

The shadow of the world's future, or, the Earth's population possibilities & the consequences of the present rate of increase of the earth's inhabitants

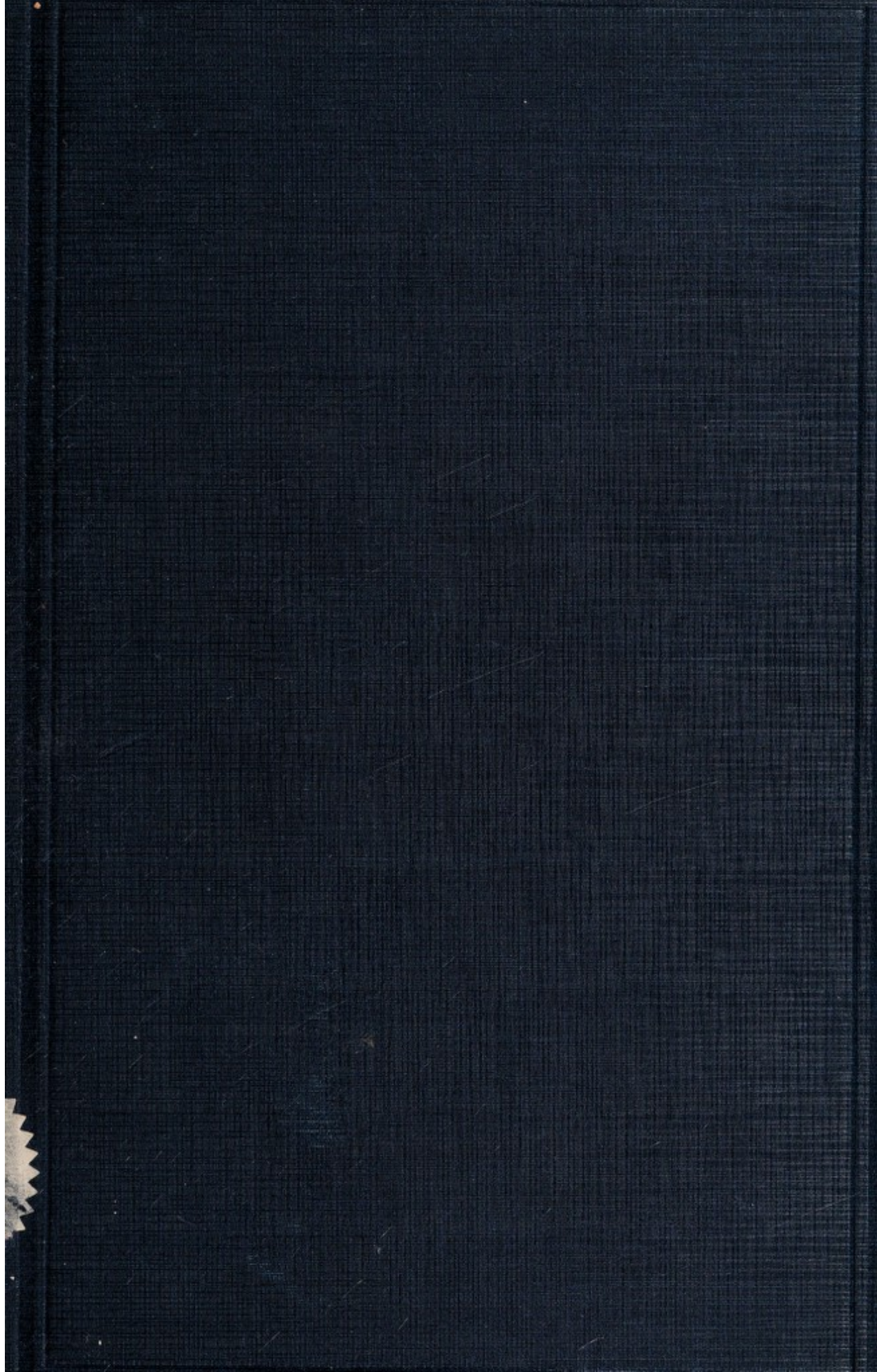
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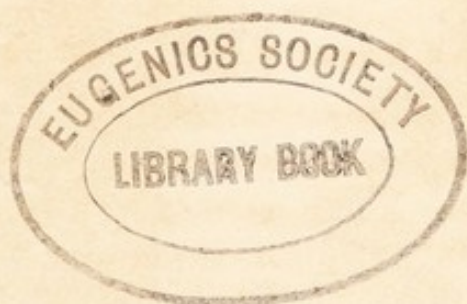
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THE SHADOW OF
THE WORLD'S FUTURE

THE SHADOW OF THE WORLD'S FUTURE

OR THE EARTH'S POPULATION POSSIBILITIES
& THE CONSEQUENCES OF THE PRESENT RATE
OF INCREASE OF THE EARTH'S INHABITANTS

BY

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PREFACE

“THE SHADOW OF THE WORLD'S FUTURE” is an exposition of the consequences of the limited population-carrying capacity, under various conditions, of our earth. Founded upon a survey of its areas, of the distribution of its present inhabitants, and of their productions, it shows that the menace of the present rate of growth of those inhabitants is most serious. This rate is of the order of about 1 per cent. per annum. Starting in 1928 with a total of say 1950 millions of human beings, the existence of such a rate is of the gravest significance, for, in the course even of the present century, mankind will be involved in very great difficulties, for which unquestionably it is quite unprepared.

The difficulties of the near future relate specially to food-supplies and to economic organisation. They are of a character which does not give any ground for the hope that they will automatically adjust themselves; there is therefore no alternative but to face them. It is for this reason that the population-question is of the first order of importance for every person who has any interest in his country's future, or in his children and children's children.

The sense of unrest existing among all intelligent peoples to-day is perhaps a precognition by the “unconscious mind” of coming troubles. Is it possible, we may ask, by envisaging the grave problems of the immediate future, to move toward a partial solution

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of them? One thinks—rightly or wrongly—that it is, even though in Man's present stage of development a completely satisfactory solution may not be possible.

This brief sketch is submitted as one aspect of this difficult problem, a problem which is now menacing the peace of the world.

GEORGE H. KNIBBS

MELBOURNE
January 1928

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CHAPTER I

THE OUTLOOK

WHAT lieth on the knees of the gods no man knoweth, thus ordinarily men do not concern themselves with anything but the immediate future. All else they leave to "Providence." The philosophic historian, however, examining the perspectives of the world's history, finds himself compelled to recognise that, as a matter of fact, coming events do "cast their shadows before them." There are, too, signs of the times which, if we are able to read them, may make the future the better for us.

A study of the early traces of Man, and of general geology in connection therewith, shows that he has been a denizen of this earth for at least hundreds of thousands of years, possibly even for millions of years. Human history, however, goes back at the most only something like ten thousand years, and for the first half of this period it is very meagre indeed. For this reason Man's occupancy of the world's surface is not as informative as one might wish it to be. Among other things the character of the fluctuations of his numbers, of his earlier aggregations and their developments, of the nature of the civilisations to which he has attained, is but very imperfectly known. The monuments of human effort in Babylonia and Egypt, in China and India, in Peru and Mexico, at least inform us, however, that great changes in the intensity of his corporate life have occurred in the past.

Despite the fact that we are compelled to recognise how little we know of the details of Man's history, there are certain things that stand out significantly. One of these is the progress of his numbers. The rate of their increase has been amazingly slow. In recent times, both in America and in Australia, this rate has, for populations of moderate size, attained to 3 per cent. per annum. The world as a whole, however, has never reached anything like such a rate, during the periods at least for which there have been accurate records. On the other hand, the numerical increase has been very slow indeed. Such a fact commands our attention, for if we are to grasp the meaning of rates, and envisage them in their proper perspective, we have to realise what they imply for the future of the race.

When we think merely of individual families, the rate of 3 per cent. per annum may not appear large as a measure of its increase. To grasp its significance it will be sufficiently near the mark to suppose that for every 1000 persons in the population about 126 are married women between the ages 15 and 44 inclusive, the important range of the reproductive ages of womanhood. If then the deaths per annum amounted to 12 per thousand, the annual increase would have to be 42 per thousand for the annual rate of increase to be 3 per cent. Thus for the increase to be by births alone, each of the 126 child-bearing women would have to bear a child about every three years, on the average. In the case of healthy women this, of course, is not the physiologically possible limit, but it is, nevertheless, a high frequency. As a whole the world is not growing at anything like the rate of 3 per cent., and, as far as one can judge, that rate never was attained.

One perforce asks: "At what rate has the world's population increased in the period during which it has

been possible to ascertain it exactly?" For the quinquennium 1906 to 1911 there were accurate statistics for twenty-six countries, and these gave a rate over all of 1.159 per cent. per annum. For the century 1800 to 1900, however, there is no doubt that the rate of increase was not even 1 per cent. Roughly it was about only 0.864 per cent.¹ Thus, although $1\frac{1}{8}$ per cent. is approximately the recent annual rate of increase for twenty-six countries, it is only about six-sevenths of a per cent. for the whole world. We get an idea of the significance of these rates by asking in what time the population would double itself, if they held good. It is sufficient to mention that 1 per cent. means doubling in 69.66 years.² Hence, supposing Man started from a single pair, it has to be doubled only thirty times to give a population of 2,147,483,648, that is more people than the world yet contains. This means that a rate of increase of 1 per cent. would give a population of over 2147 millions in 2090 years.

We get also, and very readily, a clear idea of the extraordinary slowness of the average rate of growth of the world's population by making any plausible assumptions as to the length of time Man has been on the planet. If this was only 100,000 years, and he sprang from one pair only, then his average rate of increase was only about one-fiftieth of a per cent. annually, or 2 per 10,000 per year. If, however, he has been on the earth as much as one million years, his increase-rate was only one five-hundredth of a per cent., instead of about 1 per cent. as at the beginning of this century. In other words, every

¹ See *Mathematical Theory of Population*, Appendix to Report on 1911 Australian Census, G. H. Knibbs, p. 31.

² The rate 0.864 per cent. doubles the population in 80.54 years; 1.000 per cent. in 69.66 years; and 1.159 per cent. in 60.22 years.

100,000 persons became only 100,002 after the lapse of a year.

It is when we realise how extraordinarily slow Man's average rate of numerical increase has been in the past, that we grasp the true significance of his rate of increase during last century and during the century on which we have entered. For the latter rate would have given the world its existing population in about 2000 years. With such a fact in view, and remembering that we start now with, say, 1950 millions, we cannot escape seeing that the world's future is ominous. Thus suppose that the rate of increase was, as mentioned, about 0.864 per cent. it would double its population every 80.54 years, and thus we should have, were such increase possible, the following astonishing figures for the earth's population, at the date-years indicated, viz. :—

Date-years	1928	2008	2089	2169	2250	2330
Millions -	1950	3900	7800	15,600*	31,200*	62,400*

It will be shown later that the figures marked with asterisks are not possible populations for this earth; and thus we are driven to ask, "What then will bring about the limitation of human reproduction?"

The existing situation may be stated in another way. The human race has reached a rate of increase which is not only enormously great as compared with its average rate in the past; it is also one which cannot possibly extend far into the future, indeed it cannot continue for two centuries!

The traces which still remain of past civilisations suggest that circumstances formerly existed which profoundly reacted upon the rate of human increase. Of these, however, we have no reliable record. Either life on earth has been subject to great vicissitudes, of which historically we know practically nothing—possibly some geological evidences remain—or else Man's powers of

self-destruction have been evoked from time to time, so as virtually to annihilate successive civilisations. Or again, it is not improbable that various kinds of diseases and plagues have acquired from time to time a virulence which he could not withstand. The modern history of epidemics indicates that their fluctuations are very extraordinary, and it is not unlikely that in prehistoric days the human being was less efficient in spontaneously developing protective reactions against a menacing environment. That he had large animals among his living enemies is evident from their remains; but the nature of his struggle with them can hardly be conjectured. To-day, however, they have practically disappeared, and the total loss from venomous reptiles, or ferocious animals, is relatively small. What he suffered from insects we have no idea, and it may be added that entomologists are by no means certain that in the future Man has nought to fear from his smaller enemies.

Further, it is by no means impossible that there have been cosmic disasters of which neither historical accounts, nor geological nor astronomical evidences remain. From facts that have come to hand through developments in astronomy and astrophysics, leading to the great surveys now being made of the solar system and of the stellar universe, these can be readily visualised. The present intense activity of the solar surface, and the changes that are taking place thereon, have been studied for only a few decades. It is becoming increasingly evident that climatological changes on the earth are largely due to physical alterations in the sun, and to variations in the energy radiated from its surface. It is likely that all manifestations of life are correlated with the energies received from the centre of our solar system, but so far we do not know whether Man's actual power to increase his numbers is *wholly* dependent upon great meteorological factors

or not, except as they directly affect his food-supply. That we are partly dependent thereon is of course self-evident. But we are only beginning to study the physical conditions of our earth. It is already felt that the future of climatology is subject to a better knowledge of the energies which reach us from space.

As regards the psychical factors which play their part in Man's increase, it is perhaps fairly correct to assume that his *intrinsic* character to-day is not sensibly different from what it was, say, 10,000 years ago. Particular manifestations of human nature vary, but so far as history throws any light upon the subject, it does not appear that man's real character has changed materially. Whether the procreative urge is unchanging or not, we cannot say. The complex interests of modern life may perhaps affect it.

A study of Man's relatively rapid numerical growth recently shows that it is doubtless due to his accessions of knowledge, particularly those occurring during the nineteenth century. The earth is richer than he knew; his power to do what he desires is greater. He has learnt that quite recondite ideas are of practical value. Applied to the field of what he has discovered in regard to Nature, it has taught him that she is niggardly, often simply because he is ignorant. As a fact his increased knowledge has enabled him to exploit more successfully his complex environment. Much of what he formerly regarded as waste turns out to be of considerable value. Already this has borne fruit in enabling him to live a richer life; and a greater number can enjoy this life than ever before. The accumulations of knowledge are potentially stores of material wealth. We do not of course know the limit of this development. Naturally Man's faith in the possibilities of his earth have become vastly greater, and the more sanguine spirits among those versed in

scientific knowledge believe that the future will greatly transcend what we witness to-day. We do well to remember, however, that the possibilities are, after all, limited by the nature not only of Man himself, but also of his environment.

There is no reason whatever to believe that the old civilisations of China, India, Babylon, Egypt, Peru and Mexico attained to anything like the great developments in science and invention which are characteristic of modern times. All available historic records indicate that recent human progress is unique. Man is living in a larger and more difficult world than in the past, and apparently for the first time. And to-day his great problem is how to carry on the issues he has raised. His intelligence compels him to have regard to the significance of this problem.

When the question of the world's past is reviewed in a large way, one realises that the vicissitudes of Nature, with which we are familiar through meteorological studies, may possibly have greatly checked human increase. On the other hand, however, the developments of agriculture, the facilities for transportation which enable commodities to be transferred readily to wherever they are found to be most serviceable, and those accessions of knowledge which have made the earth more productive—for example, schemes of irrigation and fertilisation—open up possibilities of supporting larger populations. The limits of this possibility are by no means definite.

There is, moreover, another side to the whole question. Human desires have no intrinsic limit. Man tends to surround himself with more than is necessary for the maintenance of life. He desires luxuries, not only in foods but also in clothing, housing and mode of living. Compared even with the general conditions of living but two or three hundred years ago, the elaborations of modern civilisation are very striking.

Thus unquestionably no inconsiderable portion of human effort goes into the development of "luxury"; and not unfrequently this portion could have gone into the development of a larger amount of food and into the maintenance of more offspring.

Man has also greatly lengthened his life by better national and individual hygiene. This affects his economic power and efficiency, and perhaps also his possible reproductive efficiency.

As soon as the existing facts of man's increase in numbers are viewed in their proper perspective in the picture of man's earth-life, the significance of them for man's future becomes, as above said, vividly apparent. The problems of that future loom large and seem gravely impressive, and this question of the future is not a mere academic one, nor is it one of small practical moment. Already it is influencing the national policy of peoples who are governed or influenced by a class capable of being affected by looking into the future, and considering its probabilities.

There are already a number of territories so peopled that they can no longer provide directly, by existing methods, the food-supplies needed by their inhabitants. They have become, as things are, dependent upon resources obtained from other territories through the exchange of their commodities not directly supporting life, for those which do. They are thus immediately affected by the developments, and by their attitude to them, of the people of such other territories, and by their productions. In this connection it is to be observed that, with the world's growing population, food-production difficulties are already coming into evidence. Migration questions are also arising, and the significance of racial, linguistic, social and economic differences is already impressing itself upon thoughtful citizens. Even as regards language manifest difficulties are arising in the modern world. For instance,

Prof. Joji Sakurai, speaking recently at the third Pacific Science Congress, 1926, said: "Multiplicity of languages is one of the greatest misfortunes of man"; and, it may be added, he gives cogent reasons for his view.

Do these things matter? One is assuredly compelled to realise that, so long as communities—races or nations—are individualistic, the instinct of self-preservation must inevitably operate. For this reason, with Man's present outlook, collisions of races or peoples are almost unavoidable, and his social and economic organisation in no way tides him over the difficulty. Notwithstanding that the world's populations are recognising more and more that a world-solidarity is rapidly developing, and that human interests generally have become a complex in which all have the deepest interest, the individualistic point of view still menaces the well-being of the whole. National megalomanias and economic greeds make even a fancied danger of a collision of interest a cause of disturbance, and they prompt situations that will almost certainly lead to catastrophe.

For the reasons indicated thus far, Man must perforce in the very near future undertake surveys of the world's possibilities of population and of the facts of its distributions and growth. We are involved in all the consequences of diverse racial characteristics, of diverse social and ethical ideals, and of diverse economic developments. Though really cultured men of high character are sensibly the same the world over, this is by no means true of the masses. A highly civilised people finds little in common with a so-called barbaric people. It is astonishing, too, that mere differences of language awaken distrust and arouse prejudice. By a trick of national vanity, any one people is tempted to compare its best with the common sort of another people, notwithstanding that all in-

formed men are aware that fine characters are much alike and that all the anti-social elements in different countries are similar to each other.

One sees then that, not only must Man face at once a study of the world's possibilities of population, he must, as a part of this, face also the question of the migration of populations. This last reacts on the whole question. To ascertain how many human beings can ultimately live upon the earth, one has to postulate that all avoidable causes of variation in the density of population have been adjusted, as far as that is possible. This latter question is by no means a simple one.

What has now been outlined reveals the importance and the urgency of a study of the World's Future from many points of view, and we propose now to consider that future from the standpoint of population itself. Of all questions that challenge the attention of Man, this occupies a unique place, and the world's statesmen are realising it.

CHAPTER II

DISTRIBUTION OF THE WORLD'S POPULATION

THE world's total population, roughly about 1950 millions, is very unevenly distributed. It is divided by the speaking of many languages; it exhibits diverse racial characteristics; and sections of it have attained to widely different degrees of culture and civilisation.

From the minute point of view the world's physical features are very varied.¹ From a world point of view, however, human beings are relatively but the merest specks on the earth's surface, and the earth's physical features, though relatively smooth compared with it directly, are imposing enough to man. His distribution and his activities are greatly influenced, therefore, by the character of the surface on which he dwells. It is well to bear in mind, however, that, judged from a cosmic point of view, man is but a mere micro-organism and his population-number of 1,950,000,000 is utterly insignificant. The duration of an individual life, compared with the totality of Man's life on earth, is also an insignificant fraction. For example, if he be taken to live on the average say fifty years—more than

¹ Looked at as a whole, the earth is nearly an ellipsoid of revolution, with a polar diameter that is less than its equatorial diameter by about the $1/293.5$ part. To the eye sensibly a sphere, its highest mountain is about $1/1443$ part of the diameter of the sphere. Represented by a globe one foot in diameter, this greatest height would be only $1/120$ part of an inch. On such a scale therefore the earth-globe would look smooth. Taking man's height as, say, 5 ft. 6 in., he would be less than one five-thousandth of this, more exactly $1/5273$. Thus on the scale of the globe one foot in diameter, he would be less than one six-hundred-thousandth of an inch ($1/634,045$ in.), that is to say, quite ultra-microscopic.

the true average—an individual life would be only one two-hundredth of the period of authentic history. If Man's life-history has extended over a million years, it is only one twenty-thousandth. When these facts are kept in view we perhaps reach a better perspective for the purposes of a larger study of human affairs, and are delivered from the temptation to over-emphasise the world-significance of human tragedies. Doubtless, from the widest point of view, the obliteration of the whole solar system is insignificant. This, however, is not for us.

