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CURRENT PROBLEMS IN RESEARCH

World Population Growth: An International Dilemma

To control his numbers man will soon be forced to choose between high mortality and low fertility.

Harold F. Dorn

During all but the most recent years of the centuries of his existence man must have lived, reproduced, and died as other animals do. His increase in number was governed by the three great regulators of the increase of all species of plants and animals—predators, disease, and starvation—or, in terms more applicable to human populations—war, pestilence, and famine. One of the most significant developments for the future of mankind during the first half of the 20th century has been his increasing ability to control pestilence and famine. Although he has not freed himself entirely from the force of these two regulators of population increase, he has gained sufficient control of them so that they no longer effectively govern his increase in number.

Simultaneously he has developed methods of increasing the effectiveness of war as a regulator of population increase, to the extent that he almost certainly could quickly wipe out a large proportion, if not all, of the human race. At the same time he has learned how to separate sexual gratification from reproduction by means of contraception and telegensis (that is,

reproduction by artificial insemination, particularly with spermatozoa preserved for relatively long periods of time), so that he can regulate population increase by voluntary control of fertility. Truly it can be said that man has the knowledge and the power to direct, at least in part, the course of his evolution.

This newly gained knowledge and power has not freed man from the inexorable effect of the biological laws that govern all living organisms. The evolutionary process has endowed most species with a reproductive potential that, unchecked, would overpopulate the entire globe within a few generations. It has been estimated that the tapeworm, *Taenia*, may lay 120,000 eggs per day; an adult cod can lay as many as 4 million eggs per year; a frog may produce 10,000 eggs per spawning. Human ovaries are thought to contain approximately 200,000 ova at puberty, while a single ejaculation of human semen may contain 200 million spermatozoa.

This excessive reproductive potential is kept in check for species other than man by interspecies competition in the struggle for existence, by disease, and by limitation of the available food supply. The fact that man has learned how to control, to a large extent, the operation of these biological checks upon unrestrained increase in number

has not freed him from the necessity of substituting for them less harsh but equally effective checks. The demonstration of his ability to do this cannot be long delayed.

Only fragmentary data are available to indicate the past rate of growth of the population of the world. Even today, the number of inhabitants is known only approximately. Regular censuses of populations did not exist prior to 1800, although registers were maintained for small population groups prior to that time. As late as a century ago, around 1860, only about one-fifth of the estimated population of the world was covered by a census enumeration once in a 10-year period (1). The commonly accepted estimates of the population of the world prior to 1800 are only informed guesses. Nevertheless, it is possible to piece together a consistent series of estimates of the world's population during the past two centuries, supplemented by a few rough guesses of the number of persons alive at selected earlier periods. The most generally accepted estimates are presented in Fig. 1.

These reveal a spectacular spurt during recent decades in the increase of the world's population that must be unparalleled during the preceding millennia of human existence. Furthermore, the rate of increase shows no sign of diminishing (Table 1). The period of time required for the population of the world to double has sharply decreased during the past three centuries and now is about 35 years.

Only a very rough approximation can be made of the length of time required for the population of the world to reach one-quarter of a billion persons, the estimated number at the beginning of the Christian era. The present subgroups of *Homo sapiens* may have existed for as long as 100,000 years. The exact date is not necessary, since for present purposes the evidence is sufficient to indicate that probably 50,000 to 100,000 years were required for *Homo sapiens* to increase in number until he reached a global total of one-quarter of a billion persons. This num-

