than the equivalent (in calorific capacity) of one ton of coal per head per year. In the advanced countries, however, the equivalent of from four to eight tons per head is used. The potential increase in demand as backward countries become industrialised is therefore enormous. Moreover the possibility of a doubling of world population in something like a century has to be faced. The repercussions of such an increase on the demand for energy would probably be complicated. One of the notable trends of recent times has been the substitution of mechanical energy (along with plant and technical knowledge) for agricultural production. Chemical synthesis has replaced the agricultural production of a number of vegetable dyestuffs; it is now to some extent replacing the production of natural rubber, the breeding of silkworms (which means the cultivation of mulberry trees), and the growing of wool and of vegetable

fibres. The position of the margin to which it will be economic to carry some of these substitutions in the near future is uncertain, but they have one common feature—they economise land on which foodstuffs can be grown—and the increase in the world demand for foodstuffs consequent upon the increase in population (and income) is therefore likely to push them steadily further. Moreover, the direct production of feedingstuffs from wood waste and other forms of cellulose—directly and indirectly a power-consuming process—may well become more important in the future as the pressure upon agricultural land increases.

Increased pressure upon agricultural land may be expected to increase the demand for mechanical power in more direct ways, too. More intensive cultivation of land already usable for food production and use of land now too poor to be so used both demand more use of artificial fertilisers, of cultivating machinery, and in some cases irrigation by pumped water or application of artificial heat. All these obviously require increased use of energy. It has been pointed out above that large-scale agricultural production in what are now the main waste places of the earth—in the Sahara with the help of irrigation, or in the Arctic with the help of artificial heat, for instance—would compete on hopelessly unequal terms with production in more favoured places under present-day conditions, even if the atomic pile provided a very cheap source of heat. This, however, would be a less cogent point if the population of the world were doubled and its demand for foodstuffs and perhaps some vegetable materials more than doubled, so that the good and accessible land had to be cultivated much more intensively and poorer land pressed into use to satisfy the need.

Thus, the demand for energy is fairly certain to be several times as great a hundred years hence as it is to-day; and if the present mineral fuels were not supplemented in increasing measure by other sources of power, the real cost per unit of energy would be very likely to rise over such a long period, improvements in the methods of extraction and utilisation of coal and petroleum notwithstanding. Even leaving atomic energy out of account, however, there is every prospect that the mineral fuels will be supplemented by other sources to an increasing

extent. The increase in the use of water power over the last generation or two has been very striking; it now contributes about a tenth of all the mechanical energy available in the world, reckoning the energy available from mineral fuels as if it were obtained by the most efficient current means—which naturally exaggerates it greatly. If all the world's inland water power were harnessed, it would indeed supply more mechanical energy than is now used by man, and it is perhaps worth noting that any very great increase in the utilisation of water power would have great economic significance on account of the locational changes which it would involve. There are other sources of power too; the harnessing of the tides would probably, in general, involve much higher fixed charges than do inland water-power sites—of the kind already exploited at least—but it constitutes a vast cushion of possibilities on to which mankind might fall back if its mineral and inland water sources were to run short. Beyond that, there are no doubt great possibilities in the exploitation of natural temperature differences between different depths in the ocean or between water and air in the Arctic regions. All these have been suggested, and there is no doubt that they could be used to supplement existing sources, even in the present state of technique, if the supply of other factors of production were so greatly increased that new supplies of power were required at higher overhead costs than are economically borne at present. There are also great possibilities of developing new sources; the sun pours down energy at the average rate (over the whole year) of a million horse-power per square mile of the earth's surface, of which energy perhaps a thousandth is stored, as calorific power, in a good food crop. If the direct energy of solar radiation could be economically captured and used, a supply vastly exceeding all our present sources would clearly be obtained.

It seems, therefore, that a general power famine is not very probable, even in the absence of any effective use of atomic energy. It may be, however, that atomic energy, a generation or two hence, will be obtainable at lower cost than energy from some of the sources to which we should have been driven in its absence; it is even possible (though here a doubt may be entertained) that it will be the cheapest

source of all. Yet the economic consequences even of very cheap and unlimited power are not likely to be cataclysmic. The economic progress of the world in the last few generations would probably not have been much greater if power had been considerably cheaper than was actually the case—the social and economic factors governing the rate of effective accumulation of capital have probably exercised a stronger influence than the supply schedule of mechanical energy. For as far as it is useful to look into the future, this will probably continue to be the case.

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