To return to the question of the effect of the earth's physical features, etc., and of its various linguistic, political and other divisions; these are so diverse that its areas differ greatly as regards their fitness for human habitation. So great are the causes of diversity in the nature of human occupation, that even countries of great size do not give at all similar figures for the densities of their population-distributions. Taking even the largest divisions, the world-average of about 37 persons per square mile is widely departed from. The order of density per square mile for the several continents is as follows :—

Europe	127·6	Africa	10·6
Asia	65·3	South America	9·5
North and Central America	17·6	Oceania, etc.	2·8

In the order of their aggregate populations in millions, these territories are ¹:—

Asia	1041·8	Africa	134·0
Europe	494·2	South America	67·9
North and Central America	157·0	Oceania, etc.	9·5

When smaller and yet still large units of territory

¹ The population of Asia is possibly understated. A recent count of China's population shows that it is very much greater than was thought recently.

are considered, a greater range of density appears, as one would of course expect. Thus for countries of relatively dense populations, where the latter exceed say about two million persons, the numbers per square mile are as follows:—

England and Wales	671	France	192
Belgium	665	Portugal	170
Netherlands	562	Cochin-China	151
Germany	347	Rumania	142
Italy	340	Bulgaria	138
Japan	320	Annam	130
Czecho-Slovakia	265	Jugo-Slavia	125
Switzerland	247	Greece	124
Hungary	233	Turkey	124
British India	226	Spain	114
Austria	202	Georgia	102
Denmark	202	Cuba	79
Haiti	199	Latvia	74
Ceylon	198	U.S.A.	39
Poland	195		

Countries of over a million inhabitants, but smaller than the above, and with two exceptions of less population-density, with however over 10 persons per square mile, are:—

Porto Rico	379	Uruguay	23
Salvador	124	Norway	21
Azerbaijan	68	Upper Volta	21
Esthonia	61	Paraguay	15
Liberia	58	Colombia	15
Sierra Leone	50	Chile	14
Guatemala	47	Ivory Coast	14
Tunis	45	New Zealand	14
Lithuania	37	Kenya	12
Nyasaland	32	Tanganyika	12
Finland	26	Ecuador	11
Gold Coast	26	Peru	10

There are also countries, with populations of a million and over, with a density of less than 10 persons per square mile. These are:—

Belgian Congo	9·4	Anglo-Egypt, Sudan	6·4
Brazil	9·3	Rhodesia	4·6
French Cameroons	9·0	French Equat. Africa	3·2
Angola	8·7	Terr. Niger	3·0
Argentine Republic	8·6	Canada	2·6
Portuguese E. Africa	7·3	Australia	2·1
Arabia	7·0	Russia in Asia	1·4
Venezuela	6·5	Tripolitania	1·3

Smaller populations and areas afford examples of still greater density of occupation. The following are examples:—

Macao	18,717	Bermudas	1,461
Gibraltar	10,383	French India	1,393
Monaco	2,769	Kwan Chau Wan	1,079
Hong-Kong	2,236	Barbados	977
Kwantung	1,963	Martinique	635
Malta	1,842	Straits Settlements	611

On the other hand, very cold and desert regions afford examples of very slight population-density. Thus we have:—

Very cold countries.		Desert countries.	
Iceland	2·5	Arabia	7·0
Russia in Asia	1·4	Italian Somaliland	6·5
Greenland	0·3	French Equat. Africa	3·2
Alaska	0·09	Tripolitania	1·3
Spitzbergen	0·05	French Sahara	0·4

The preceding examples are sufficient to illustrate the great diversity in the density of the distribution of the human race; they also may be taken to indicate that, at any given point of time, the actual capacity of different parts of the earth's surface to carry population

varies greatly. The differences, however, are not by any means solely due to the physical differences of that surface. They are affected by the degree of civilisation attained, by the capacity for civilised life, by the prevailing standards-of-living, and by the nature of human activities. Japan and her dependencies have no less than 320 per square mile; British India has 226; Ceylon has 198; Tongking has 182. These are instances where the standards-of-living do not make great demands upon the natural resources of the territory. The very elementary wants of the inhabitants make it possible for large numbers to occupy very small areas, a common phenomenon in China, India and Japan.

When a comprehensive survey of the densities of existing human populations is made, it becomes evident that the natural resources of the areas they occupy cannot of themselves support these populations in foodstuffs. In other countries the territories can support them, but the natural resources are only just sufficient; in others again the resources are but moderately drawn upon; in some cases the natural resources greatly exceed the population requirements. In general, it may be said that no simple relation exists between a territory's capacity to carry population and its actual population-density. It does not depend solely upon the physical characters of the territory itself.

It is worthy of note here, that increasing knowledge of the nature of the earth's crust, and of the forms of life existing upon its surface, have made territories, formerly useless, now available for human occupation. The discoveries, for example, of artesian supplies in America, Africa and Australia, have opened up regions which had appeared to be quite useless. Great irrigation schemes have successfully met various dangers to human life, and have enormously increased the numbers that can live in the territories served by them. Again,

the discoveries of methods of combating yellow-fever, sleeping-sickness, hookworm, malaria, filariasis, etc., have rendered many territories much safer for habitation—territories which formerly were so dangerous as to be virtually uninhabitable. To put the matter more briefly, advances in medicine and hygiene, by diminishing the risks of life, and in science and its applications by increasing human wealth, have already achieved much in helping the world to carry a considerably larger population. And it is this fact which appears strikingly in the astonishing collateral advance of population which has characterised the nineteenth century—viz., an annual increase of about six-sevenths of 1 per cent.

It is obvious that, as the world's population develops, the actual population-densities in the different regions tend to approach the population-carrying capacities under the existing conditions. Since this is inevitable, the question of the migration of human beings is at once raised. Behind this, too, lies the measures of response to the reproductive instinct which are characteristic of different peoples. What is the multiplying power of various races under the various conditions that are possible on earth? This, it may be said, is—as it is in all forms of life—vastly greater than the food-conditions of the earth will permit to be realised. In Chapter I we have already seen that rates of increase recently experienced, could they possibly continue, would inevitably involve the world in difficulty. Adequate food-supplies are not possible. Man's reproductive powers are held in check by what has been called "the niggardliness of Nature." How, we may ask, does Nature hold in check all undue increase? It is immediately evident that to answer this we shall have to make the survey of world-conditions cover many matters which at first, or on a superficial view, might have been thought quite irrelevant. In our

present state of knowledge, and with the very limited ordination of human effort, an exact estimate cannot be given of the world's possible limits of population. Nevertheless a sufficient indication, depending upon certain contingencies, can be given.

CHAPTER III

MAN'S AGRICULTURAL, FORESTAL AND ANIMAL NEEDS

ANY attempt accurately to estimate the population-carrying power of the world, requires that account shall be taken both of Man's agricultural and his forestal needs, and, as life is organised at present, account must also be taken of animals required for transport, for clothing, for food, and for other and minor purposes.

There can be little doubt that as the world's population-density increases, Man will become more vegetarian in his diet, for this will better economise his energy and the earth-space per capita which he must occupy. He will also use fewer animals for transport. Existing statistical returns for examining relevant facts are unfortunately by no means complete, but as regards existing numbers, the following have been recently recorded (1921), the unit being a million:—

Year.	Horses.	Cattle.	Sheep.	Goats.	Pigs.	Total.
1911	89·1	539·0	446·6	107·6	158·2	1340·5 millions.
1921	99·8	510·9	532·2	116·8	208·7	1468·4 „

Besides these, are those animals of which no record has yet been obtained. There are also considerable numbers of asses, buffaloes, camels, caribou, deer, elks, elephants, llamas, reindeer, etc., for some of which there are no statistical records whatsoever. For 1922, the number of 36·40 million buffaloes was recorded and also 1·14 million camels, but these were not the complete totals. The aggregate for the larger animals probably closely approximates to the 1950 millions representing the human total, and

it is to be remembered that the land-areas have to provide for all of these.

The rate of increase of horses, cattle, sheep and pigs combined, from 1911 to 1921, was about 0.923 per cent. per annum, but from 1913 to 1925 was only 0.355 per cent. per annum. In countries subject to droughts, the numbers of cattle and sheep are found to vary enormously.

Regarding provision for animals and their food, it may be noted that there is a certain scheme of exchange in Nature in respect of the vitamins produced by animals and existing in vegetables. It is not simply their energy-values that need to be taken account of when foods are considered since their vitamin constituents are important. For this reason animals will always be required. The existing state of things in this respect, however, is by no means the best possible. It may be noted also that, whatever advance may be made by substituting mechanical energy for animal power, a considerable number of animals will be required always; and this fact ought not to be overlooked.

From the point of view of food-supply, it may be observed that sea-mammals, fish, and sea-products generally, will doubtless be drawn upon in future to a very much greater extent than in the past. They will be used for general purposes as well. The possibilities of progress in these directions may be considerable, and possibly can fairly well be gauged from existing human experience. Life in the sea-world is already held in check by factors operating within its own domain. The multiplying powers of fish are so enormous that, but for their consuming one another, the space they occupy would become inadequate in a few decades. Industrial uses may be found for certain predatory fish; in this way no doubt a larger use may be made of food-fishes than is now possible. That the possibilities

of food-supplies may in this way be increased is obvious. It is not easy, however, accurately to determine to what extent this will ease the situation. What is known of the cod-fisheries shows that the possibilities can easily be over-rated, and we are disposed to think that, taking into account all the facts, the possibilities of exploiting the oceans will not materially alter the situation in respect of man's fundamental needs. Moreover, however great within the limits of human possibilities this source of food-supply may become, it will always, we venture to think, be small as compared with land-supplies. The experience of such countries as Japan tends to confirm this.

To obtain a concrete idea of the areas really needed for agriculture, for forests, etc., for Man's various needs, unfortunately, we have to depend upon very partial statistics. To get these into due perspective, it has to be remembered that the earth's entire surface is only 197·05 million square miles, and that the land-surface is only about one-fourth of this. More accurately, and neglecting some portion of the polar areas, it is 52·5 million square miles. Quite a considerable portion of this, however, is rocky surface or it is desert, sandy, or barren. And here, again, statistics though good are incomplete. Thus out of a *recorded* total of 24·13 million square miles, about 7·53 are regarded as productive, 6·25 as unproductive, and the nature of the balance of 10·35 is unspecified.

This recorded total embraced areas the populations of which were then roughly 777·6 millions or about 40·9 per cent. of the world's total at the time. The aggregate area was 46·0 per cent. of the whole. In view of this, and having regard to the characteristics of the countries not included, the proportions furnished by existing statistics may be assumed fairly well to represent the total surface of the earth. On this assumption we obtain, in millions of square miles, the

following results for the subdivision of the earth's land-surface into different classes of area:—

Total 52·5.—Unspecified 22·5, Non-productive 13·6, Productive 16·4.

Productive 16·4.—Pastures 2·8, Shrubs 0·2, Forest 7·3, Marsh 1·0, Arable 5·1.

Arable 5·1.—Grasses 0·79, Foods 0·39, Industrial 0·37, Seeds 0·02, Cereals 3·53.

Thus we may say that at the present time the arable lands form only about one-tenth of the whole land-surface. The available area for the effective use of human beings is thus seen to be very limited. In this connection it is to be remarked that for different countries the percentages available for food-crops varies enormously. For example, while for Tunis it is only 0·1, for Czecho-Slovakia it is 43·1, for the whole world it may be taken as somewhat under 8 per cent. The productivity of various areas also differs as much as seven times. This matter will be dealt with more fully in a later chapter.

A merely cursory glance at the above figures may at first suggest that the possibilities of developing the world's agriculture are very great. Such an inference, however, is not valid.

It would not, of course, be quite accurate to apply the results of a statistical survey of only 46 per cent. of the world's surface to the entire area of that surface. It may nevertheless be taken as a rough guide. Applying it, we get the following results:—

Total.	Productive.	Non-productive.	Not specified.
52·5	16·4	13·6	22·5 million square miles.
100·0	31·2	25·9	42·9 per cent.

How far the unspecified areas may be made to contribute to the productive or arable areas we are unable to say. It is, however, clear that we should regard the

31·2 per cent. as probably too small to represent the ultimate possibility of the world's productive surface.

By way of illustration it will suffice to consider two countries, say Japan and the United States of America, and the data for Japan will be reviewed first.

Japan proper had an area of 147,650 square miles and a population, at the time the statistics were compiled, of 55·961 millions. From the standpoint of agriculture, if we retain the world-divisions as above indicated, the area may be subdivided as in the table following. The figures given are in square miles.

Productive.	Unproductive.	Unspecified.	Total.
115,560	1,520	30,480	147,650 square miles.
78·32	1·03	20·65	100·00 per cent.

The productive area, in this case relatively very large, may be divided approximately as follows:—

Total productive.	Arable.	Pasture.	Shrubs, etc.	Forest.	Marsh.
115,560	27,155	172	2,361	71,926	14,036 square miles.
100·0	23·48	0·15	2·04	62·19	12·14 per cent.

The arable land was utilised approximately as follows:—

Total arable.	Cereals, etc.	Food.	Industrial.	Fallow.	Others.
27,155	20,138	4,516	866	1,622	13 square miles.
100·0	74·16	16·63	3·19	5·97	0·05 per cent.

These figures show that the unproductive and unspecified areas added together amount only to 21·68 per cent. of the whole. The proportion of this really utilisable, even at very great trouble, is probably not large. Of the so-called productive area, woods and forests occupy no less than 62·19 per cent. It is, of course, possible that some portion of this could with more or less difficulty be used for cultivation. But the population conditions of Japan have been difficult for some time past. It is evident therefore that a material increase in the quantity of arable land cannot

easily be made. As Man lives at present, forests cannot be dispensed with. And in Japan, and several other countries, practically all land available for the growth of food-stuffs has been utilised. It is not simply a question whether more food-stuffs can be grown or not, but whether they can be profitably grown. The results must be sufficient to reward the effort. We have to remember that the areas now cultivated have been selected for their fitness, and those left uncultivated have been such as do not warrant their use in this way, under the conditions which at present govern human effort.

Out of the total arable land, no less than 90.79 per cent. is used for cereals and food-crops. An examination of the whole of the data makes it quite evident that any possible variation, by human effort, of the above areas can bring about but relatively small changes. The Japanese Department of Agriculture hopes, of course, still to improve the agriculture of the country, but well-informed Japanese think that, relatively, the total effect will be inconsiderable. Already Japan uses, exclusive of chemical manures, large quantities of fertilising agents over the whole of her cultivated areas. For each inhabitant the area devoted to the growth of her cereals and food-crops averages an area equal to a square the sides of which are slightly less than 111 feet. The survey of the whole situation does not offer any ground for believing that the future will be characterised by material changes for the better.

Moreover when one considers possible extensions of agricultural area, it is quickly realised that, as already pointed out, there are conditions to be fulfilled. Thus the land must not be quite infertile and must not be too stony or hilly for cultivation; it must either have a sufficient rainfall or must be irrigable; and the supply of water for particular crops, and at the growing

season for them, must not be less than a certain minimum. Finally, the crop produced must at least pay for the labour of cultivation. In connection with this last condition, however, popular ideas as to what constitutes a "reasonable standard-of-living" affect the issue. This covers not merely food, according to some "dietary standard," but clothing, housing, education and the whole paraphernalia of social life. These are the governing conditions previously referred to.

In this connection it may be mentioned that although the American "dietary standard" is a cheap balanced ratio consisting largely of vegetable products, the energy-value of which is 3500 calories per diem, it cannot be regarded as in any way representing a world-average. The standards of the Chinese, Japanese and Hindu masses are, of course, much lower than this. Even that of Europe is only about 3000 calories per diem.

In regard to living-standards, too, it may further be said that if, as appears to be already beginning, the multitudes of the East should westernise their conceptions as to what constitutes a reasonable standard, the population-problem is at once raised to a plane of greater difficulty. On the other hand, if western races ever abandon both their present love of what may seem to some inordinate luxury, and all useless complication of the paraphernalia of social life, it is certain that the population difficulty, for a time at least, will diminish. It is also temporarily diminished by every betterment in the organisation of human effort in production and distribution, and by success in insuring against the vicissitudes of Nature, which often, in quite a little while, wreck the effect of long periods of effort. Some of the countries considered are subject to repeated periods of calamity.

Turning now to the light which American research

has thrown upon the question of possible future improvements, we note that an analysis has been made by Mr O. E. Baker, the agricultural economist of the Bureau of Agricultural Economics of the United States. This analysis is based largely on the Census results of 1920. And though agricultural production in the United States is believed in certain respects to be efficient, it is said that it is no longer keeping pace with the increasing population. The *per capita* peak was reached about 1906-07, a fact of great and obvious significance.

Baker's important estimate of the present and future possible developments may be clearly shown in the following tabulated form, in which the figures denote millions of acres, and which form purports to show the ultimate possibilities in contrast with the facts existing in 1920:—

Lands as existing in 1920.	And as they may become ultimately.	Per cent.
Highly improved lands 503	may become as much as 800	42.04
Forest cut-over and burnt lands 465	may be reduced to 355	18.65
Unimproved pasture lands 863	may be reduced to 658	34.58
Non-agricultural land 72	may be increased to 90	4.73
Total, in million acres 1903		100.0

The changes indicated can be made by irrigation, drainage, clearing, reducing the forest and desert lands to a minimum amount, making mere pasture- and range-land also a minimum, but allowing for an increase in the areas for cities and villages, for public roads and railways, etc. The whole matter is outlined in "A Graphic Summary of American Agriculture," see *Year Book*, 1921, pp. 407 *et seq.*, and has apparently been carefully considered.

The importance of these particular estimates depends upon the fact that the interests of agriculture have been quite specially promoted in America, and that

the Census of 1920 was sufficiently comprehensive to enable a calculation of high value to be made of the possible future. The areas for cities and villages will change from 10 to 20 million acres, for public roads from 18 to 25, for the railroad right-of-way from 4 to 6 millions, while the desert will be reduced from 40 to 39. Thus, according to Mr Baker, the area for agriculture can be increased from 503 to 800 million acres, in round numbers say about 60 per cent. It follows that on the present lines of human development the ultimate increase in the yields of agriculture can attain only to the same amount. How far the sciences of chemistry and physics and the technology of agriculture can advance this increase, is a point which will be dealt with later. The way in which the estimate touches the problem generally will also be considered hereinafter.

Here it may be mentioned that there are large areas in South America, in Africa, in Russia-in-Asia, and in Australia, which could be agriculturally developed provided certain conditions were fulfilled. These conditions are of a varied character. For example in South America the physical and economic difficulties of conquering the regions drained by the great river-systems, and of dealing with the tropical growths therein, are enormous. They will involve the possession of certain characters in the populations intending to occupy them, such as courage, pertinacity and intelligence, that are not readily found in suitable combinations. The expenditure of considerable amounts of capital is probably also involved, and there are other economic difficulties to be faced. These operate to limit the utilisation of areas which contain necessary physical elements for an advance in the world's total agricultural effort.

Similar remarks apply to South Africa, and indeed Africa generally, and *mutatis mutandis* to Australia.

To place an agricultural population where it can become successful, either by inducing the people of the land to "work on the land," or by promoting immigration of an appropriate character, is by no means a simple matter. It involves expenditures of capital, and is beset with political difficulties and also with educational ones. It has been found that to place men "on the land" without seeing to their general fitness and technical knowledge is a mistake.

In Russia-in-Asia recent political changes, and the want of a general and suitable educational development, offer difficulties, to overcome which the lapse of a considerable period of time will be required. The productivity of the human race, and the rate of its progress, is a complex function of its state of development and of its moral and economic characters.