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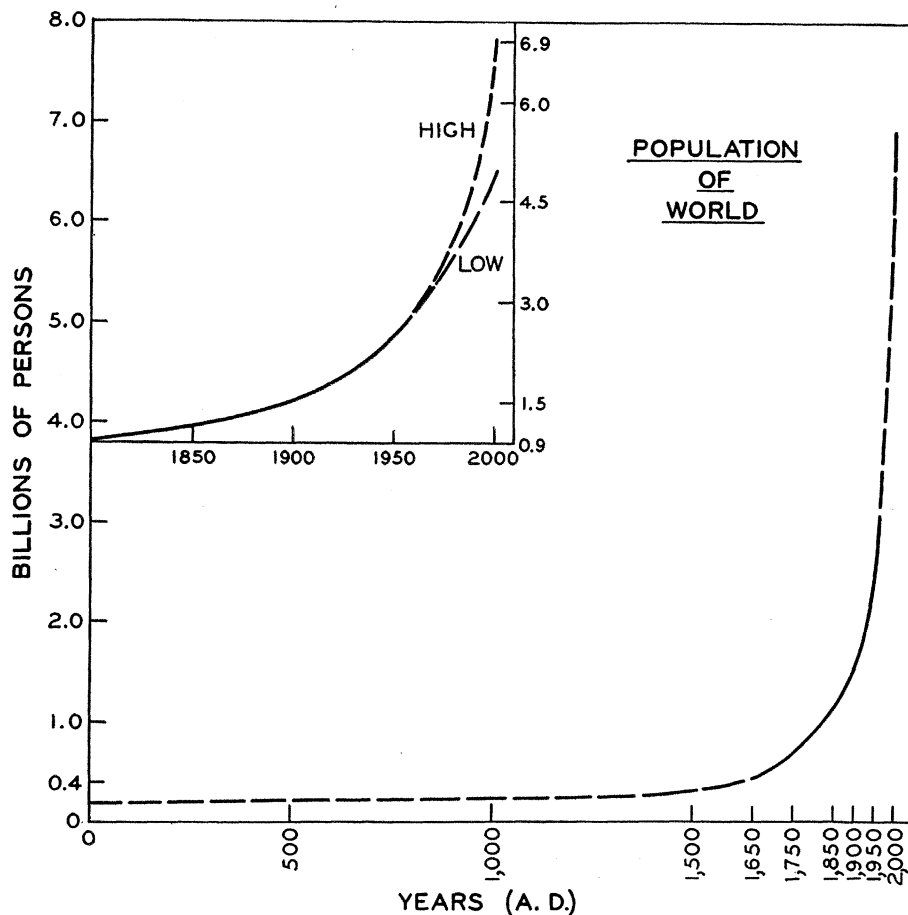


Fig. 1. Estimated population of the world, A.D. 1 to A.D. 2000.

ber was reached approximately 2000 years ago.

By 1620, the year the Pilgrims landed on Plymouth Rock, the population of the world had doubled in number. Two hundred years later, shortly before the Civil War, another 500 million persons had been added. Since that time, additional half billions of persons have been added during increasingly shorter intervals of time. The sixth half billion, just added, required slightly less than 11 years, as compared to 200 years for the second half billion. The present rate of growth implies that only 6 to 7 years will be required to add the eighth half billion to the world's population. The change in rate of growth just described has taken place since the first settlers came to New England.

Implications

The accelerating rate of increase in the growth of the population of the world has come about so unobtrusively that most persons are unaware of its implications. There is a small group

who are so aroused by this indifference that, like modern Paul Revere, they attempt to awaken the public with cries of "the population bomb!" or "the population explosion!"

These persons are called alarmists by those who counter with the assertion that similar warnings, such as "standing-room only" and "mankind at the crossroads," have been issued periodically since Malthus wrote his essay on population, about 200 years ago. Nevertheless, says this group, the level of living and the health of the average person has continued to improve, and there is no reason to believe that advances in technology will not be able to make possible a slowly rising level of living for an increasing world population for the indefinite future. Furthermore, the rate of population increase almost certainly will slow down as the standard of education and living rises and as urbanization increases.

A third group of persons has attempted to estimate the maximum population that could be supported by the world's physical resources provided existing technological knowledge is fully

utilized. Many of these calculations have been based on estimates of the quantity of food that could be produced and a hypothetical average daily calorie consumption per person.

As might be expected, the range of the various estimates of the maximum world population that could be supported without a lowering of the present level of living is very wide. One of the lowest, 2.8 billion, made by Pearson and Harper in 1945 on the assumption of an Asiatic standard of consumption, already has been surpassed (2). Several others, ranging from 5 to 7 billion, almost certainly will be exceeded by the end of this century. Perhaps the most carefully prepared estimate as well as the largest—that of 50 billions, prepared by Harrison Brown—would be reached in about 150 years if the present rate of growth should continue (3).

I believe it is worth while to prepare estimates of the maximum population that can be supported and to revise these as new information becomes available, even though most of the estimates made in the past already have been, or soon will be, demonstrated to be incorrect (in most instances too small), since this constitutes a rational effort to comprehend the implications of the increase in population. At the same time it should be recognized that estimates of the world's carrying capacity made in this manner are rather unrealistic and are primarily useful only as very general guidelines.