CHAPTER IV

THE WORLD'S CEREAL AND FOOD-CROPS AND ITS MINERAL NEEDS

IN order to get something like an accurate idea of the possible extent available of the world's surface, for the growth of the cereals and food-crops required to meet its inhabitants' needs, we note that if the land-areas of the whole world, of Japan, and of the United States be compared, we get the following significant facts, viz.:—For the whole earth 31·2 per cent. is actually productive in some way; for the United States, 27·8 per cent., which may ultimately be raised to as much as 42·0 per cent.; and for Japan, 78·3 per cent. The land classed as arable, however, is only 9·98 per cent. for the whole world; 18·39 per cent. for Japan; and as existing in the United States at present 15·17 per cent., which however might possibly be increased to say about 24 per cent. as an ultimate limit. The actual areas utilised for the growth of cereals and food-crops are, however, less than this. For different countries they are, as one would expect, very different proportions of the whole, ranging from less than one in a thousand to over 43 per cent. Thus in many cases the proportion actually cultivated for cereals and food-crops is much greater than the world-average of the land classed as arable. The following table will give a more definite idea of the great range in the proportions devoted solely to the cultivation of cereals and food-crops:—

Percentage of Land occupied with cultivation of Cereals and Food-Crops

Country.	Per cent.	Country.	Per cent.
Czecho-Slovakia	43·1	Fr. Morocco	4·0
Denmark	34·1	Switzerland	3·9
Germany	30·3	South Africa	2·25
Italy	28·1	Canada	2·0
Belgium	27·7	Egypt	1·8
British India	27·6	New Zealand	1·4
Japan	16·7	Chile	0·7
Austria	13·8	Australia	0·4
Sweden	4·3	Tunis	0·1
Argentine	4·2	World	7·66

For the world-average, the percentage of the arable land used for cereals and food-crops is 76·8, that is, 69·2 for cereals, plus 7·6 for other food-crops; hence at the present time these may be taken as about 7·66 per cent. of the world's total land-area. The question arises, "How much may this be increased?" The answer to this question depends, however, upon the standard-of-living assumed to be necessary, and upon future advances in the art of agriculture. The matter will be referred to again later. It is sufficient here to observe that, as any population-limit is approached, the poorer lands will necessarily be more and more included in the agricultural areas. In this connection it is proper to note again that out of the recorded total of 24·13 million square miles of the earth's surface, no less an area than 6·25 million square miles are classed as "unproductive," and 10·35 million square miles are "unspecified": this out of a total land-area of 52·5 million square miles. There is reason to believe, however, that the areas, of which there are no records,

are relatively almost negligible in so far as they are to be counted on for the future supply of food-stuffs. The reason of this is that the statistics cover the more important countries, excepting those in the East. It would be clearly an exaggerated estimate were we to take the entire area as though it were similar to the portion statistically surveyed. Hence we are able to obtain a fairly correct idea of the world's possible output of food-stuffs under existing conditions. We know at least that there are large areas that are practically worthless as far as food-supplies are concerned.

As already pointed out, sea-mammals and fish will doubtless be drawn upon to a much greater extent than at present, not only as food-stuffs but also as fertilisers, as well as for general purposes. This, however, will not greatly alter the situation in respect of the world's population-carrying power. For the purposes of this review of the whole question they need, perhaps, hardly be taken into account. The error of neglecting them cannot be very great, though it is not easy to estimate it with any precision.

Inasmuch as the value, for the support of human life, of given areas of the earth's land-surface differs greatly, we have to be guided not only by the percentage of area available, but by the average-value of that area for food-production. The point may be illustrated, for example, by the very great differences in the yields of any staple crop, say, for example, wheat per acre; though, of course, it must be borne in mind that a particular crop may not be suitable to any given area. In bushels per acre the yield of wheat for different countries averaged in 1921 about as follows:—

Average Bushels of Wheat per acre in 1921

Denmark	51.0	Uruguay	16.4
Netherlands	49.2	Spain	14.0
Belgium	42.2	Jugo-Slavia	13.6
Great Britain	35.4	Australia	13.3
Sweden	34.9	Canada	13.0
Switzerland	32.4	United States	12.7
Germany	30.3	Rumania	12.3
New Zealand	29.9	Algeria	12.0
Egypt	25.4	Fr. Morocco	11.9
France	24.6	Greece	11.3
Czecho-Slovakia	24.1	Argentine	11.1
Japan	21.3	Eur. Russia	10.4
Bulgaria	18.0	U.S. Africa	10.4
Chile	18.0	India	9.7
Austria	17.1	Portugal	7.9
Poland	17.1	Tunis	7.1
Hungary	17.0	Asian Russia	7.0
Italy	16.4	Arith. Average	19.95

This arithmetic average of about 20 bushels per acre would be correct only if the areas in each country were equal. They are of course very different, and when the areas corresponding to the yields quoted are taken into account, the average becomes only 13.27 bushels per acre. In China, which has not been included, as much as 111 bushels have been raised on some small plots. The true world-average is probably slightly over 14 bushels per acre: thus Spain, Jugo-Slavia, Australia and Canada represent the average rate of yield; the United States is slightly below it. An important point to be noted is that the lowest yields are about half the average, and the highest are nearly four times the average. Such results, as have been shown in the above tables, may undoubtedly be still further increased by the use of appropriate natural and artificial fertilisers. They may not in this way be

enormously altered, as some persons have somewhat speculatively supposed, but it has recently been shown that greatly increased yields are at least temporarily attainable with cereals by transplanting. The increased yields are due to the greater root-development thus obtained. The use of carbon dioxide has also led to higher yields. We see, therefore, that improved agricultural technique may yet yield surprising results. Whether on a large scale such results are readily obtainable or not, and whether it is possible to increase yields three- and four-fold permanently or not, it is perhaps too early to say. In any case these results, while they relieve the outlook for the immediate future, do not warrant any disregard for the outlook resulting from population-increase.

It may here be noted that China, which has at any rate till recently produced probably the highest yields, has for many centuries used human waste. Experts have stated that before long this will be a feature of *all* agriculture: world-economics will, it is alleged, make it necessary. There is reason to believe that, in human affairs, waste of material and of effort will continually diminish.

One is reminded also, in this connection, that the extent of the possible use of fertilisers is a factor of great moment. In South Australia, for example, wheat-growing was unprofitable until superphosphates were used; and as soon as they were used the economic position was completely altered for the better. Before passing on, however, to consider the light which the use of manures throws on the world's possibilities of population, some consideration may be given to the magnitude of the production of artificial fertilisers. Statistics are collected regarding these by the International Institute of Agriculture at Rome. For 1920 the production in millions of metric tons—2204·6 lbs.—was as follows:—

Fertiliser.	Weight.	Fertiliser.	Weight.
Natural phosphates	6.912	Norwegian nitrate	
Superphosphate of lime	11.425	of lime	0.312
Basic slag	2.387	Calcium cyanamide	0.542
Natural guano	0.084	Sulphate of ammonia	1.630
Salts of potash	1.189	Sulphur	1.609
Chilean nitrate of soda	7.432	Sulphate of copper	0.166
		Total of above	33.688

This total of a little more than 33 million ordinary tons, probably somewhat short of the true amount, will undoubtedly be greatly increased as population grows, and the increase—so long as it can be maintained—will aid agriculture correspondingly. The elements most needed are nitrogen, potassium and phosphorus. Calcium is of course abundant.

In regard to the first, nitrogen, it may be noted that the total nitrogen content of the earth's atmosphere is about 3920 million million tons, and inasmuch as there is some return to the atmosphere through the agency of anærobic bacteria,¹ it may easily be drawn upon to the extent *per capita* necessary for nitrogen supplies for human needs. Owing to lightning, etc., rain brings down—directly and indirectly—in the form of ammonia, nitric nitrogen and organic nitrogen, the amount of no less than about 300 million tons annually. The amounts are about as follows:—Nitrogen in the form of ammonia, say about 2.8 lbs., in the form of nitrates and nitrites about 1.2 lbs., and in the form of organic nitrogen about 1.3 lbs., all per acre per annum. This means a little over 1½ tons per square mile.

¹ A general survey of "Recent Progress in Soil Biology and Bio-Chemistry" shows that much has still to be learnt regarding the fixation of nitrogen in the soil, and that much existing literature on the subject is invalid.—See S. A. Waksman, *Soil Science*, 25, 29; 1928.

This quantity of 300 million tons annually is, however, for the entire earth's surface; for its land-surface it may be taken to be about 80 million tons. This quantity, however, is not a simple function of the amount of rainfall. It may be added further that the necessary statistical surveys to enable one to state exactly what is available on given areas do not exist. It is seen at once that, in general, the scale of Nature's operations are, compared with Man's, colossal. Eighty million tons annually is, however, only about $2\frac{1}{2}$ times the total weight of chemical fertilisers produced annually. Only a part of the nitrogen arriving on the earth in this way is effective. Considerable loss occurs through drainage, and some return is made to the atmospheric nitrogen through the agency of anærobic organisms, as already stated.

Although a shortage of nitrogen will not occur, the same cannot be said of phosphorus or possibly of potassium. The supplies, economically exploitable, of natural phosphates, of guanos and of bones, are very limited. A shortage must occur in the near future, as those concerned in the phosphate business well realise. There may also be economic difficulties in obtaining phosphorus even where it is known to exist.

The sources of potassium are the ashes of land and marine plants, sea-water, alkaline springs, saline deposits, felspars, micas, wool, etc. Already there are difficulties in obtaining supplies cheaply, but what the economic limits are has not yet appeared. The necessity for supplies of potassium is now better understood than it was even a short period ago, and it is certain that the near future will witness greater effort to solve the problem of securing sufficiently cheap supplies. At the same time it may be noted that the experience of the Chinese appears to show that very high yields can be obtained without artificial fertilisers; and it may be added that should the world's population

become more largely agricultural, the need for new sources of potassium or even for phosphorus may diminish, since they are not lost but are largely returned to the soil.

The facts we have just reviewed indicate, however, that there are after all very real limits to the possibilities of agriculture and to the population that is dependent upon it. The somewhat popular notion that an intensive system of agriculture can be almost illimitably developed, so as to meet all possible difficulties that can arise in respect of food-supplies, is invalid: it is without basis. Indeed to obtain fertilisers economically in sufficient quantity to meet the needs of even a small multiple of the existing 1950 millions of population will be very difficult, and will involve the use of more expensive methods than those characteristic of the present time.

There is, too, a prevailing popular notion that, in some way or other, the developments of science will be such as to meet any difficulty of this kind. It has even been thought that the question of food-supplies can be met in perpetuity, and under all circumstances. This notion has, however, no valid foundation whatsoever. It is one of those surmises for which there is no warrant from any reasonable point of view. It is of course true that, with every accession of scientific and technical knowledge, a possibility of the earth carrying a larger population collaterally arises. The science and invention of the last one hundred years, as already said, have actually enormously increased human population by increasing the food-supply, by making life-conditions better, and by reducing human mortality. But it is inevitable that the rate of such advances will slow down and ultimately that they will cease, in fact in a much shorter time than is popularly believed. Even as far back as the time of Quetelet (1796-1874), a contemporary, Verhulst, submitted a theory that a territory

had a limit to its possible population, and that its rate of growth diminished in the ratio of its possible future increase of numbers to its ultimate population. This has again been advanced by Prof. Pearl and Dr Reed of the Johns Hopkins University, and they have shown that such a law does hold good, with a high approximation, for the yeast organism, and for the fly *Drosophila melanogaster*.

The difficulties of the world's present rate of development are by no means confined to questions of food-supply. A study of the *increasing* rate at which its mineral resources are being used up leads to the same conclusion, viz., that we have before us a troublous future. For be it noted that the rate of exploitation of the earth's resources of coal, oil, iron, copper, zinc, tin, aluminium, and perhaps even of gold, etc., is one that has been increasing, and it cannot possibly go on increasing as it has in the past. The denizens of the earth have greatly raised the standard of living for the higher civilisations. This has attained to a degree of luxury which must perforce come to an end, and that soon. The known supplies of minerals and metals would soon utterly fail, if the *accelerating rates* at which many of them have been recently developed were to be kept up. The exploitation of these has been faster even than the population has grown. It should be noted, however, that such accelerations of the rate at which some of the metals have been used, are unlikely to last for more than a very limited time, and that the supplies of iron and aluminium are practically inexhaustible, while those of copper are very great. The population-possibilities of the earth are such, that the correctives to the present rates of use will come automatically.

It is not proposed here to give examples from the statistics of the Mineral Industry: it must suffice to say that the curves showing the rates of advance are

ominous, to anyone who considers to what they point for the world's future. From the use *per capita* of the metals, etc., this will at once be realised, if we remember to what numbers the population itself will attain, should the rate of increase of the recent past continue *even for a very limited number of decades*, not centuries. This is why a review of the world's recent growth in numbers is a desideratum. We shall recur to this matter later.

Many countries are coming to recognise not only that future agricultural needs are calling for systematic examination, but also that their future supplies of timber are also calling for similar attention. The features of modern life have intensified the demand for this commodity. This, and carelessness in the past, have made reforestation an urgent necessity. Well-organised schemes for minimising the danger of forest-fires, and of avoiding the colossal losses that occur through them, are being developed. Constructional substitutes for timber have been invented, and in the future metal and cement structures will minimise the use of wood. These things help human increase. Nevertheless, the possible expansion-rates of human populations outrange all possible developments in this direction. It ought not to be forgotten, on the other hand, that the forestal areas may have to be encroached upon, in order to increase the arable areas devoted to the growth of food-stuffs. The forestal areas are at present very considerable, but they cannot be very largely encroached upon if supplies of timber are to be maintained on the scale, *per capita*, now characteristic of world-usage.

When we realise that our usage of the world's surface can without doubt be greatly improved upon, we are brought face to face with the fact that we have an urge to elaborate the scheme of our whole life. And not merely to elaborate it. We are reckless with the

resources which our increasing knowledge and power have placed at our disposal. It is only too easy to make the advantages, which accrue through a more sensible use of our earth's surface, disappear. Thus comparing the different standards-of-living which are characteristic of the various peoples of the earth at the present time, we see that there is no fixed limit to human desire for luxury. If, then, we consider the further possible expansion of the spirit of luxuriousness, we recognise that there is no unique solution to the problem before us. For there is no intrinsic limit to human desires, and the luxury of to-day tends to become the penury of to-morrow.

It is because of this that the population-problem is not merely a mathematico-physical one. It involves our whole conception of life. Our social and our ethical traditions are real factors in the adjustment of communities to world-conditions. The evidence of this may be seen in a nation's consideration, for example, of what may reasonably be expected by its citizens in respect of the standard-of-living to which it deems them to be entitled. Thus it immediately affects the solution of the migration question. One nation has experts who solve its population-possibilities on the assumption that its existing mode of living is to continue, whatever may happen elsewhere. Another people object to the rapid influx of others because it affects the non-economic rate, judged by world-standards, at which, for example, even unskilled labour is rewarded.

The significance of the acceleration of the rates of production of the minerals and metals, before referred to, the rate at which forests are being exploited for timber wants and for paper, and indeed also that of the mere rate of human increase, is readily seen by considering the actual meaning of any such rates, in a suitable way. The rate of increase of individual

populations throws light upon the world-possibilities of population generally, and upon the general issues of the future. We shall review, therefore, the population-growth between 1906 and 1911.

For the quinquennium mentioned France was growing at a rate which would double its population only in 436 years, while Canada's rate of growth would double it in 23½ years. From 1790 to 1860 the population of the United States grew at a rate which would double it in less than this, viz., in a little over 22 years, a rate which Australia slightly surpassed in the quinquennium 1887 to 1891 inclusive, her increase-rate being then 3.06 per annum. The rates for different countries are given in the table hereunder, and the number of years requisite for the populations to double, at such rates.

Growth of Populations between 1906 and 1911

Rates per 1000 of population, and years necessary to double

Country.	Rate.	Years.	Country.	Rate.	Years.
France .	1.6	436	Switzerland .	12.1	57½
Jamaica .	2.8	248	Netherlands .	12.2	57
Scotland .	5.5	126	Denmark .	12.6	55½
Norway .	6.6	105	Germany .	13.6	51
Belgium .	6.9	101	Finland .	14.3	49
Italy .	8.0	87	Rumania .	14.8	47
Sweden .	8.4	83	Servia .	15.5	45
Hungary .	8.4	83	Chile .	15.6	45
Austria .	8.6	81	United States	18.2	38½
England & W.	10.4	67	Australia .	20.3	34½
Japan .	10.8	64½	New Zealand	25.6	27½
Wd. Average	11.6	60.1	Canada .	29.8	23½
Ceylon .	12.0	58	Simple Average	12.3	57

We have already dealt with the significance of various rates of increase, and the further elaboration of this

may be remitted to footnote.¹ It will suffice here to observe that had the human race started only from a single pair, it could not increase at 1 per cent. per annum for 10,000 years, for this would require over 248 million million million of our earths to provide material for their bodies. We see how misleading popular conceptions are as to what is

¹ In order to estimate the exact population-effect of various annual rates of increase, from one-half per cent. per annum to 4 per cent., the following table is of service :—

Annual increase per cent.	} 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Years to double	138.96	69.66	46.56	35.00	28.07	23.45	20.15	17.67

From this last table one sees at once the consequences of any particular rate. This, however, involves some calculation. It is more simple to have a table showing, for various date-years, the population to which the world will have attained should certain rates be characteristic of its growth. For this table, given hereunder, we have taken the population for 1928 as about 1950 millions. The numbers are millions.

DEVELOPMENT OF POPULATION AT VARIOUS RATES OF
INCREASE PER CENT. PER YEAR

Year	1930	1950	1975	2000	2025	2050	2075	2100
Rate . 0.5	1970	2175	2465	2792	3163	3,583	4,059	4,598
„ . 0.75	1979	2298	2770	3339	4025	4,852	5,849	7,050
„ . 1.00	1989	2427	3113	3992	5119	6,565	8,419	10,797
„ . 1.25	1999	2563	3496	4770	6507	8,876	12,109*	16,519*
„ . 1.50	2009	2706	3926	5696	8265	11,992*	17,400*	25,246*

* The populations marked with asterisks are not possible for the earth.

The evidence of such a table as this is startling, for it will be noticed that the rates in the table are well within those of the quinquennium 1906 to 1911. Increase, even at the average rate of 1.16 per cent. per annum, cannot last for any length of time, or at the rates of England and Wales, Japan, Ceylon, Switzerland, the Netherlands, Denmark, or Germany, to say nothing of any greater rates. This fact is one that is not commonly realised. It is very significant that the consequences of increase at a continuous and even small rate, over quite moderate periods of time, are not visualised in our everyday thinking. Probably no one, who has not given the matter quite special attention, would be at all startled if he read somewhere that, during the his-

implied by a rate of increase, and how fallacious is the common notion that the recent rates of increase of the earth's inhabitants—given above—are by no means ominous. At the same time it has to be borne in mind that, as the earth's population increases, the difficulty of maintaining the same rate of increase also becomes greater.

torical period of the development of the human race, it was known that its rate of increase had averaged sensibly 1 per cent. per annum. Yet such a statement would be the wildest absurdity, for, taking this as 10,000 years, the whole of the solar system, multiplied many times over, would not make bodies for the population numbers so reached.

For computers it may be of interest to note that an increase of even 1 per cent. leads to large numbers. The log. 1.01^{10000} is 43.213738 , that is, it is the logarithm of 16,358,290, followed by 36 noughts. The earth's average density is about 5.527 times that of water. If we take the latter to weigh 62.321 lbs. per cubic foot, then the earth weighs about 344.48 lbs. per cubic foot of volume on the average. From its dimensions it is thus easy to obtain its total mass. One finds in this way that the logarithm of the number of earths necessary to provide bodies, each of 100 lbs. weight, for the population from a couple, increasing for ten thousand years continually at the rate of 1 per cent. per annum, would be no less than 20.3949644, that is the number is 248,293,000,000,000,000,000, and this would be the number of earths required to provide material for their bodies.

It may be mentioned that during the period 1909 to 1923 the earth's population increased from about 1679.9 millions to about 1841.0 millions, say annually at the rate of 0.656 per cent. or roughly two-thirds of a per cent. per annum. The numbers reached, if this rate, and the larger rate of 1.16 per cent. were maintained, are worthy of note. They mean the doubling of the population in respectively 104.32 and 60.1 years. Starting with 1950 millions for 1928, these rates would give the following populations in millions at the dates indicated hereunder:—

Date-year	1928	2028	2128	2228	2328
Increase, $\frac{2}{3}$ per cent.	1950	3,790	7,365	14,313*	27,817*
Increase, 1.16 per cent.	1950	6,179	19,579*	62,041*	196,590*

The populations marked with asterisks are not possible for the earth. We see from these figures that, with the lower rate, the population would be increased nearly 14.3 times, and with the higher rate over 108 times, in four centuries!

It is only when we recognise the colossal numbers to which progress at what might, at first sight, seem to be quite small rates leads, that the question of the possibilities of the growth of cereals and food-stuffs generally, is seen to be a momentous one for the human race. Fortunately we may rest assured that, when the intelligentsia have fully grasped these facts, they will antagonise themselves to any *laissez-faire* policy, or one which treats the whole matter with indifference. In the next chapter these matters will be more fully considered.

CHAPTER V

HOW POPULATION INCREASES

THE question how any particular population increases, and why its rate of increase may change at different stages of its development, is not only interesting *per se*, it is, as we have seen, a question of great practical importance, and is specially so whenever an attempt is made to forecast its future growth. It may be mentioned that, between 1909 and 1923, the world was increasing at a rate which would double its population in 104.32 years, or say in round numbers 105 years. This may be taken as one of the most recent fairly accurate estimations covering a sufficient period to give results of value.

Accepting this, and assuming—to suppose the impossible—that this rate of increase is to go on unchanged, it is instructive to inquire what the effect would be as regards the total population at different dates, how many persons this would give to the square mile, and further what area, on the average, each would occupy. The answers to these queries enables us better to *envisage the significance of the numbers*. In the table below the date-years are 105 apart, the population being always doubled. The second line gives their numbers in millions. The third is the number per square mile. The fourth gives the side of a square, which each would occupy if they could be distributed uniformly over the 52.5 millions of square miles of land-surface. The fifth line gives the name of the country whose average density of population most nearly agrees with that shown on line three,

and this helps us to give our view a more concrete form.

Date-year	. . .	1928	2033	2138	2243	2348	I.
Population, millions		1950	3900	7800	15,600 *	31,200 *	II.
Per square mile	. . .	37.1	74.3	148.6	297.1 *	594.3 *	III.
Side of square, feet.		866	613	433	306 *	217 *	IV.
Density equals	{	United States.	Russia-in-Europe and Latvia.	Rumania.	Japan.	Netherlands.	} V.

The populations and average densities marked with asterisks are not possible for the whole world. The number of feet giving the side of the square for a single person, takes no account of the fact that a very considerable part of the world-surface is quite uninhabitable, but supposes it all to be uniformly occupied. Thus the figures do not give at all a correct idea of the average available area of *habitable* land. Owing to the vast area of mountainous, rocky, desert and barren character, the real average amount is very much less than that shown.

We have now seen that, even the recent and *apparently* very moderate rate of increase, were it constant, would lead to enormous numbers in two, three, or four centuries. We are thus compelled in this way to face the fact, that such a rate cannot possibly continue for the periods mentioned. Although there are no adequate statistics available, showing over a great length of time how the rates of increase fall off, there has been a very remarkable similarity in the developments of the population of China, and in that of the aggregate of the populations of Australia, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Netherlands, Norway, Portugal, Servia, Spain, Sweden, the United Kingdom and the United States. Thus, accepting not the individual counts but the general trend of the counts given in the Tung-

Hwa-Luh for China's population, the successive value in millions in the two cases are as shown hereunder:—

Correspondence in the Modes of Population-Increase

Date-year for China .	}	1715	1735	1755	1775	1795	1815	1835
Date-year for Europe, etc.	}	1800	1820	1840	1860	1880	1900	1920
Population of China .	}	133	154	187	235	288	348	403
Population of Europe, etc.	}	137	162	196	232	280	347	419

If we reduce the population figures for Europe, etc., so as to make the two aggregates equal for the 120 years covered, it gives a better comparison of form. The bottom figures would then be: 135, 160, 193, 229, 276, 342, and 413.

The present population of China is probably 468 millions, to which it had nearly attained in 1870 (436 millions): its increase had markedly diminished over half a century ago. The above figures show that the population of the western world is revealing something of the same characteristics, in respect of the changes in the rate of increase, that China did about 85 years earlier. This is a striking fact and obviously cannot be ignored by the student of the *mode* of population-increase.

Long ago a much more limited survey of such changes of increase as have just been illustrated, suggested to a Belgian, Verhulst, that any country may be regarded as a sort of totality, analogous in its nature to a restricted region populated by organisms, the mere multiplication of which was continually and increasingly limiting the possibility of their further increase in number. The simplest mode of expressing this idea, is to assume that the group of organisms tend to reproduce themselves, continually reacting to a

reproductive impulse of constant intensity; but at every moment the effectiveness of the impulse is being reduced in the ratio that the further population-possibility of the region, at that moment, bears to the total number which can live therein. Recently Prof. Raymond Pearl and Dr Reed in the United States, Mr Udney Yule in England, and others have systematically examined this supposition; have—following Verhulst—called the curve representing it a “logistic curve,”¹ and have developed formulæ for its application. In character the curve is similar to the “crossover” from one railway line to another line parallel thereto. Initially it is concave upwards; its middle is sensibly linear; after that it becomes convex upwards, and approaches a limiting value asymptotically. That is to say, as time goes on the population-numbers increase more and more rapidly, per unit of time; attain to a maximum rate of increase; then increase more and more slowly as the numbers approach the limiting number of the population.

The plausibility of this view is such that it cannot be passed without comment. The underlying assumption, viz., that human beings can be regarded as organisms, exhibiting essentially constant qualities, living in an environment which also is essentially constant, is certainly not true to a sufficient degree of approximation to warrant its being accepted as representing the facts. The instantaneous rates of increase for the United States for the 10-year periods, which are 5 years on either side of the middle of the years shown in the table hereunder, were actually as indicated

¹ The axis of abscissæ represents time, and the axis of ordinates represents population-numbers. The curve will undoubtedly represent very approximately the growth of, say, micro-organisms, developing in a limited region, where they are exhausting their pabulum by developing. It was found also to represent the mode of increase of the fly *Drosophila melanogaster*, similarly circumstanced.

in the table. If, however, the curve had really harmonised with the assumption mentioned, the "logistic rates," also shown in the table, would have been the ones experienced. When these are compared with the "actual rates" it is seen that they sensibly differ from them. And this difference can be fully explained.

Year	.	1795	1805	1815	1825	1835	1845	1855
Actual rates	.	300	310	286	289	283	307	304
Logistic rates	.	300	298	294	290	284	277	265
Year	.	1855	1865	1875	1885	1895	1905	1915
Actual rates	.	304	204	263	227	188	191	139
Logistic rates	.	265	254	239	220	201	178	156

One sees immediately from the above table that the steady diminution of the rate of increase, characteristic of the logistic rates, does *not really characterise the actual rates* of human increase. Similar examinations of the rates of increase for France, for Australia, and for other places, also show that the assumption does not represent the facts: in other words, human populations certainly do not conform to the law of growth which the logistic curve expresses, excepting accidentally for a limited period.¹

This result is not a merely academic one. It has recently been asserted that the United States can carry a population of not more than 200 millions and it is not impossible that this view may have political consequence. It is evidently already reacting upon the national attitude to questions of migration, etc. The amazing deduction that the United States can never have a greater population than 197·274 millions, that it can never have more than 65·2 persons per

¹ See an article "The growth of human populations, and the laws of their increase," by G. H. Knibbs, in *Metron*, Vol. V, No. 3, 1st Dec. 1925. Also "The laws of growth of a population," *Jour. Amer. Stat. Assoc.*, Dec. 1926, pp. 381-98, and Mar. 1927, pp. 49-59. See also "Is there a biological law of human population growth," by A. B. Wolfe, *Amer. Quart. Jour. Economics*, Vol. XLI, Aug. 1927.

square mile, though England and Wales have no less than 671 per square mile, has been made.

What actually does govern the rate of increase are factors of the following character, viz.:—

- (i) The force of the reproductive impulse which characterises the particular nation or community as a whole, but modified by any contraceptive influences.
- (ii) Its social traditions as to the proper frequency of reproduction, and the constancy of such traditions.
- (iii) The known natural resources of the territory inhabited, and also the success with which they are exploited: both of these are variable factors.
- (iv) The political security and the economic stability of the territory, and all factors which affect these.
- (v) The relative numbers in the community of each sex and age, that is, what has been called "its constitution according to sex and age."
- (vi) The health of the inhabitants at each age and of each sex, and particularly of the females of child-bearing age.
- (vii) The characteristic ages of the males and of the females, at which marriage takes place, which is also a variable factor.

So long as these elements, and any other elements affecting the reproductive function, remain unchanged, the rate of increase will continue uniform. Thus the normal law of increase of a population is what is known as the compound-interest-law, the interest being continually added to the principal. The continuity of a particular series of rates of mortality according to sex and age has not been mentioned,

because it is virtually included in factor (v) above: it of course affects the rate of increase.

An examination of these factors discloses at once that they are liable to be influenced in many ways. For example, in regard to (i), the effectiveness of the reproductive impulse is greatly influenced by social traditions and religious beliefs, etc. It is also limited by the standard-of-living assumed to be necessary, and by the common refusal to subordinate all the more immediate promptings involving expenditure, to the more remote issues of the development of families. In so far as the future is sacrificed to the present, the possibility of population is liable to be hindered.

Matters of this kind are, of course, all reflected in the social outlook of a people. For example, many French people in the near past regarded large families with disfavour, and the economic situation, on a limited view at least, and perhaps actually, appeared to justify the attitude. People who defer marriage, however, until every life-vicissitude appears to be amply provided for, create a tradition which tends greatly to limit the rapidity of increase in population.

Favourable economic conditions tend, of course, to lessen the forces opposing marriage. A study of the correlation of the marriage, the birth, and the increase rates, with the production per head, for example, in Australia, from 1860 to 1923, affords unmistakable evidence of the economic reactions on the rate of increase.¹

The history of the United States of America supplies perhaps one of the best possible examples of the effect of social changes on the rate of population-increase. From 1790 to 1860 there was nearly a constant rate of increase of about 3 per cent. per annum; see the table previously given. It has been pointed out by

¹ See the Australian Commonwealth *Year-Books*, and also *Metron*, Vol. V, No. 3, 1st Dec. 1925, article by G. H. Knibbs.

Mr F. A. Walker, an eminent American statistician and economist, that in 1790 there were in the United States only about 600,000 white families, few either very rich or very poor. Food was abundant, domestic tranquillity prevailed, and both social traditions and religious beliefs encouraged fecundity. The land was but slightly settled, and thus the people occupied what, virtually, was an unrestricted area. Up till the year 1850, particularly in the north, instead of mechanical labour being employed, the farm labourers consisted of young men, who worked for a few years in order to acquire sufficient money to enable them to marry. These conditions enabled the population to increase freely.

Between 1840 and 1850 a change, however, came. Artificial "necessities" were multiplied, domestic service was extended, and women were introduced into factory labour. Then from 1861 to 1865 came the war of secession, which it was estimated caused a defect of 1,765,000 persons at the 1870 census-enumeration, notwithstanding that the immigration from Ireland and Germany had become enormous, as the following table shows:—

Decade ending	}	1830	1840	1850	1860	1870	1880	1890	1900	1910
Immigrants in thousands		143	599	1713	2593	2314	2812	5246	3844	775

Despite the very large numbers of immigrants, the old rate of increase, of about 3 per cent. per annum, was never re-established. There is no doubt that the multiplying power of any people can best be exercised from within itself, if the thrift and energy, and the resolution to live humbly, are there. Probably also these last conditions promote, too, immigration of the best kind for the increase and quality of the population.

Incidentally it may be noted that the fall in immigration, for the decade ending 1870, is an instance con-

forming to the principle just stated in (iv) of the factors above. Touching the matters referred to in (v) and (vi), doubtless better personal hygiene will tend to make a population more efficient, and this also will indirectly tend to bring about more favourable economic conditions. In this connection may be mentioned the recent uprising of the idea of "constructive birth-control," advocated by Dr Marie C. Stopes, Mrs Sanger, and others, and in many countries in Europe. The aim of this is to avoid reproduction, when undesired, with a view to ensuring that the conditions surrounding reproduction shall be more adequately considered, and practically attended to. Reproduction, under better conditions than those at present prevailing, will also tend to increase human efficiency, and will improve the human race probably in every way. On the other hand, however, any widening of the knowledge of contraceptive technique will probably tend to somewhat limit reproduction, at least of the worse kind. Statistical evidence does not yet exist as to the ultimate effect of this movement, hence at present its consequences have to be inferred from general considerations. The importance of attention to constructive birth-control is obvious from such evidence as is given in Dr F. G. Crookshank's *The Mongol in our Midst*, 1925, and also in various studies of the consequences of reproduction from degenerate human beings.

A review of the surface-conditions of various countries shows that many could carry probably much greater populations than they do at the present time, and some could certainly carry very much greater populations, *e.g.*, Russia-in-Asia, the northern part of Asia generally, Persia, Irak, etc., a considerable part of Africa, Canada, Central and South America, Brazil, the Argentine, etc., Australia and New Guinea. Recent advances in hygiene for cold and tropical

regions, a knowledge of methods of combating yellow-fever, sleeping sickness, hookworm, malaria, filariasis, etc., have made it possible to live fairly safely in almost any region. When, therefore, backward peoples advance, or when they are replaced by more capable and sturdy races, who know how to live in, and how to deal with the territories they occupy, and who, moreover, are in earnest about the general purposes of life, then the countries in which they dwell will be greatly improved, and will as a consequence carry many more people to the square mile. The data do not exist for evaluations of these possibilities in detail for given countries and with any given standards-of-living: for this reason any practical estimates have also to be based upon general considerations.

Initially all countries depend upon primary productions, and rely upon the exchange of their commodities, etc., for such secondary productions as they need. Primary production, however, in general, does not lead to dense populations, and it leaves a people largely at the mercy of others in respect of political control, and of the conditions of trade and commerce. It is not too much to say that, when one has regard to the risks of armed conflict, it is also evident that it leaves a people subject to the risk of national ruin. The significance of this matter was ably dealt with, as far back as 1841, by Friedrich List in his *Das nationale System der politischen Oekonomie*. It is because of the limitations and dangers of a dependence solely upon primary productions, that as nations advance they find themselves compelled more and more to become self-supporting, and therefore to promote secondary industries. This in its turn tends greatly to increase the population they can support, provided outlets for their manufactured goods, in return for the raw supplies needed, are found. In recent times the economic history of the United States of America and

that of Germany afford notable examples of changes in the direction of more intense industrial development. It has to be borne in mind, however, that the attempt to support industries by high protective tariffs, without an equally self-denying ordinance being applied in the case of labourers engaged in secondary industries, tends to react in such a way that the conditions will not necessarily develop that are required to ensure a large population for the country in question.

Though the part played in a country's development of population by its measure of industrial advance is of very great importance, there are certain things to be borne in mind. The world, as at present organised, is apt to mislead as to its population possibilities, unless due account be taken of those just referred to. As pointed out by Sir Henry Rew, in his estimate in 1912 of the food-production of the United Kingdom, and by Prof. E. M. East of Harvard, in 1923, in *Mankind at the Cross-roads*, many countries do not themselves supply directly their own food-requirements by agriculture. The United Kingdom was estimated to produce only about 41 per cent. of its needs thus directly. According to Sir Henry Rew, in acres per head, the position of things was as follows:—

Date.	Farm area.	Under plough.	Wheat.	Cattle per head.
Year 1871 . . .	1.18	0.71	0.14	0.20
Year 1911 . . .	0.79	0.36	0.05	0.17

The situation existing was really what has already been stated, viz., that populations with great secondary industrial and similar developments purchase from outside countries much of their required foods, etc., with the products of their secondary industries. Hence, in any endeavour to estimate possible populations, it is but little use comparing merely areas. Switzerland, for example, produces 32.4 bushels per acre, but her cereals and food-crops together cover only 4 per cent.

of her very mountainous territory. Spain and Portugal live practically within themselves. Great Britain, Belgium, Holland, Italy, France and Germany, on the other hand, are supporting their populations largely by the exchange of industrial products for food-stuffs. Before the Great War, Russia and Rumania, and both before and since the war, Australia, the Argentine, Canada and India have supplied great quantities of food-stuffs to the industrial countries, and could probably supply much more whenever world-conditions are favourable.

The fallacy of a somewhat common assumption, viz., that all countries are virtually living, or can live, on their agricultural activity, has been clearly pointed out by Prof. East. The crude form of error in estimates is that a country tilling so many acres is supporting its entire population thereon, and the balance untilled could support per unit of area the same numbers. Japan, for example, East estimates, feeds only 40 millions through the use of her cultivated areas. In the cases shown hereunder his estimates are that the proportions fed through the country's own agriculture are as follows:—

Germany, 72 per cent.; France, 70 per cent.; Italy, 64 per cent.; and Belgium 37 per cent.

and that on the average the area, expressed in acres, devoted to the support of one person is actually

Germany, 2.0; France, 2.3; Italy, 2.4; and Belgium, 1.7.

Higher estimates exist for France; and it is to be noted that Germany's recent improvements in agriculture, by planting out seedlings, etc., will no doubt enable her to meet the agricultural needs of her people more fully. East suggests that for the world as a whole, 2.5 acres per person are necessary. "Can this be

applied in estimating the possible population of the whole world?" This is a question which we must examine.

In the World Population Conference of August and September 1927, we note that H. Brenier takes strong exception to Prof. East's estimate of 2.5 acres being applied to the whole world. It may be, he says, merely the figure for the United States, and he declares that the half (?) of humanity does not eat beef, but eats fish, mentioning the great quantities of fresh-water fish in China. Moreover, the soya bean, containing far more proteid than beef, 33 per cent. as against about 21, gives quicker returns on a far smaller area, and a more nourishing element. Also in Java, people are living *per capita* on about one-fifth of an acre, eating rice. We see at once not only how the standard-of-living comes into the question, but also that advances in practical dietetics come into it also. Diets differ at least according to climates. Maurel (*teste* H. Brenier) estimates that a male weighing 55 kilograms, and performing light work, needs, say, 1650 calories in a hot climate, but as much as 2750 calories in a cold one.

If East's estimate, however, could properly be applied to the entire area of land-surface, 52.5 million square miles, it would indicate that no less than 13,440 millions of inhabitants was the possible limit. But if, on the other hand, it ought to be restricted to the probable total of "productive land," viz., 31.2 per cent. of the above, the possible population would be only about 4200 millions. One sees from this that we must have regard to the possibilities of a better scheme of culture for the world as a whole in order to estimate its possible population.

If the United States proportion of 503 millions of acres of highly improved land, out of a total of 1903 millions, could rightly be taken as representing the

world-average, however, it would make the ultimate total of population possible for the whole world as low as only 3552 millions, see Chapter III. But further, if the supposed possibilities of improvement could reach the 800 millions referred to in that chapter, instead of remaining at 503 millions, this would indicate a limit of 5650 millions of inhabitants. These results, 4200, 3552, and 5650 millions, are all very moderate, as compared with undisciplined speculations on the basis of mere guessing as to how many people the earth can carry. What has been pointed out by H. Brenier, however, indicates that 4200 millions is an underestimate. It is also very probable, as already shown, that the 31.2 per cent. is too low an estimate of the productive surface.

CHAPTER VI

POPULATION AS AFFECTED BY VARIOUS CONDITIONS

THE history of the very remarkable nineteenth century has compelled us to recognise what important factors scientific and technical knowledge and systematic organisation are in enlarging the world's population-carrying capacity. The better correlation of all Man's efforts in connection with his exploitation of Nature's resources generally, and the more efficient use of the earth's surface, are problems already commanding attention. In this connection we may appropriately refer to Man's dependence on cereals.

Cereals play such a rôle in the world's life, that some idea of its population limits may be had by considering what are the possibilities in respect of their production. To enable the relative values to be computed with great rigour, their food-values are of course really required. It happens, however, that the effect of this element is practically negligible, a fact that later will be fairly obvious.

The latest available returns indicate that, omitting China, Siam, and some other countries, for which there are no statistics, the world-production recently was as follows:—

Product.	Wheat.	Rye.	Barley.	Oats.	Maize.	Rice.
Food-value, calories } per lb. .	1560	1611	1525	1553	1710	1640
Million acres cultivated } .	238·7	92·8	64·7	124·5	168·3	123·0
Million tons yield .	89·20	33·15	28·43	53·54	106·98	79·14
Tons per acre .	0·374	0·357	0·439	0·430	0·637	0·643

It may be noted that the yield of wheat and rye could be taken as about 0·365 tons, of barley and oats as

about 0.435 tons, and of maize and rice as about 0.640 tons, each per acre. The maize and rice happen to have the highest food-values, but the locality governs the kind of grain that can best be produced. For this reason no practicable change in the kind of grain grown can be regarded as affecting the above results appreciably.