In the first place, these calculations have assumed that the earth's resources and skills are a single reservoir available to all. In reality this is untrue. The U.S. government attempts to restrict production of certain agricultural crops by paying farmers not to grow them. Simultaneously, in Asia and Africa, large numbers of persons are inadequately fed and poorly clothed. Except in a very general sense there is no world population problem; there are population problems varying in nature and degree among the several nations of the world. No single solution is applicable to all.

Since the world is not a single political unity, the increases in production actually achieved during any period of time tend to be considerably less than those theoretically possible. Knowledge, technical skill, and capital are concentrated in areas with the highest level of living, whereas the most rapid increase in population is taking place in

Table 1. The number of years required to double the population of the world. [From United Nations data (9, 14)]

Year (A.D.)	Population (billions)	Number of years to double
1	0.25 (?)	1650 (?)
1650	0.50	200
1850	1.1	80
1930	2.0	45
1975	4.0	35
2010	8.0*	?

*A projection of United Nations estimates.

areas where such skills and capital are relatively scarce or practically non-existent.

Just as the world is not a single unit from the point of view of needs and the availability of resources, skills and knowledge to meet these needs, so it also is not a single unit with respect to population increase. Due to political barriers that now exist throughout the entire world, overpopulation, however defined, will become a serious problem in specific countries long before it would be a world problem if there were no barriers to population redistribution. I shall return to this point later, after discussing briefly existing forecasts or projections of the total population of the world.

Most demographers believe that, under present conditions, the future population of areas such as countries or continents, or even of the entire world, cannot be predicted for more than a few decades with even a moderate degree of certainty. This represents a marked change from the view held by many only 30 years ago.

In 1930 a prominent demographer wrote, "The population of the United States ten, twenty, even fifty years hence, can be predicted with a greater degree of assurance than any other economic or social fact, provided the im-

migration laws are unchanged" (4). Nineteen years later, a well-known economist replied that "it is disheartening to have to assert that the best population forecasts deserve little credence even for 5 years ahead, and none at all for 20-50 years ahead." (5).

Although both of these statements represent rather extreme views, they do indicate the change that has taken place during the past two decades in the attitude toward the reliability of population forecasts. Some of the reasons for this have been discussed in detail elsewhere and will not be repeated here (6).

It will be sufficient to point out that knowledge of methods of voluntarily controlling fertility now is so widespread, especially among persons of European ancestry, that sharp changes in the spacing, as well as in the number, of children born during the reproductive period may occur in a relatively short period of time. Furthermore, the birth rate may increase as well as decrease.

Forecasting Population Growth

The two principal methods that have been used in recent years to make population forecasts are (i) the extrapolation of mathematical curves fitted to the past trend of population increase and (ii) the projection of the population by the "component" or "analytical" method, based on specific hypotheses concerning the future trend in fertility, mortality, and migration.

The most frequently used mathematical function has been the logistic curve which was originally suggested by Verhulst in 1838 but which remained unnoticed until it was rediscovered by Pearl and Reed about 40 years ago (7).

At first it was thought by some demographers that the logistic curve represented a rational law of population change. However, it has proved to be as unreliable as other methods of preparing population forecasts and is no longer regarded as having any unique value for estimating future population trends.

A recent illustration of the use of mathematical functions to project the future world population is the forecast prepared by von Foerster, Mora, and Amiot (8). In view of the comments that subsequently were published in this journal, an extensive discussion of this article does not seem to be required. It will be sufficient to point out that this forecast probably will set a record, for the entire class of forecasts prepared by the use of mathematical functions, for the short length of time required to demonstrate its unreliability.

The method of projecting or forecasting population growth most frequently used by demographers, whenever the necessary data are available, is the "component" or "analytical" method. Separate estimates are prepared of the future trend of fertility, mortality, and migration. From the total population as distributed by age and sex on a specified date, the future population that would result from the hypothetical combination of fertility, mortality, and migration is computed. Usually, several estimates of the future population are prepared in order to include what the authors believe to be the most likely range of values.

Such estimates generally are claimed by their authors to be not forecasts of the most probable future population but merely indications of the population that would result from the hypothetical assumptions concerning the future trend in fertility, mortality, and migration. However, the projections of fertility, mortality, and migration usually are chosen to include what the authors believe will be the range of likely possibilities. This objective is achieved by making "high," "medium," and "low" assumptions concerning the future trend in population growth. Following the practice of most of the authors of such estimates, I shall refer to these numbers as population projections.