The total yield in the above table is 390.44 million tons, and represents the requirements of less than, say, 1850 millions of people, about the total corresponding to the date of the returns. Making no allowance for the fact that 1850 millions is too large a number to which to relate the returns—possibly the error caused thereby may be disregarded—each person on the average annually requires, directly and indirectly, 473 lbs. of the mixture of the above cereals, etc. If we take account of the fact that 1850 millions is too large a number, this result should be increased by about, say, 37 per cent. It would thus be about 648 lbs. instead of 473. We are inclined to think that this figure is somewhat excessive.

Man has, of course, out of this to provide for his seed supplies, and also supplies for his dependent animals. In Australia, where meat-eating is considerable, about 342 lbs. is the average quantity per person for direct consumption. Supposing every acre cultivated could be made to grow the world-average of 13.27 bushels, say about 796 lbs., then the available area of 31.2 per cent. of the so-called "productive land," viz., 16.38 millions of square miles, would give, with the requirement of 473 lbs. per person, a possible population of 17,642 millions, or with the larger figure, say about 12,900 millions. Remembering, however, that the "productive area" is enormously greater than the area that could possibly be applied to the growth of cereals, etc., it can be seen that a population of, say, 17,000 millions is unquestionably not even approximately

attainable, human life being organised as at present, and even allowing that 31.2 per cent. is an underestimate.

Continuing still the consideration on the lines indicated here, we note that we must, however, take account of the fact that of the 31.2 per cent. of the so-called "productive land" only 32 per cent. is arable, hence the above estimated 17,642 millions of population is at once reduced to 5645, a figure almost identical with one of the results given in the end of the last chapter. Further, if it were supposed that the United States ratio of 503 to 800 could really be a possibility for the whole of this area, this would raise the limit only to about 8978 millions, an estimate of ultimate population that is very probably fairly accurate, the average standard-of-living remaining as it is at present.

There is still another way by which we can get some idea of this earth's ultimate population. Of the 52.5 millions of square miles of land-surface some amount has to be deducted for rocky and mountainous regions, for deserts, and for cold and arid areas. All of these can never carry more than negligible numbers of human beings. Provision must be made also for necessary forests, and for animals both for food and clothing. Areas for cotton-growing, for sericulture, and for many minor purposes are also required. When an allowance has been made for all of these, the area for agriculture which is to feed all will of course have been materially reduced.

The aspect of the world's possibilities which takes due account of the correlation of all human activities ought to be mentioned, for it very materially affects the possible numbers which the earth can carry, and affects also the rate at which those numbers can increase. For the social organism is so arranged that, to be most efficient, the numbers in industrial occupations, those engaged in distribution, and those engaged

in the forms of agriculture necessary for the production of all forms of food and clothing supplies, would have to be properly correlated and co-ordinated. It is self-evident that it is only in this way that the highest possible measure of efficiency can be reached. Thus the numbers concerned in mere distributing should always be the minimum requisite. This, of course, implies a very highly developed organisation of human effort, and one which minimises as far as possible the limiting effects of national egoisms. Industrial and agricultural production should also be so co-ordinated that the highest food-producing efficiency can be attained. For ordinary industrial purposes aggregation is necessary, the necessities of the case frequently involving the use of land which otherwise could be of agricultural service. We thus see that even with a perfect industrial, distributing and agricultural organisation there is no possibility of using the entire earth's available surface for the production of food-stuffs.

The allowance for rocky, for mountainous, desert and cold regions, for woods and forests, for roads and railways, for factory and residence purposes, will reduce the 52.5 million square miles to the order of one-half, say to 26.25 million square miles or 16,800 million acres. If it be ultimately possible that only two acres will have to be provided per person, which is equivalent to a square of slightly over 295 feet side, the maximum population for the earth would be only 8400 millions.

Or yet again, the actual arable land in Japan proper is, as already said, only 27,155 square miles out of 147,650; say, roughly, 18.4 per cent. Its population is considerable, and its standard of living so simple that the possibilities of using the land agriculturally may be taken as very near to that of the possible maximum for that country. For the world, as we have seen, it is somewhat under 10.0 per cent. For the United States, though by no means for the whole of North

America, it may be taken as over 26 per cent. Obviously something like 15 per cent. is probably too high an estimate of the possible total. Accepting it, the 52·5 million square miles of entire surface become reduced to 7·875 of available surface, that is, 5040 million acres.

It can hardly be assumed as probable that this area can be made to produce more than the equivalent to the average of, say, 14 bushels of wheat per acre. This at the outside, accepting an annual average requirement of, say, 473 lbs. per person as probably fairly correct, would make provision for, say, 1·776 persons, hence the possible population would be 5040—see above—multiplied by 1·776, that is, say, 8950 millions, an estimate which is almost identical with one obtained a little earlier.

The several figures thus far obtained in this review of the possible population of the earth, expressed in millions, are then as follows: 13,440,* 4200, 3552, 5650, 17,642,* 5645, 8978, 8400 and 8950, of which the two largest—marked with asterisks—were recognised as not really possible estimates. The mean of the seven others is 6482 millions. We do not submit this as in any way representing the probable limit.

It has already been indicated that, neglecting the vicissitudes of Nature, “the greatest possible population” is a function of such things as (*a*) the efficiency of human organisation, (*b*) the appropriate localisation of human beings upon the earth, (*c*) the standard-of-living adopted, and (*d*) the degree of freedom of migration attained, for the purpose of permitting any degree of concentration reached in any region to be adjusted to the local population-capacity of other regions. It may again be remarked in this connection, that even differences in language impose real difficulties in making the earth’s inhabitants the largest number possible, and because of this it is not

quite appropriate to indicate any particular number as an actual limiting value: such a value is not unique but is dependent.

Prof. E. M. East has given 5200 millions as his estimate of the limit. His cogent reasons for this figure have been set out in his work, *Mankind at the Crossroads*, already mentioned. These reasons are manifestly based very largely upon the assumption of a status not differing fundamentally from the existing character of our civilisation. Subject to this, it will no doubt command a high degree of assent with anyone who weighs what has been submitted in the work in question. From a review of the whole situation, and taking account of probable advances in the technique of agriculture and in industrial processes generally, the limit may, perhaps, be set somewhat higher, perhaps even as high as 35 per cent. more, say 7020 millions. With a lowering of the standard-of-living it may be made higher yet; and again still higher if all migration difficulties could be completely eliminated. The following numbers are suggested as likely to be possible in the several cases indicated in connection with them, viz.: Prof. East's estimate 5200 millions; allowing for the extension of agricultural areas and some advance in agricultural and general industrial technique, say 7020; allowing for scientific advances more fully—this, of course, is somewhat conjectural—say 9000; and finally allowing for the freest possible migration and the appropriate co-ordination of all human effort, with the complete elimination of the jeopardy of war, so that all effort could be directed to the maintenance of human beings, say 11,000 millions. These numbers are, of course, subject to a considerable measure of uncertainty.

This last estimate is equivalent to each human being occupying on the average only about 3.0 acres, and this area has to provide for his forests and his share in

all the uninhabitable areas of the globe, as well as all that is required for his civilised occupancy. This, of course, may well raise a doubt as to whether it can ever be attained, for it involves a perfecting of human knowledge, of human organisation, and of human character, which transcends all our ordinary conceptions of real possibilities. Existing national egoisms at present make it an impossible estimate.

The world-averages of the population-densities corresponding to the four last-mentioned estimates of possible population are:—

For 5200 millions, 99·0, sensibly the population-density for the Feudatory Independent States, India, viz., 101·2; or of the Philippine Islands, viz., 99·1.

For 7020 millions, 133·7, the population-density for Bulgaria being 137·7, Jugo-Slavia 125·0, and Rumania 142·2.

For 9000 millions, 171·4, the density for Portugal being 170·0.

For 11,000 millions, 209·6, the density for Austria being 201·9, for Hungary 233·0, for British India 225·7.

The world-averages above indicated are an enormous increase on the present world-average of 37, and it is to be observed that it is not possible to distribute human beings at all uniformly upon an earth with so diversified a physical surface, and a surface, too, whose population-carrying power varies so greatly. It is obvious therefore that the density of great areas must be immensely increased, and doubtless some increase would have to occur everywhere.

The considerations submitted clearly show that the numbers of human beings which the world-surface can carry is limited to a relatively small multiple of the existing population.

CHAPTER VII

THE MIGRATION OF POPULATIONS

THE considerations referred to at the close of the preceding chapter raise at once the question of the distribution of the human race over the earth's surface; since to increase Man's numbers greatly his territorial distribution must accord with the potential advantages of each region of that surface. They show, for instance, that to attain even to the population-density of 99.0 per square mile, corresponding to East's estimate, that is about 2.7 times that now existing as an average, vast progress has to be made in human affairs generally, while to attain to the highest limit, or over 5.67 times the existing average density, the co-ordination of all Man's activities will need to be very highly perfected. The great wastage directly and indirectly arising from every form of ruthless competition, which in part is a consequence of his existing distribution, will have to disappear in order to reach the limits in question. Human energies will have to be devoted, not to attaining efficiency in the making of engines of destruction in order to maintain substantially the present features of that distribution, but to correlated studies in the difficult social and economic problems that even now call for solution. Even to-day the social and economic aspects of Man's rapid growth in certain parts of the world, and the necessity of some readjustment of his "scatter" over its surface, constitute problems of great intrinsic difficulty.

We have to face not only the situation as it is, but as it will be in the very near future. The first question

that naturally occurs is, "How quickly can the world advance to such densities as have been referred to, for her peoples?" and the second is, "In what regions will the situation first become one of challenging difficulty?" We may, therefore, perhaps at the risk of being tedious, refer again to the significance of the rates of growth. For the last one hundred years it may be taken as two-thirds of a per cent. per annum. Assuming the world-population for 1928 to be 1950 millions, the four limits 5200, 7020, 9000 and 11,000 would be reached in only 147.6, 192.8, 230.2 and 260.4 years respectively, if the rate continued constant; that is, before the following years of this era, viz., before the year 2076, or 2121, or 2158, or, finally, before 2188. These are but short periods in history; they are very roughly only about one-thirteenth, one-tenth, one-eighth, and one-seventh respectively of the present era of 1928 years.

If the annual rate for the western world from 1906 to 1911, viz., 1.16 per cent. per annum, were to hold continuously for the whole world, these limits would be reached in much less time, viz., in 85.0, 111.1, 132.6 and 150.0 years respectively. It does not materially alleviate the situation, either, to be told that the rates of increase will diminish as the limit, whatever it be, is approached, and that the ultimate figure will be very slowly reached. Long before that figure has been attained the population-difficulty will have become terribly acute, and it has to be borne in mind that, from time to time, the trouble about populations and their food-supplies is certain to be painfully accentuated by the inescapable vicissitudes of Nature. Man can cope with these to some extent, it is true, but, after all, only very inefficiently. He has learnt to modify the disaster coming upon him through a drought, but he cannot wholly escape appalling losses. Recently he has again been reminded

that even the insect-world can menace him. Observation has shown that this menace can develop upon a colossal scale. It is too soon to say whether he will be able to meet this source of trouble or will be overcome thereby. That is the problem for the economic entomologist. Already situations of difficulty have occasionally developed from insect invasions. Will a redistribution of densities of populations in any way alleviate this? If it will, then the migration question takes a place of still greater importance.

As already indicated, the magnitude of recent rates of population-increase has been brought about by Man's inventive powers and by his accessions of knowledge. His ability to utilise the great resources of Nature, often previously undreamt of, has been enhanced in a very extraordinary way. He has learnt, to some extent, to avoid the incidence of her evil inflictions. To a remarkable extent this has been brought about by his migrations from one region to another. He has learnt of the possibilities of new advances and of new dangers, and in facing the menaces that characterised the regions to which he wandered he has acquired knowledge of general value for human increase. *En passant* we may remark that such facts as he has learnt by these experiences show us that the exact dates at which we shall reach given population-numbers cannot be predicted with any precision.

One aspect of the migration question, which informs us of its great importance at the present time, is that certain consequences arise from population-expansions themselves. It has already been noted that some agricultural countries grow more than is needed for their own food-supplies. Such a condition immediately admits of other countries expanding industrially, increasing their numbers and their political power. Increases of material wealth and man-power in the case

of any countries are, however, a source of danger to others in a world where wealth and power are regarded as supreme desiderata; for they confer advantages in the arbitrament of war, should it be resorted to. This, one is compelled to recognise, is a limiting factor, so long as the principle of nationality governs the human race and divides the interests of the world's populations. Thus it is important for certain countries to add to their possible "natural" increase a further increase by immigration. A notable example is Australia, at the present time, with its average density of about two per square mile.

The necessity for emigration and birth-control arises in the following way. Whenever a country develops its agriculture and its industries to the uttermost, and still finds its population increasing beyond the carrying-capacity of its territory, it is immediately faced with two alternatives. Either its excess of population must emigrate, or the excess must be made to vanish by birth-control. The latter is but a partial remedy. It runs counter to natural tendencies. There is no doubt, however, that the more rapidly a people multiply the sooner must come the appropriate measures of birth-control, which with civilised peoples are, in some form or another, always operative.

As soon as, in any country, the condition of relatively dense population, or over-population, arrives, the impulse to emigrate therefrom is stimulated, and countries whose population-carrying capacity is unexhausted tend to be invaded, the tendency—other things being equal—being measured by the difference between their potential and actual populations.¹

¹ If we denote the greatest population a country can carry by P , and its actual population by p , then the measure of the immigration-potential is a function of the quantity $(P - p)/P$. The function, however, is not a simple one.

Such a fact concentrates one's attention upon the nature of the right of occupation of territory.

This *right of occupation* may be regarded from two points of view, one concerning itself with the legal aspect merely, the other concerning itself with the moral aspect, or what may be called the right of the occupants to hold the territory as against all comers, and equitably so from an international or world standpoint. In this connection it is well to bear in mind that, from the widest standpoint, and also from the point of view of a people with insufficient territory for their maintenance and development, the right of the occupants of all territories tends to be regarded, at least by those in overcrowded countries, as relative rather than absolute. And one of the principal measures of the relative right will naturally, and perhaps justly, be conceived to be the effectiveness of occupation. This, however, has to be broadly understood, as we shall see later.

Throughout the world's history, civilised peoples have gone into other countries and have replaced inferior and barbaric peoples. Sturdy, vigorous and informed races have possessed themselves of territories occupied by peoples who do not possess such attributes in the same degree. Recent examples are the United States, South Africa, and Australia. This is a world-advantage.

Wherever the population-density is relatively slight, and that of near countries or regions is relatively great, the condition exists to bring into sharp prominence the issue of migration. The impulsion is reinforced when one of the countries is decidedly over-populated and the other is as obviously under-populated, and particularly so when they are near to one another. Whether such world-conditions are agreeable or not, this is the fact, and it would be fatuous not to keep it in view, a matter which will now be considered.

The principles of the migration question may be thus envisaged:—In a world in which, say, the physical conditions of its surface were homogeneous, inhabited by a race not differentiated in any way with respect to language or economic, political and social character, migrations would of course occur readily. Great diversities of density of population over very large areas would tend automatically to disappear. Man's social instincts lead, however, to concentrations of population, and actual physical conditions are by no means homogeneous. These two factors powerfully influence his movement and affect his choice of location. A good climate and great fertility, or other resources, offer inducements to aggregate densely, while rigour of climate, and the absence of resources easy of exploitation, tend to limit aggregation. Such tendencies, however, are greatly modified by differences of language, differences of political and social tendency, of racial characters and instincts, and also to a considerable extent by the expense and difficulties of transportation, the rupture of social ties, as well as by communal or national prejudices, etc., the last sometimes fully justified, but also often with little real foundation.

It is easily seen that, in the present constitution of the world, collisions of interest are inevitable. And owing partly to the factors mentioned, the world to-day exhibits those great differences in population-density referred to in Chapter II. It may be noted that even within populations which are sensibly homogeneous, and within areas of like physical nature, differences of density can arise from mere diversity of occupation. For example, as before stated, the conditions of agricultural life operate ordinarily to limit the closeness of aggregation, and at best the aggregations can, in general, constitute but small villages. Industrial life and commercial life, on the other hand,

lead to larger and more dense aggregations, and by the sheer influence of numbers, one which can often express itself in the field of politics and otherwise for its own immediate advantage. Such aggregations tend to increase in size, and to attract individuals of certain types of mind and character. This would appear to be inevitable. Ultimately these tendencies frequently produce sharp collisions of interest between the scattered agricultural populations and the dense industrial and commercial ones. The political power of the latter aggregates, especially in so-called democratic communities, tends also to accentuate the diversity by the obtaining of greater privileges and advantages in many ways as compared with the agricultural aggregates. Often, for example, this is expressed by high tariffs, which, as between the two classes, are by no means equitable.

Operating continuously, and over extended periods of time, factors such as have been mentioned, and similar ones, create a distinct heterogeneity, out of what initially were homogeneous groups of people. As a consequence the world now exhibits great diversities of population-density, even where the language and social ideals are, or were, either identical or very similar, and these are not always referable to physical diversities.

The world-situation in respect of these matters is by no means a simple one, or one easy of betterment. Owing to the multiplying power of the human race, the world-populations are already threatened with the difficulties of an adequate provision of food-stuffs, and with the cost and labour of transporting them to the places where they are needed. The question consequently arises, "How shall the population-carrying power be increased without accentuating existing difficulties?" While obviously migration can help, the conditions governing migration are by no

means simple. Racial, linguistic, social, and political hindrances have to be overcome in order to facilitate migration movements. The various peoples of the earth exhibit differences which greatly hinder even their adventitious mixing, to say nothing of a thorough miscegenation. We are not yet assuredly aware whether racial antagonisms are the outward expression of what may be called sub-conscious judgments, or are merely fatuous prejudices which it is desirable should disappear. The proper degree of miscibility of different populations is by no means easily ascertained.

The question of migration, therefore, is bound up with that of the admixtures of peoples. Were they merely geographically divided into groups, but belonging to the one primitive stock, then no doubt the matter would be fraught with much less difficulty than the problem actually existing. Anthropological and anatomical researches, however, indicate that the human race is divided into at least three great groups, their facial appearances being aptly described by Linnæus as those of the *Homo Europæus*, the *Homo Asiaticus*, and the *Homo Afer*. Researches like those of A. de Gobineau into the *Inequality of Human Races*; like those of F. Sievert in *Mongolism*;¹ of J. and R. L. Langdon-Down on the *Ethnic Classification of Idiots*; of G. Pouchet on the *Plurality of the Human Race*; of Sera on the *Morphology of Man and of the Primitives*;² of H. Klaatsch on the *Evolution and Progress of Mankind*; of L. Macauliffe on the origins of actual man;³ of F. G. Crookshank and many others, show unmistakably that the question of the desirability of the miscegenation of different peoples is one demanding consideration. It is not a mere colour question, but one of fundamental characters.

¹ *Die mongoloide Idiotie : der Mongolismus.*

² *Giorn. p. la Morf. dell' Uomo e dei Prim.*, 1918, 1921.

³ *Les Origines de l'homme actuel*, Paris, 1923.

When all the factors are adequately considered, it becomes evident that a world-situation has arisen, such that areas capable of carrying much larger populations cannot be allowed long to remain empty. It is, of course, very foolish to shut one's eyes to this. The economics of the situation point clearly to two issues, one for peoples living in dense aggregates of population, the other for peoples living in sparsely populated areas. For the former birth-control and emigration are appropriate policies ; for the latter a high birth-rate and immigration are needed. It may be taken as certain that any dog-in-the-manger policy by a people, for reasons that take no account of the general situation, will result, sooner or later, in that policy being challenged, and perhaps deservedly so.

It is desirable to review the nature of the factors that are inimical and those that are favourable to increase. But, before doing this, it is advisable to examine the things which tend to limit, and those which tend to assist the multiplication of a people. They are of two kinds, one depending upon man's environment, the other upon his intrinsic characters. To put this in another way, one set of factors are cosmic and impersonal, the other set are human or personal. Both may be described quite briefly, and they are important. They are easily recognised.

As a physically insignificant denizen of the earth, Man is dependent upon the energy, resources, and the vicissitudes of the system of which his earth forms part. He is dependent upon the energies radiating from the sun, perhaps more generally those arriving from space, and upon those also contained within the earth itself, such, for example, as radio-activity, internal heat, etc. He depends, too, upon the material of the earth itself. These, his natural resources, are known only in part ; it is not at all unlikely that his knowledge will be rapidly increased concerning the various forms of

energy, and the possibilities for him of the mineral, vegetable and animal wealth, which potentially is at his command. These are what may be called the environmental factors.

There are also what may be called the human or personal factors, and these are also of the first order of importance. In turning his resources to account Man needs knowledge, inventiveness, and that insight which leads to discovery. He needs also strength of purpose, courage, the capacity to create and to regulate the social organism, and the ethical qualities by means of which all human relationships are ameliorated, and which facilitate both his economic and his social development. All these things affect his scatter upon the earth's surface.

To be most effective in the purposes of life, he must perfect both his physical and his mental organism; in other words a good physical and a good mental hygiene are desiderata which profoundly affect his well-being and the security of his territorial occupation. Clearly he needs also to create and to develop such a scheme of economic and of social relations with his fellows, as will best conserve his energies and render them most fruitful and beneficent. For, by reducing all clashing of interest to a minimum, it becomes possible for his productivity to become a maximum. Thus the attainment of individual, communal, national and international justice, the systematic spread of acquired knowledge, the co-ordination of all effort to secure the most complete acquaintance with his environment, are factors of far-reaching importance. Thrift, self-discipline, energy, habits of perseverance, and indifference to luxury are all conducive to increase of population-density. Thus, as previously indicated, the ethical elements of Man's "make-up" are essential to his well-being. This is a difficulty when we take into account something more than mere numbers in regard

to migration. For the transfer of people with unsuitable ideals into the midst of others of higher status would be a most unsatisfactory migration. We are involved thus in considering aspects of the question which at first sight might appear quite irrelevant.

To consider for a moment the simple matter of the degree of luxury to which a people has become accustomed, the complication of its mode of living, and the consequential effects of these, it is easy to see how these things operate. Increase of population depends mainly upon the frequency of marriage, upon its taking place early, upon its fertility, and upon the age at which that fertility eventuates. A thrifty self-denying people reaches the economic possibility of marriage earlier, while luxuriousness, inordinate love of wealth, marriage with persons of disparate age,¹ etc., all tend to reduce both the frequency of marriage and its fertility when it actually occurs.

The economic load borne by a fertile married people is greater than that which is borne by those of less fertility. Thus personal qualities are factors of very high importance, a fact well illustrated by history. The growth of the population of the United States of America reveals this in a very remarkable way. As was mentioned earlier, from 1790 to 1860 the rate of increase was sensibly uniform, and was no less than a little over 3 per cent. per annum. And since 3 per cent. per annum means the doubling of a population in 23.45 years, the attainment of such a rate involves the exercise of sterling physical and moral qualities. These in their turn have an influence on migration: see the table hereinbefore, Chapter V. (page 58).

Although physical and other complexities in the distribution of the human race over the earth's surface

¹ It has been shown that fecundity depends upon the ages of both husband and wife. See *Mathematical Theory of Population*, sec. Di-isogeny, pp. 349-69, G. H. Knibbs

involve difficulties in attaining to the densest possible population, the best distribution and the most suitable forms of activity are not easily ascertained. They are obscured by the existence of various conflicting interests, and are by no means easy to analyse completely. The different peoples of the earth cannot be regarded as immediately available for any admixture on a large scale, even if the language and political difficulties did not exist. What are known too as "vested interests" greatly intensify other difficulties. The complexity of human interests is very great, but they must be adequately taken into account when considering even the migration question.

At the risk of seeming to be leaving somewhat the matter immediately under review, we note some of the issues that influence peoples, when the consequences of certain policies are considered. In earlier times monarchs counted their subjects and estimated their resources, not always to organise them better for their own good, but in order sometimes to judge of the probability of success in thought-of schemes of war and plunder. To-day such action has by no means really quite vanished; rather, it may be said, often it has only been masked. Monarchs have been more or less replaced by other agencies which really govern peoples. And it may be said that nominal governments may easily be more or less unaware of the operations of the groups of personalities who—usually in more or less direct association—are actually giving direction to, or even controlling, the issues. The operations of these are of course not made patent, and the ethical impulses, awakened in order to justify any developments, are often of an order quite different from those which are really in action as fundamental causes. Such matters as these must necessarily be taken into one's purview in all studies of the characteristics of human relationships. We have to bear in mind that

even migration may be promoted with a sinister intention. It may even happen that one nation is anxious to see migration promoted elsewhere, in order to relieve its own fears of consequences.

The whole plexus of relations which modern transport and economics, and the intricacies of trade and commerce have established, have really welded the peoples of the earth into a kind of pseudo-solidarity. The evidence of this is that disaster to any one people means some measure of disaster to all. By the application of science to industry, and by the magic of invention, the life of humanity has been quickened and enriched, and the possibilities of physical and psychical enjoyment have been promoted. The plane of possible moral and intellectual effort has also been raised. Through this the destinies of the peoples of the earth have become a much deeper and more intricate problem. It is one, however, which needs to be faced. Every day this need becomes more pressing. There is a reason for this. Man's *power to destroy* has been *enormously enhanced* by recent achievements in chemical and physical science. On the other hand, although his *power to ameliorate* and meet all evils has also advanced, the measure of this advance is *relatively insignificant* as compared with his powers of spreading ruin and disaster. As a consequence war has become more pregnant with horror, and more frightful in its effects both material and psychical. In addition to the magnitude of the wreckage actually done, a still greater evil is that war tends to engender perpetual distrust and a sense of insecurity, and further it breeds suspicion and dislike and a deep hatred. These deflect human efforts into a markedly anti-social direction.

Behind evils such as have been referred to lies the spirit of selfishness. Its manifestations are of course protean, and often it is masked behind what, on a superficial view, appears to be a commendable national

spirit. For example, an aggressive nation will often persuade itself—really or apparently—that its domination over others, even by armed threats or by war, will advance the culture of the subjugated peoples. It will perhaps do this even while arguing that all relations between nations are necessarily a-moral, and that “force” is that which must and which ought to decide all issues.

Again, a supposed democratic people, occupying a relatively empty country, may often violently oppose the immigration of peoples who are prepared to work harder, and to live more thriftily and humbly. Such an attitude may also attempt to mask itself by a profession of patriotism. In reality attitudes such as these need to be dissected for motives; they are not always what they seem to be on the surface; and, too, they may ultimately lead to unexpected issues, which are likely to fall not always upon those that develop them, but upon their unfortunate descendants.

To some extent, it may be, Man is involved in conflict, partly through the niggardliness of Nature. Whenever it is realised that the ultimate issue, as between two communities, is necessarily the downfall of one or of the other, doubtless the issue will depend upon intelligently directed force. Possibly the prevailing system of civilisation involves this: but this civilisation has been indicted in Sir Rabindranath Tagore's *Nationalism* (Macmillan, 1918). Without committing oneself in any way unreservedly to Tagore's point of view, he has undoubtedly recognised some of the limitations of western civilisation, and the penalties that have been paid, and doubtless will yet be paid, for its defects. These defects operate to increase the difficulty of migration adjustments.

It is proper to observe, at the same time, that but for the influence of western civilisation upon India, it would have been impossible for her to have maintained

the populations she has carried. These have been due to the greater personal security reached, and to the improvements in irrigation, etc. We are perhaps apt to forget these benefits, when attention is focused upon limitations. As a matter of fact material benefits have been conferred by such migrations as those from West to East. It should perhaps be added that clashes of interests between peoples are inescapable howsoever they are organised. The practical problem is "how to minimise them," not "how they can be completely eliminated." All forms of civilisation have their defects. This is a matter, however, which is outside the limits of the question we are discussing.

In connection with what has been said above, it is appropriate to observe that the cost of preparedness to attack, or to defend, has no intrinsic limit. The cost is an ever-increasing one and becomes appalling. Its essential character tends to render it provocative. Moreover history shows that, for the purposes of war, a people will spend unhesitatingly amounts which they would not merely grudge, but would actually refuse, for the promotion of the arts of peace and for beneficent ends. The colossal expenditures in preparing for war, and also in war itself, would be far more than adequate for all the higher efforts of mankind. War is an uneconomic way of deciding issues, and it must either cease or be more terrible than ever before.

The studies of racial characteristics, of the possibilities of beneficent human intercourse, of the problems of miscegenation, of a better personal, communal, national and international hygiene, of eliminating or ameliorating the more terrible diseases and scourges of mankind, of international economics, and of international relations generally, would all become financially possible were war assuredly obsolete. All these things, though of the highest importance and incalculable value to mankind, are allowed to remain relatively in abeyance,

that Man may prepare more elaborate and terrible engines of destruction, with which one people may confound other peoples and impose its will upon them.

To revert now more directly to the part that the migration of populations can play in bettering the world's future and making it possible to carry a larger number. It is evident, from the issues just referred to, that the question is complicated by the divided interests of the human race, and by the limitations involved in the egoistic view which is characteristic, not merely of individuals, but also of communities and nations. Some matters present themselves for consideration with pertinent insistence, notwithstanding the difficulties which have been mentioned. The inevitable troubles of the human race arising from the necessity of its meeting its needs, if possible, indicate quite clearly that peoples will have to consider the migration question whether they will or no; and they will be well advised if this is done with the world-facts before them, and not from a narrow standpoint. There can be no evading of the real question, viz., that world-conditions are such that the rights of all peoples will have to be equitably considered, if the world desires peace. This involves the full consideration of the admixture of peoples who have attained to very different degrees of culture or civilisation, and it is full of difficulty.

It has lately been pointed out by the Very Rev. Dean Inge that it is possible for immigration to have a very bad effect on the development of a people,¹ and that in certain cases it may be "politically and racially wise" to prevent it. The unrestricted influx into a country of low-grade citizens from other countries will almost invariably tend to diminish the total possible aggregate of the populations of the countries concerned. No country whatever should be ready to

¹ *Scientific Ethics*, 1927, Norman Lockyer Lecture, pp. 14, 15.

absorb the derelict elements of other countries' peoples, if their own progress is to be the criterion of success in the problem of peopling the earth.

There is yet another hindrance to migration, to which attention must perforce be given in the future. Immigrants may be divided into two classes, viz.: (*a*) those who really combine with the people who receive them, and (*b*) those who endeavour to maintain a quasi-separate social and political existence. With the former, the only questions for consideration are those relating to what may be called personal qualities. With the latter, the possession of those personal elements may have to be regarded as quite subordinate to others. For example, certain classes of immigrants have shown a tendency to segregate themselves, and to maintain their own native tongue in order to ensure a differentiation from the people of the country into which they enter. Both prior to and upon the outbreak of war they have acted, not in the interests of the country of their adoption, but as hostile and dangerous groups therein. They have been known even to carry on a system of espionage in the interests of a foreign power.

Here it may be noted also that it is an open declaration of one country that it will do all in its power to spread its political doctrines throughout the world, with a view to changing the existing order of civilisation into one—their own recent forced scheme—which so far has proved a ghastly failure, and has cost an untold number of lives, unspeakable misery, and widespread economic ruin.

The whole situation may be summed up by saying that all immigration which is likely to be characterised by ulterior actions, subversive of the social regime and political development of the recipient people, ought to be met with hostility and prevented. Thus the elimination of such characters in future migration is

an essential to the active relief of difficulties arising through over-dense aggregations of the world's peoples. In this connection it is also to be noted that it has already appeared that persons in one territory, anticipating trouble for itself from population-growth, have advocated that another territory not under its political control directly or indirectly should freely open its borders to immigrants, because, according to the (uninformed) judgments of these persons, the other territory is capable of increasing its population-density. Since, however, the recipient country carries all the economic and political consequences of its immigration policy, such advocacy is unwarrantable, and dictation in the matter would but intensify the difficulties already in existence. Readiness to consign troubles to others is not an unknown feature even in national human conduct.

CHAPTER VIII

INTERNATIONAL ECONOMICS AND MIGRATION

IN a purview of world-affairs the two great elements which stand out unmistakably as calling for serious consideration are of course international economics and migration. The late war has shown that the interests of mankind are so interlocked that war is an international disaster. The wrongs and damage borne even by unoffending parties were such that, so long as the war lasted, innocent individuals were suffering, and however much some nations managed to profit through the calamities of others, and however great the fortunes made by individuals, internationally the war was a disaster of the first order, and its evil fruit is not yet done with.

Since the greater issues between peoples concern their national systems of economics, and the freest possible movement of other peoples through their territories, it will be appropriate to consider these matters, for they must act upon the world's future growth. In regard to economic issues all existing national attitudes are egoistic, and within the nations themselves they are individualistic. Attempts to obtain an undue control of important products, and to take full advantage of such control whenever it can be acquired, have been asserted not only as between nation and nation, but also against one's own nation by its own citizens. As an indication of things that are happening, a system of world-survey of economic developments has already been formulated and put into partial execution, in order to give the nation

which has undertaken it an aperçu of the whole position, so that it can deal with the situation in the immediate interest of its own citizens. For example, in the agricultural survey of the world being undertaken by the Department of Agriculture of the United States of America Mr Michael, the agricultural economist, says that the United States' farmers need it "in order to adjust their production to demands and successfully compete with the farmers of other countries," etc. That is to say, the survey is definitely undertaken in order to secure for the United States a full knowledge of the world's necessities, so that they can efficiently deal with all excess of production when it occurs. At the present time the recognition of future oil requirements is being similarly dealt with. The splendid work of the "International Institute of Agriculture" at Rome has made the world-situation in respect of agriculture clearer, and it is now possible for it to be studied intelligently. Incidentally it has made the "cornering" of cereals and agricultural products generally either impossible or more difficult. Many more examples could be given. It is easy to see that, when all such efforts shall have been co-ordinated in the common interest, the result will be beneficent for the world as a whole. Man needs for most things similar schemes, and the possibilities of inter-communication have made this possible through appropriate organisation.

In regard to the migration question, it would appear that a survey of the entire world, in order to determine the population-carrying power of various countries, has become a desideratum. Initially this would have to be made according to some adopted "standard-of-living." It would be possible then to grasp the essence of the migration situation, which increasing populations will assuredly soon make an urgent one. It will be necessary for all peoples to

realise that in the nature of the case *effective occupation is the only safeguard* ultimately of their rights. Dense and expanding populations will be compelled, whether they will or no, to challenge cases of ineffective occupation, and that will be one of the *great problems of the very near future*. It is a problem that certainly deeply concerns peoples whose countries exhibit very small population-density, more especially when they are countries capable of carrying much greater numbers. A refusal to face a question of this kind is not only fatuous; it is also morally reprehensible in the last degree. And it is not too much to say that such refusal may be the presage of doom.

We do well, of course, to bear in mind that people of our own race and nationality not only have a first claim to consideration because their language is the same, and their ideals, traditions, social habits are akin, but also for the reason that those who wish to emigrate from their own lands, if adults, are often not the most eminently desirable. This, however, hardly applies to the younger folk, and for this reason they constitute usually the most desirable among those who wish to migrate. Hence the importance of such a migration as has been called the "little brother" movement. We are not, however, here dealing with the grounds for preferences for particular classes of migrants. We revert to the general question.

What has been said above reminds us that behind any serious study of the population problem lies a question of ethics. It is this:—"When sensible differences exist between the actual and the possible populations of given countries, what principle is to guide world-politics in regard to the situation thus existing?" There are, it would appear, at least four fundamental elements in this question, and they call for solutions. These elements are as follow, viz.:—

- (i) What should constitute the norm of the standard-of-living, and how should it be ascertained?
- (ii) What population can each country carry normally, and how is it to be determined?
- (iii) What principles should govern migration as between any two countries, and how are these principles to be given effect?
- (iv) What are the governing factors which should relate to birth-control; how are they to be ascertained and given effect?

These questions not only touch fundamentally the life and development of nations, but also the whole system of their mutual relations. They react profoundly upon the issues of peace and war, a point already noticed. Assuming that the questions are treated as world-questions, as indeed they ought to be, what should be the world-attitude in laying down a basis for fixing the standard of living? Which, for example, is really to be preferred, the possibility of larger numbers with more modest living, or of fewer numbers living in relative opulence or even great luxury? The solution of this assuredly governs the answer to the second of the four fundamental questions. It is self-evident that the answer to the third element is profoundly affected by the answers to the first two; and finally they all react upon any decision in regard to the fourth element.

It is not, of course, intended to attempt an answer here to the questions indicated above, but it is proper to point out that not only can the recent increasing of the luxury of living not be maintained, but a halt even to the existing state of things will soon have to be called. The destructive forces of human extravagance are already in evidence. Intensifying the egoistic impulse, they create oppositions and those clashes of interest

which tend inevitably toward war. Intrinsicly they are of a character which involves this. And one sees that Tagore is right when he says that "knowledge and efficiency are powerful in their outward effect, but they are the servants of Man, not Man himself" (*op. cit.*, p. 41).

From what has been said it is evident that the problems directly connected with the world's future in respect of its population are of fundamental importance. A world-survey to obtain the data for their real solution has not yet been made. As already indicated, it is indispensable. Countries which, like Australia, Africa, South America, and parts of Russia in Asia, are under-populated, have essentially the deepest interest therein. Countries which have an overplus of people are also greatly interested. Concentration on these matters may save the world much trouble, for the issues cannot be avoided. The losses that will eventuate from armed collisions in future are likely to be more appalling than heretofore. Over-concentration on the various questions of the moment to the detriment of the possibility of reaching satisfactory world-conclusions as to the future of mankind is, we submit, supreme folly, and the danger is that it will be paid for terribly.

Over-population is, of course, a relative term, not an absolute one. Advances of scientific and technical knowledge will continually open up new possibilities of population, though relatively these will become continually less. But, as things are, many countries find themselves already greatly over-populated, and must perforce very soon see to the remedy. Many countries in Europe are already in difficulty. However much—for example—the *contadini* of Italy or the peasants of Germany and of many other parts of Europe may be helped by a better knowledge of agriculture, such countries are now actually under the pressure of a

tendency to emigrate. Baron Keikichi Ishimoto's research on the question of birth-control, of the imports and exports, and on the food and migration needs of Japan; the aspects of the whole situation for his country as indicated in the papers of Benedetto Croce; Dr Brownlee's *Lessons of the 1921 British Census*; Charles Rist's and Compère Morel's review of the situation in France; Hahn and Merz's discussion of the position of things in Germany; Pribram's *Population Survey of Austria*; Sir Henry Rew's discussion on the food-supplies for Great Britain, etc., show that the problem of population is—to use the words of Professor J. M. Keynes—not merely an economist's problem, it will in the very “near future be the greatest of all political questions”; and the peoples in sparsely populated countries, like those mentioned a little while back, will do well to have regard thereto.

In respect of such matters as have been discussed, we may add finally that Dr S. M. Shirokogoroff published lately in Shanghai a study of the question of the relation of population and environment under the title, *Ethnical Unit and Milieu*. His deductions are based upon studies of the peoples of north-eastern Asia. When increase of population exceeds the possibility of nourishment, he believes that the excess must perish, the only remedy being the control of natality by artificial, social, or other means. The controlling factors, he holds, are culture and territory, and the density of population is dependent on these. His general conclusion is that there will be a degeneration, and ultimately an end, to the species of man.

Without accepting Shirokogoroff's conclusion, one of course sees that his research points to the necessity of a thoroughly systematic study of the whole question of the world's future. It is a mysterious fact that, with the natural powers of human reproduction, Man numbers only 1950 millions, after the many æons that

he has existed on the earth. It is a mystery that historically is inexplicable. One can only guess at the reasons. To give point to the significance of things as they now stand, and to anticipate a future possibility, let us assume that the rate of increase for the whole world has fallen as low as one in two hundred per annum, that is 0.5 per cent. As we have already seen, this is considerably lower than it has been recently. At this rate population takes 138.975 years to double, say 139 years. Then, if the rate could be maintained, the world's population would reach the following numbers in the date-years indicated, viz.:—

Date-year	. 1928	2067	2206	2345	Anno Domini.
Millions	. 1950	3900	7800	15,600	population.

The last figure unquestionably can never be reached. The 7800 millions is considerably greater than Prof. East thought possible for the world. Is it possible—we may ask—for anything to be more patent than that to escape desperate trouble the whole system of relations among human races and between nations needs to be reviewed and adjusted? This means that world-economics, world-politics, and the whole question of admixture of miscegenation and of migration urgently demand study. Or more generally the study of economics, from the point of view of international equity and *mutual* interest, is one of the supreme needs of to-day; and, further, we shall have to consider what migrations are possible and what are best.

CHAPTER IX

WORLD-POPULATION AND NATIONALISM

IT has already been mentioned that the existing attitude of the people of any nation to the balance of the world's inhabitants is egoistic; and, within the nations themselves, the attitude is individualistic. It is self-evident that these conditions conflict with the possibilities through which the world can carry the greatest population possible. The economic pressures that must inevitably arise as a consequence, and conflicts between peoples, greatly affect the question of what numbers the earth can carry. So long as nations are liable to go to war, great freedom of migration is hardly possible, and human activities and wealth are, moreover, deflected into unprofitable channels. Governing authorities rely upon the numbers of their citizens both for the drafts for navies and armies and for the taxation and loans for the purpose of prosecuting war.

There is a point of view which, while it may not obviate the difficulty entirely, tends to do so. If we recognise that humanity has *moral* obligations, then, just as in individual relations, it is required that man shall maintain goodwill toward his fellow-citizens, and that he shall react favourably to his communal and social obligations generally, so is it to be regarded as normal, and indeed essential, that each people should have goodwill to all others, and should recognise its obligations to mankind as a totality.

Should the point of view of, say, a Treitschke or a Bernhardt become general, the world would certainly

suffer terribly. When such a view goes as far as deciding for either "Weltmacht oder Niedergang"—World-Power or Downfall—then such issues arise as those which recently cost mankind many millions of lives, terrible suffering, and great economic loss. A commitment to such a decision as is expressed by these three words costs, however, much more than this. It does not end with the immediate disaster. The suspicion and hatred which are begotten are a terrible detriment to mankind, and greatly hamper favourable developments subsequently. They destroy the sense of security in mutual relations; they mock at all ideals of honour and good faith; they turn the world into a realm, not merely where Man may have to suffer at the hands of Nature, but where he also has to fear, as a ghastly enemy, his fellow-man.

While issues, such as those which are bred by the attitude just referred to, may arise, and must necessarily be looked upon as dread possibilities, peoples have no option but to anticipate them and their consequences. To do this, not merely are their thoughts and material acquisitions appropriated in costly preparations for defence, and even for attack by way of self-defence; they have also to shape their whole careers with these issues in view. They have also to *dehumanise* their political attitude. Thus arise the forms of diplomacy which at present exist. For example, a nation, having secretly decided to invade another in order to attain certain military ends, does not hesitate to assure that nation that it need not fear such invasion. Such an attitude makes international goodwill an impossibility.

This illustrates how it is that the a-moral view of all international relationships comes into being. The most solemn agreements and most positive assurances are in no way to be regarded as binding. They will be adhered to only while it suits, and will be set at naught as soon as one believes that it can be done with impunity,

or when the consequences of so doing seem to be of little material—not moral—moment.

The intrinsic difficulties arising from differences in language, in education, in social ideals, and in race are very real, but are by no means wholly insuperable. But when the possibilities of being the victim of bad faith and of cruel attack are superadded, that co-ordination of effort and necessary co-operation, which are a prime requisite, become quite impossible. Perfidies as between nation and nation really mean that physical disasters are inevitable. They mean also something vastly worse, viz., the antagonism of human souls, and the degradation of the human spirit. They involve the culture of a cynicism for which we pay dearly.

This brings one to the heart of the whole question, viz., "What is the spirit which should be behind nationalism?" Is the aim only organisation for power, or is it organisation for the soul of humanity? In short, is this to be considered really a non-moral world, in which force and material ends are the things to be regarded as of supreme value, and dreams of the ennobling of the life and spirit of man to be treated as a futile phantasy? Or is it a world in which a moral law is deep written in the constitution of things, where the real object of unspeakable value is nobility of character and the development of the human mind? One's answer to these questions goes to the basis of the whole matter. Is the cynic right, or is the believer in some sort of higher destiny of Man right?

We shall venture to assume that Man's greatest discovery is that, after all, there is an ethical foundation in the heart of this world. Attempts apparently to dominate the world do not succeed, though judged by the probabilities of the issues, on the basis of the persistent physical and mental preparation made, they may have seemed certain of success. One

thing that may evidently be misjudged is the world's psychology. The spirit behind aggression can never promise a bright future for Man. There are those who think that the only mistakes made are the decisions to make the conflicts armed conflicts. To such it is submitted that had the conflicts been non-moral commercial ones, the issues would still be subject to the moral world-basis and would be untoward ultimately. They create intense antagonisms.

It is when such matters are kept in view that the relationship of Nationalism to the peopling of the world becomes very significant. When nationalism is supremely egoistic, it is non-moral and conflicts with the ideals of nationalism developed for the benefit of humanity. Is it, as a fact, true that "no nation liveth unto itself?" In short, is there a higher world-purpose than the organisation of a people for power and self-aggrandisement, viz., to ensure both its well-being and its beneficence to all other peoples?

One sees the smile of incredulity of those whose real faith is that there is but one god and that god is Material Power, power which arises from a knowledge of the nature of material things; power which can create material wealth; and can create also instruments of awful disaster to those who oppose them; power which can create instruments, too, that can help us to explore the realm of the physical and subjugate Nature to our ends with extraordinary success, compelling her to contribute more to the purposes of human life and human sustenance.

It is this power, some will assert, that has already revealed the way for greater multitudes to live on earth; a fact proved by the large rate of the recent increase, compared with Man's mysteriously slow development in the past. To this one may answer: "Yes, it has undoubtedly shown that the accessions of knowledge *may be* beneficent in their effects, but

the recent war has also shown that they may be terrible." Every student of the possibilities of future wars realises that the dangers that threaten mankind in future wars are ghastly.

Clearly it makes all the difference whether the purpose behind nationality is solely egoistic, or is not so. Inherently nationality is not necessarily detrimental to humanity and to the life of larger numbers on earth. But nationalism, which is the expression of a system of economics, intended to exploit all chances, irrespective of the humanity of so doing, and is moreover the organisation of power in order to ensure the success of such a system, regardless of its incidence, can have no place in the hearts of those who hope for the betterment of mankind, and hope that peace on earth may yet be attained.

That attitude on the part of a people which is consistent with, or makes it sympathetic with, the genuine advances of other peoples, creates possibilities of international goodwill, and gives birth to the sense of an international solidarity. Man has acquired and is still acquiring such knowledge that, organised for maleficent ends, he can become more and more an enemy to his fellows. His destructive powers are already very terrible, and can wreck in moments the labour of years and even of centuries. The facility with which he can injure the human organism and destroy life is enormously developed, hence knowledge is a potential power for evil as well as good. If organised for beneficent ends, it is solely a power for good. The reactions certainly seem to be, in this latter direction, less powerful, but they lead to a higher culture of the spirit of humanity—a higher civilisation. Difficulties as between nation and nation tend then, and then only, to disappear, and it becomes possible for man to multiply and replenish the face of the earth, with joy, or rather well-being, for all.

Science and technology have shown themselves capable of rendering splendid service, but they need to be the handmaidens of men good enough to be entrusted with them. They can be Furies and may rend, when they are the handmaidens of a spirit of evil.

Another and similar aspect of international spirit of evil relationships calls for mention. When a people, having become subject to a control which has actually destroyed enormous numbers of them, a control which also has plunged them into economic ruin, endeavours by all sorts of subterfuges to spread its political creeds among other peoples, it makes a national goodwill to it fatuous, hinders economic relationships with it, and renders mutual migrations impossible. From this we see that political perfidy is a great hindrance to the population development of the world.

CHAPTER X

NEW MALTHUSIANISM AND MAN'S FUTURE

FROM what has preceded it is obvious that the rate of population-increase witnessed on earth during the last century and a quarter cannot continue under any circumstances whatsoever: it *must* diminish. What will bring this about? Will human intelligence cooperate, or will Man be the victim of disaster, and what kind of disaster? These are questions which remind us that, in any consideration of the World's Future, we must give attention to *all* relevant matters.

Although Malthus's work on Population appeared as far back as 1798, his propositions on population have continually, and even quite recently, been wholly misunderstood and utterly misrepresented. The essence of the whole matter was that, from its intrinsic nature, the power of increase led to multiplication in a geometrical ratio, except in so far as it was hindered by things inimical to Man. The food-supply could not keep pace with this geometrical increase. Food tends, it was said, to increase only in arithmetical progression. The latter is not quite correct; actually it may increase at a greater rate, or increase not even at that rate. From what has preceded it is not necessary to labour this matter, for it is already evident that very soon—speaking in even the historical sense—Man will be in difficulties.

Many ingenious views have been put forward as to the nature of the progress of populations: some reference has already been made to these in Chapter V. The matter need not be further elaborated. It will

suffice to say that some measure of the control of births, in some way or other, is *inevitable*. The difficulties, which necessarily present themselves in life, are accentuated by the fact that there is no limit to human desire, nor are there any abstract standards for human guidance. What satisfied us yesterday is inadequate to-day. The son believes that he must outdistance the father. The standards-of-living, of civilisation, elaborate themselves. Any one class of the people, in so-called democratic countries, imagines itself to be rightly entitled to what any other possesses. The scale of individual demand has no fixed limit, and the economic efficiency of the human race must keep on rapidly advancing in order to meet the *double tax*, viz., increasing numbers and the more elaborated and luxurious living now characteristic.

Already there are, of course, factors which tend to limit births. In all the higher grades of life the educational, the cultural, and the social demands tend to defer the age of marriage to a later period of life, and in this way operate to limit the family. They menace and restrict the reproductive impulse. The growing insistence that quality, and not only numbers, shall be taken into account, is also operative in the same direction. Anyone who surveys the tendencies of human development soon realises two things. One is that Man is commencing to ask: "How can the standards attained be stabilised or even further elaborated?" the other is, "What are the general world-conditions, and how will they act on the general drift of things?" In facing these questions we bear in mind—as said previously—that while science has enormously advanced human powers of destruction, the ameliorative possibilities she has created are, relatively thereto, but slight. And we recognise also that modern finance, transport and communication have made the problem bristle with new difficulties,

and that great wisdom and insight are needed to attain to satisfactory adjustments.

Although the large and relatively unoccupied spaces in Asia, Africa, South America and Australia could perhaps be used, for some little time, to meet shortages in the food-supplies, the existing rate of increase will soon exhaust these, and it is not to be forgotten that many countries are not even now able to meet their own requirements by means of such agriculture as they can possibly develop, a feature which has already been considered. The food-supply and other supplies necessary to maintain whatever state of civilisation is adhered to, and the finding of profitable occupation for human beings, mean that there will always be a pressure against unrestricted increase. The form which the newer Malthusianism endeavours to take account of, is the necessary adjustment to the complex of modern conditions. It endeavours, also, to formulate ideas as to the nature of the problem which urgently needs solution, if the human race is in any way to minimise the evils which are now threatening.

When we remember that throughout the world, enterprising men, driven by the spirit of world-competitions, are considering the futures of their activities, are asking, "What will be the needs of the industries upon which they depend?" and "What opportunities still exist for further profitable activity?"—we see that these questions involve a wide outlook and an interest in other peoples' countries and conditions, if they are to be answered satisfactorily. In this connection has arisen a matter that has given pause to all economic thinkers with vision. This is what has been called the "anonymity of capital." The fact that the uses and applications of capital are not associated with particular persons, nor are they collateral with particular nationality, has also shown that the economic organisation of the world is, at present, very unsatisfactory. This was

ably discussed some years back by Prof. Fedozzi of Genoa, in *Scientia*. Issues as between nations may have very little relation to the groups of individuals concerned in their decision.

All possible progress depends upon the existence of capital, that is upon the accumulations of suitable forms of wealth, over and above the current needs of persons and of communities. Formerly capital was more largely, if not wholly, individually controlled; and the sense of responsibility for the manner of its use was correspondingly personal. In the world's economic system of to-day, larger accumulations occur and are indispensable for the maintenance of the greater activities and the larger schemes of transport. But these are, relatively, impersonally controlled, and the ethics of such control is humanly less satisfactory than when it was associated with personal responsibility. It is because of this that the larger economic issues frequently cause trouble, often intensified by national prejudices, since there is, as yet, very little realisation of any unity of interest among the peoples of mankind, regarded as citizens of the world.

It is easy to see that as human difficulties increase through the growth of populations, adjustments as between its increase of numbers and its economic organisation must take place, if trouble is to be avoided. Keeping such considerations in mind, and having in view the imminency of a food-shortage, "New Malthusianism" proposes that we shall review the whole situation carefully and not multiply without the slightest regard thereto. What, then, is the world-position in respect of this matter, and how does it affect various divisions of the human race? On a very superficial view the solution might seem to depend merely upon migration from the thickly settled areas to the sparsely settled ones, and therefore—in principle at least—to be easy of solution. The trouble is,

however, that the cultures and ideals of different peoples are by no means identical. Nor are their physical, intellectual and temperamental characters always mutually agreeable or even compatible.

Among different peoples the ordinary standards-of-living vary greatly. Because of this, and also because of racial and national vanities, not always well-based, migrants are not always welcome. And even if they were very welcome, there are economic difficulties in the way of reaching relatively equal degrees of population-saturation. Usually great hardships have to be faced in opening up new country, and also in developing new conditions. Satisfactory migration often requires that the migrants should possess some capital, and it is to be noted that the capacity of any people to receive migrants with small amounts of capital or none at all, is usually very limited indeed, as things are at present, or as they are likely to be. Thus migrations of human beings are only a palliative of the kind of difficulties that are arising, and are merely a very partial and temporary solution of the troubles occurring through large increases of population. And one has, too, to remember that immigrants often unreasonably hope for the benefits of a new country, without being prepared to share in the hardships and effort made by the earlier possessors, and by pioneers generally, in developing it. They are prepared to profit by the heavy labours of others, without making corresponding sacrifices.

Fundamentally different attitudes in respect to what constitutes the best form of civilised development; race-prejudices, intensified by differences of language and temperament; the regarding of any territory whatsoever as a realm for exploitation for *foreign* as well as native interests; uncertainty in regard to interest and good faith in cases of multiple nationality; penetrations into affairs by capital subject to foreign

controls and operated in foreign interests; and diversities of aspiration when people are not of one race and language; these, in the existing state of things, greatly intensify the difficulty of those movements of population, which are necessary to minimise the troubles coming from undue local increases of numbers. All these matters bear upon the question as to how the principles, enunciated by Malthus, can act upon the modern world. They forcefully remind us that "New Malthusianism" has to take account of the type of difficulties now existing or arising. It has also to envisage the possible elements in the reconstruction of human affairs. For example, when the peoples of over-populated countries decide against birth-control, other peoples have to take into account whether the former propose to force the migration question in any way. One of the immediate difficulties, sometimes, is to decide as to whether such decisions are merely official or are national. In the latter case they may mean conflict, which, in the circumstances, may be unavoidable. One sees that Malthusianism, as soon as it takes practical account of world-facts, has become a thing of immense moment.

Another important aspect of the migration-issue is this: if a territory be appreciably relieved by the emigration of its inhabitants, the condition before relief tends to re-establish itself. In other words, the habitual social and economic pressure, due to the excess of the effective reproductive impulse over the normal density conditions, is almost certain to renew itself whenever it is relieved. Thus, other things being equal, constructive birth-controls will have to be permanent, though adapting themselves to fluctuating population-conditions. Thus people with a high residual rate of natural increase (that is, a rate allowing for infantile and early mortality) challenge the occupation of territory by other peoples. Such a fact directs

attention to the difficulty of guiding international policy in such matters.

The question of birth-control just referred to is inescapable. Its best form is what has been called "constructive birth-control," viz., that which takes account of what has been discovered in regard to the laws of inheritance of physical and mental qualities. Mendelism, a study of the nature of heredity, embryology, advances in psychology, in education generally, and in national and personal hygiene, have shown that it is easily possible to have far better conditions in the matter of the reproduction of human beings. To secure them practically is worth while. As peoples grow in intelligence and develop in character, their interest in the quality of future generations progresses, and we realise that what in the past was left entirely to chance, may in the future be wisely directed, to the great advantage of humanity. One may say that the human race is rapidly reaching new ideals in regard to its responsibility to the generations to come. Indifference to the fate of those born under bad economic, physical and psychical conditions is giving place—perhaps all too slowly—to benevolent concern. When this concern embraces not merely the more immediate surroundings, but also the world-conditions entered upon, great ameliorations in the status of mankind are likely to arise, for they are certainly possible.

The greater and nobler personalities among all peoples whatsoever are extraordinarily similar in their sympathies and their outlook. Brothers by nature, it behoves them to do all in their power to change national and racial egoisms and vanities into a spirit of real friendliness and co-operation. Though not an easy task, it is assuredly a possible one. The mutual touch of peoples to-day is unique in human history and it can bring forth good fruit. Thus a world-survey in the interests of all is a desideratum of the first order,

and assuredly it can create sympathetic touch internationally. The opponents of this view are those who see in human limitations and ignorance greater possibilities for exploitation in the interests of unscrupulous competitions. As we have seen to our cost, the future of unfriendliness is fraught with appalling dangers to the whole of humanity, and may even mean the blotting out of human civilisation.

An international review of all the greater questions affecting mankind seems to be now a *sine qua non*; must it not take into account the migration and settlement possibilities of the earth, and the adjustment of the normal rights—if there are such rights—of races and nations? And will not such adjustments of mutual rights include the questions of the possibilities of food-supplies and the conditions of mutual well-being of the peoples of the whole world?

In order that the New Malthusianism may be of the greatest service, at least all the greater peoples of the earth must react to its demands. Yet the task of securing human interest generally seems to be one of hopeless magnitude. How is the task to be faced, and what elements in it are most pressing? Answers are not easy. Ultimately the education of the peasants of Russia, of the millions of India and China, and of the similar grades in the other parts of the world, is involved. It is true, of course, that this may operate in two ways. Better agricultural methods in Russia would enormously increase the supply of cereals and food-stuffs generally. This would tend to increase numbers. Ultimately, but by no means at once, the effect would be to so raise the standard-of-living as to reduce the rapidity of the increase of density. Analphabetas cannot make as effective a use of a country as people of appropriate education; and there are to-day enormous numbers of analphabetas in the world, and it is very difficult to help them effectively. Readers of

the monthly review of the league of the Red Cross Societies, known as *The World's Health*, will appreciate the difficulty and also the possibility of helping the illiterates among mankind to attain to the necessary knowledge for their own and their children's betterment. On the other hand, Prof. Laky's study of intellectual culture in Hungary shows how very difficult effective work will be for many years to come.¹

The scourges of mankind can be greatly checked by intelligent popular response to suitable official action. Tuberculosis is on the decrease, and the action of such remedial agents as solar rays, ultra-violet light, and heat are making the outlook generally more hopeful. Venereal diseases are yielding, and the popular attitude thereto is more satisfactory. The overcoming of thyroid troubles, the prevention of diseases arising from malnutrition, the prevention of scoliosis by attention to school-conditions, a better psychological guidance in the matter of education, and similar things, are securing better originating conditions for the rising generations in many lands. Infantile life is being greatly helped, and in many countries the infantile death-rate has fallen in a remarkable way. So extraordinary has been progress in these directions that a world-conscience in regard to them is being developed, and already men are raising their ideals as to the proper *normal* demand for attention thereto. International conferences and correspondence between persons deeply interested in matters affecting these, and in similar questions touching the evolving of movements for the good of mankind, are among the things that tend to create the new order of things, an order which, one may hope, will make international adjustments of relations possible. These, too, are essential to such a

¹ " *Etude sur le développement de la culture intellectuelle en Hongrie dans les temps récents,*" Désiré Laky, *Revue d. l. Soc. Hongroise d. Stat.*, 1926, Nos. 1-2, pp. 1-60.

control of the rates of increase as will be manageable. Should we elect to go on without such adjustments, then future troubles are likely to be serious indeed.

One of the most important questions, even at the present time, is a proper selection among the various possibilities of migration, etc. It is self-evident that the world's empty spaces would be better filled by the progeny of the superior human stocks, rather than by that of the more degenerate. Peoples who are robust physically, temperamentally stable, just, equitable, friendly and forceful in life, mentally well-endowed, have pre-eminent rights not merely in their own interests but in the interests of the world's future. The gap between human derelicts and degenerates and the finer specimens of humanity is enormous. But there seems unquestionably to be very little intellectual and moral difference between the best of all ages. Mankind is perhaps better organised than in past times, and its information and technology have greatly advanced; the machinery of collective action seems to be in a relatively high position. But the degenerate elements have become assertive, and the signs of disruptive forces, threatening our whole civilisation, are unmistakable. Appeals to the baser elements of human nature are systematically made and with most prejudicial results. Drastic remedies are imperative, and, if the new era is to be a vastly better one, no country can without peril accept migrants without regard to their character. The question is, can human character be favourably affected by more intelligent mating, based upon a deeper concern for the new generation. The destiny of peoples assuredly lies in the hands of those who give birth to, and guide and educate, their children. And all, who have really studied the question, are beginning to realise that the time has arrived when defectives and degenerates should not be allowed to reproduce their kind; when

the future of the human race should be safeguarded from the mischief that such people perpetuate.

A sardonic and disinterested observer of the issues for the earth might well smile at the interest taken in the breeding of its animal and bird stocks, collaterally with the neglect of human progeny. "Why this orientation of genetics?" he might well ask. Is humanity to take its chances without guidance, or are the accumulations of a knowledge of heredity to be used in the interests of its difficult future? To what is mankind to be devoted? Is it to be to ruthless economic aggrandisements with their frightful consequences; or is it to be to economic adjustments with a normal, steadier, and more friendly life? This is the problem, and Malthus was one of the very few who had a clear vision of the great controlling factor.

Man can be for ever the victim of blind impulse and of egoistic greed, or he can witness ameliorative action based on true eugenics and a finer sense of the claims of those who are to be. Is this all a fatuous and futile dream, or is it a guiding aspiration? The last one hundred and twenty-five years have seen the development of the great locomotive, of the enormous liner, of the airship and aeroplane, of telegraphy, of telephony, and wireless communication. It has witnessed a wonderful reduction of the menaces to the beginnings of human life. It has been characterised by an enormous increase in the average length of life of all born, the expectation of life at birth. In Australia in one-third of a century the death-rate for the first year of life fell to 46 per cent. of what it was. At the age of minimum mortality, 11 years and 10 months, it fell to 59 per cent. of its original value; at every age up to 86 it has witnessed improvement. These are amazing advances. But they mean that Man carries new responsibilities, and that there are certain consequences which involve international adjustments.

New Malthusianism aims at so regulating birth-conditions that the new-born will be ushered into a healthier world than now. Certain migrations will help, but it is inimical to the world-future's interest that inferior sections of humanity should be transferred even to relatively empty countries. Everywhere the common intelligence needs to be raised ; when this is done it will not be quite so difficult to secure adjustments to local and to world conditions. If this can be achieved then human Destiny will be of fairer aspect, and Earth's future more smiling to Man.¹

It is in the interests of the human race that each nation should retain and deal with its degenerates or defectives, its derelicts, and its poor. It should not be possible to pass them on to other nations by way of migration. The discipline for a people of having to deal with the consequences of its own ignorance or its indifference is salutary, and humanity will best progress by each nation being continually under the obligation of looking after its own more wretched elements. It then has a deeper concern in that advance which can come through national hygiene in the broader sense, and through a consideration of the bettering of its new generations by attention to the conditions governing their origination: then and probably then alone will these command the attention they deserve.

¹ See *Scientia*, "The New Malthusianism in the Light of Actual World Problems of Population," G. H. Knibbs, pp. 379-88, Dec. 1926.

CHAPTER XI

CONCLUSIONS AS TO POPULATION INCREASE

WE have already, in Chapter VI, given some slight indication of the significance of the population-question. Owing to the imperfections and inadequacies of existing statistics, we cannot fix the population-limits with any precision, and we have shown that it is dependent largely upon factors at our disposal, viz., our economic and ethical advance, and the standard-of-living which we are prepared to accept. What has appeared in regard to the significance of rates has shown us that, even if the "unspecified" area of the world's surface should turn out to be "productive," the issues are not materially altered. The shadow is not lifted. We may now revert to what has been established in the preceding pages, and ask, "What are the conclusions to be drawn in regard to the problems of the world's future?" "Is there really a population menace, constituting the Shadow of the World's Future?"

The rate, at which Man has increased for more than a century, informs us that we have unquestionably entered upon a new era. That rate will probably not diminish except through the arrival of unforeseen troublous times. Of itself, the rate will create enormous difficulties, for mankind has not yet become an economic unity, nor has it yet learnt to regard issues from the standpoint of the good of the whole. The time available for all necessary adjustments is so short that Man's immediate task is indeed a very heavy one, and it is inescapable. History reveals, however, that the building up of the character of a people is a

slow process and one which involves centuries of experience and effort.

Existing conditions are such that, if they continue, mankind could perhaps attain to 3800 millions, double its present numbers. This would involve no more variation of its organisation than would seem to be easily possible with any sincere and well-directed effort. But to reach even this population without world-wide calamities supervening, quite special efforts will be essential, as anyone will readily perceive who has taken account of the movements in the East, in Africa, and in America. Man is face to face with issues which demand attention, and which call for an incisive inquiry into the position of the inferior and the so-called coloured races. A new liberalism, and a less egoistic regard for the well-being of all races, is being called into existence.

For the world to attain to thrice its existing numbers, that is to 5850 millions, fundamental changes in the existing characters of human civilisations will not necessarily be involved; but it will involve great improvements in respect of international economics, and in respect of the moral aspects of national and international life. It will involve also many further advances in science and technology, advances greatly surpassing those of the past and present century. Doubtless, too, it will involve the cultivation of areas now neglected.

For the earth to quadruple its numbers, that is to attain to 7800 millions, is a huger task, involving not only a much more efficient use of its surface, but also a deeper study of the climatological factors which can aid in the enormous improvement of its food-supplies that will be required. But that is not all. The chemico-physical factors are relatively simple as compared with what is also essential, viz., the virtual elimination of all forms of unscrupulous egoism in the life of nations and in the relations of races. This means

that thorough and sympathetic studies of those things in international life which reveal that Man is subject to moral law will have to be undertaken. (Is there any real expression of such law in the inter-relations of mankind?) Moreover, the financial and economic systems, and the different productivities of the various peoples of the earth will have to be co-ordinated with the greatest possible equity and goodwill.

This limit of 7800 millions will be passed only with the greatest difficulty and probably very slowly. It is, however, quite possible that still further increase can take place, to the order of say five times the present population, viz., to 9750 millions, and ultimately it might reach even six times, say 11,700 millions. It seems certain that, under any conditions whatsoever, the numbers of the human race can never surpass this. Even to attain to 9750 millions, the perfection of all human organisation would have to be so high on the moral as well as on the physical plane, that it is very difficult even to imagine how this can transpire in the limits of time which are probably available. The history of the human race appears to indicate that only very slow changes, if any at all, in the fundamental elements of Man's character are possible. Unless the changes arrive through intelligent reproductive controls, taking every advantage of appropriate methods of reproduction, it would seem unlikely that the 7800 limit will ever be passed.

Although the history of Japan has been a revelation of how rapidly a people, with devoted and mentally capable leaders, may develop in a particular direction, viz., in that which has characterised Western civilisation, and although the rapid rise of various other peoples has been almost equally surprising, there is no doubt that, to attain to a high population-density, the prevailing aims of human lives will have to be less concerned with complications in the mere standard-of-living. A

more humble life, physically, with a deeper regard for the higher issues, is a *sine qua non*, if it be really desired to see the earth covered with contented peoples, whose well-being is assured and whose living is a disclosure of generous attitude and noble purpose. When such propositions are really examined, it is at once apparent, that for mankind to multiply greatly is not merely a physical difficulty: it is one involving his higher powers, and that view lies behind much of what Sir Rabindranath Tagore has had to say in regard to the limitations of nationalism. We do not accept his view as an unassailable verdict as to the essence of the whole position, but it is one which it is desirable to analyse carefully. And, reverting again to Japan, the Bushido ideals of that nation, exemplified in the readiness of the former Daimios to forgo their privileges for the nation's well-being, shows that ethical elements can play a very real part in the numerical and dynamic development of a people.

Finally, one may say that although the dream of a densely peopled earth, living in relative contentment, is not an impossible one, it is, of course, a dream of the impossible, *as things are*. The earth numbers to-day only 1950 millions, after its long life-history; an amazing fact even after only its 10,000 years of *recent* development. This has been because of its great intellectual, and also its great moral, limitations. The cynic may well say "these dreams of the world's possible future are but idle phantasies," and the sneer would be well-founded. Nevertheless, it is suggested that the world's future *can* be vastly better than its present, and the future is worthy of sympathetic consideration, as to ways and means of advance, by the finest minds and the noblest characters.

At the present time the mere increase of population, coupled with the fact that Man's moral development has not kept pace with scientific knowledge, is threaten-

ing trouble. With the collisions of interest that are now in existence, the future looks not merely threatening but very ominous indeed. If that future is to be better than appears, it will depend largely upon the attitude of its inhabitants to the era that is dawning. The matter even of its growth in numbers is truly momentous, and, with its assertive and unscrupulous greeds, is no less alarming to any one who has any vision, and who realises to what past history is pointing. The frightful indifference to ghastly miseries and unspeakable sufferings which made the last war possible, reveal the spirit which is governing so large a part of mankind even now. *That spirit is a limiting factor* to the growth of the human race and to material and spiritual advances in its future. Virtually we are told it will never change; if that be true, then the Shadow of the Future will be very dark.

The World's Future is, then, *the problem* of problems. That we should at once face it, is revealed by the fact that the rapidity of the increases in population-numbers is already threatening us with apparently almost insoluble difficulties: we are rapidly approaching numbers that make the problem a stupendous, aye, even an appalling, one. At the present time one country, at least, must make provision for the emigration of some of its inhabitants. We may elect to ignore these matters, but if we do we only accentuate our future difficulties. It is here that we see that the way of humility is needed, for the ablest are intellectually incompetent, and the noblest fall short of the splendour of purpose, demanded for its solution.

Anyone who has read Dean Inge's *England* (Benn, 1926) attentively will realise something of the magnitude, not merely of England's problems, but those of the world. His epilogue sums up the situation. The issues for all great nations do not differ materially. What Dean Inge has to say, in his most able review

of the problems pressing upon the British nation for solution, reveals, either directly or incidentally, what the world situation is. It discloses also how enormous the work to be done is if, with an ignorant and selfish humanity, ill-consequences are to be *minimised*. Humanity has both to be instructed and governed. Naturally enough the situation appears to be well-nigh hopeless, not because it is essentially insoluble, not because it is beyond the reach of the intelligent, but because humanity is mentally and morally what it is at the present time. Nevertheless, the World's Future calls for consideration by all who are not wholly wrapped in the garment of utter indifference, for the auspices are not favourable, and the population-pressures, so rapidly developing, are inescapable.

When one thinks of the periods which have been necessary for the development of all the highly civilised peoples among mankind, and of the crude stages only now reached by the backward peoples, it would seem that no possible effort during the remaining three-fourths of the present century can materially alter the conditions existing, at any rate for the greater portion of the human race. The complexity of modern life with the more advanced nations, the range and excellence of their comforts, the elaboration of their methods, of their customs and their enjoyments, the luxury and ostentation of their appointments, the enormous expenditures of money, or its equivalent in labour, of those who control the social and political world, all imply an accentuation of the elements of human nature which constitute the main promptings of modern Man. It is these things that make the future difficult.

When one knows something of the world's surface and of its peoples, and finds it possible for a country like Switzerland to carry a population of 247 to the square mile, while a country like the United States of

America is carrying only 39, being told also by certain special and able students that it can never carry more than 66 to the square mile, one realises how superficial are some of the studies of the world's possibilities.

The data do not yet exist by means of which a really exhaustive estimate can be made of the world's population-limits, as things are at present, nor as they are likely to be. But we do know enough to affirm with confidence, that the fear that a country with immense resources can carry only 66 to the square mile is created by too narrow a view of the problem in hand. No sufficient account has been taken of the standard-of-living assumed to be essential, nor of the fact that the theory leading to this estimate is based upon merely temporary, undeveloped and unessential conditions. It may of course be true that the easy state of things in any new country must pass as the world's peoples multiply, and that the standards existing must perforce change. If they do change in the direction of less luxury, then the estimate of 66 people to the square mile goes by the board.

Even should our estimates of the limits of population be too modest, it still remains true that mankind is profligate in the use of such of Nature's materials as are immediately at his disposal, and he is applying them, and the food-stuffs likely to be available, recklessly. For this reason Man will certainly be pulled up in the near future, and the Shadow of his future remains in being. What we said in our report on the Australian Census of 1911 remains true. Our words were:—

“The limits of human expansion are much nearer than popular opinion imagines; the difficulty of future food supplies will soon be of the gravest character; the exhaustion of sources of energy necessary for any notable increase of population or advance in the

standards of living, or both combined, is perilously near. Within periods of time, insignificant compared with geologic ages, the multiplying force of living things, man included, must receive a tremendous check."

And we went on to add the following:—

"The present rate of increase in the world's population cannot continue. . . . The extraordinary increase in the standard of living, which has characterised the last few decades, must quickly be brought to a standstill, or be determined by the destructive forces of human extravagance. Very soon the world-politic will have to face the question, whether it is better that there should be larger numbers and more modest living, or fewer numbers and lavish living; whether world-morality should aim at the enjoyment of life by a great multitude, or aim at the restriction of life-experience to a few, that they may live in relative opulence."¹

We pointed out that the student of the future would "utilise all discovery of the mysterious play, and no less cryptic limitation, of life-force to make prediction sure." And further that with "co-ordinated international effort, there would be no difficulty in so directing future statistical technique" that a more perfect study could be made of the drift of mankind "in the more important relations of civic, national, and international life" (p. 454).

Certainly, in so far as Man is ignorant he is both the puppet of fortune and the victim of desire. He knows but little of the driving forces in the world of life. He sees but the surface of things and his science is far from being a perfectly co-ordinated system of concepts, representing the world as he beholds it.

¹ *Report of Census, 1911, Appendix A, Vol. I, p. 453.*

It may be that his future was written upon the Tablets of Destiny, æons before his world came into being. And thus one cannot learn whether the present tendencies of Man's life on earth are but a hint of the passing of this civilisation, or are remediable through the labours of the leaders of humanity. Thus attention to the menaces of the future may presage the lifting of the World's Shadow, or may be merely the informing of human intellect of the dark promise of the immediate Future.

CHAPTER XII

EPILOGUE

AN epilogue after a "conclusion" may seem pleonastic, and but a dull humour. There is a sense, however, in which a second conclusion may not be without interest in considering our main theme.

Man's view of his world is frankly anthropocentric. Certain sacred writings accord with this point of view. On the other hand, the study of the story of life upon earth, it may be said, has rendered it of a value which is not exhausted by thinking of it wholly in connection with its relation to him. Apparently æons passed in earth's life-story before even the crudest progenitors of the human race appeared. Colossal animals had wandered over the world-surface, only to pass to oblivion, except in so far as their traces remain as fossil skeletons. Prof. E. Rignano has submitted in *Scientia*, and elsewhere, reasons for their disappearance, among which may be mentioned even *too* favourable conditions for their development. This operated to cause an increase which produced numbers that could not be maintained: sometimes the consequence was annihilation! Attempts have been made to formulate the life-experiences of living forms quantitatively, and to develop even a mathematical theory of the "struggle for existence."¹ Drs. Pearl and Reed have thought to show that Man's rate of increase follows a very simple biological law. In certain experiments of theirs they

¹ By Vita Volterra, "*Una teoria matematica sulla lotta per l'esistenza*," *Scientia*, Vol. XLI, No. 178, pp. 85-102 (1927).

found, as we have already stated, that this law was approximately fulfilled by some small forms of life developing in restricted regions.

We have already indicated that any attempt to prognosticate the future numbers of Man, by extrapolating the curve of his growth in the past, must fail, not merely because we have no exact numerical record of his past, but also because the factors which determine his numbers are numerous, and are liable to momentous changes. And even had we a numerical measure of all the factors, and numbers sufficiently accurate to permit of an analysis disclosing the part played by each, accurate prediction would still be impossible, for we are not aware what governs the rising of life-forms inimical to, or beneficial to, Man. In the past, plague, cholera and yellow fever have at times played havoc with the human race. What we regard as utterly insignificant and useless forms of life often thrive at our expense. We disappear while they develop in countless numbers. Plagues of caterpillars, of "locusts," of the "boll weevil," of mice, etc., reveal how relatively helpless we are, when Nature develops life on lines that oppose our well-being. Entomologists have expressed a fear that Man may actually be overwhelmed by the insect world. However much we may discount their terrors on the ground that possibly they magnify their office, the dangers, it is easy to see, may become formidable. It oftens happens that Man reaches results, through better (?) agricultural technique, that are most hopeful; only to learn a little later that his improved varieties of plants are very liable to be attacked by disease or by insect pests. At present we have no knowledge what it is causes the various evils, that harass mankind, suddenly to take on a serious form, and it is by no means certain that increased scientific knowledge will enable Man to cope with his enemies. We do not know what Nature's

future movements will be, nor what part Man is to play in the world-future.

Thinking men have at last, however, apparently reached more sanity in their estimate of their place in Nature, and in regard to their status as denizens of the earth, than characterised them in the past. The ablest of them, endowed with intellectual powers of a high order and endowed also with imaginations of some reach, with the genius of invention, and with the ability to create—within limits—new world-situations, are able to envisage to some extent the problems of their own future. But the ordinary demands of life are pressing, and one is apt to forget those issues, at least, that are dated to arrive later than the immediate future. To those who have vision, however, comes the call of duty, viz., that of shaping the interests of their country and of the world in respect of the tremendous problems that loom large in the future life of humanity.

But Man lives not only in a physical but also in a psychic atmosphere, created by the mass around him. He can no more escape this than it can escape him. And if the mass fail to react to great issues when they are revealed, it is merely so much evidence that Nature has a different end in view from that which presents itself to his mind.

In August and September 1927, a well-attended international conference met in Geneva, under the presidency of Sir Bernard Mallet, to discuss the problem of the world's future in respect of population. This, at any rate, discloses that experts have awakened to the fact that all is not well with the world in respect of its inhabitants, and their future. It is a hopeful sign. But there is no adequate world-reaction yet to this important movement. It may be the beginning of the solution of some of the greater difficulties of the world's future, but if it is to achieve that measure of

success which is necessary for the real amelioration of things, then it must engage the attention of every country that can influence the issue.

With Man's reliance upon his intelligence, it is not altogether impossible that he has lost some measure of—if he ever had them—his intuitional powers. The so-called instincts, which to some extent appear to guide animals, are of little service to him, although the researches of Boirac, Ochorowicz, Osty and others seem to show that Man has what—for the want of a better term—may be called *præternatural* powers. Is his insight really of this nature? There is abroad a sense of unrest, as if we were in the thrall of an unseen trouble. Is this verily some apperception of the fact, which we have here tried to establish by means of appropriate statistics? One of course can hardly say. But one can say, quite positively, that the rational evidence is unmistakable; the world cannot escape the issues, which its rate of increase is rapidly developing. May not this be the Shadow of the World's Future, which is mysteriously influencing its thought?

With a normal perspective, the picture of Nature's activities is of profound intellectual interest. But those activities are by no means always a comfort to human beings. Even the mere shaking of the earth's crust may be appalling to the earth's peoples. In the 1927 Norman Lockyer Lecture, Dean Inge, speaking on Science and Ethics in relation thereto, pointed out that the time has gone by when Man could regard the world as in being for his benefit alone, and one may add, or even primarily for his benefit. At the present time Man has the upper hand, and must exploit his opportunity in the best way possible. Is he, however, to be an uncontrolled animal, whose instinctive reactions are to carry him on to his doom? Or is he to be relieved by his vision of the world's possibilities, and by his adapting himself to its inescapable issues?

These are the questions which human history is, in some measure, about to answer.

The human being may, of course, have issues to face soon, which to-day are absolutely hidden. These he must perforce meet as they arise. It is well that to these should not be superadded those which are not hidden. For this, and many other reasons, everyone with an interest in our race will view with pleasure all efforts to lift the shadow which is looming darkly in respect of Man's future. The widespread recognition of the developing solidarity of our race is an omen of promise. But, at present, it is specially characteristic of public men of exceptional eminence only. It is not yet a pervasive faith with the masses of mankind. The readiness with which antagonistic feeling arises between nations, and the intensities of national dislikes, occasion forebodings which counter such appreciations of human solidarity as are growing. One can only hope that concerted action, in the attempt to solve the problems arising from the menaces of human increase, will create centres of sympathetic interest. These problems involve for their solution the cordial co-operation of all. Economic equity, the abandonment of unscrupulous competitions, and the promotion of a world-concentration on the great issue, is the way of peace. It may lead mankind in the end to discover that their world has, like Chamisso's *Peter Schlemihl*, lost its shadow. So mote it be.

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