The most authoritative projections of the population of the world are those made by the United Nations (9, 10) (Table 2). Even though the most recent of these projections were published in

Table 2. Estimated population of the world for A.D. 1900, 1950, 1975, and 2000. [From United Nations data (9), rounded to three significant digits]

Area	Estimated population (millions)		Projected future population (millions)			
	1900	1950	Low assumptions		High assumptions	
			1975	2000	1975	2000
World	1550	2500	3590	4880	3860	6900
Africa	120	199	295	420	331	663
North America	81	168	232	274	240	326
Latin America	63	163	282	445	304	651
Asia	857	1380	2040	2890	2210	4250
Europe including U.S.S.R.	423	574	724	824	751	987
Oceania	6	13	20	27	21	30

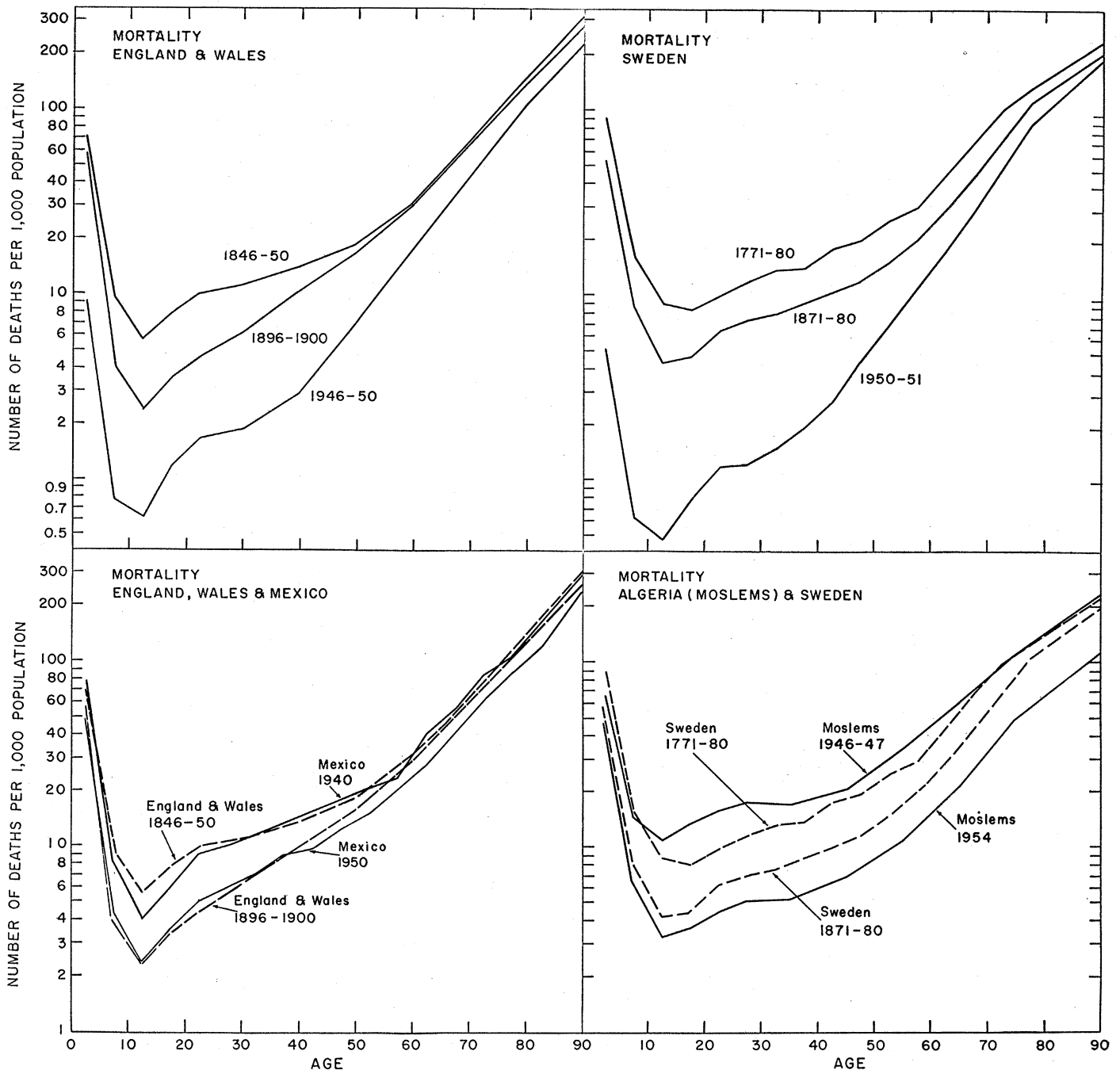


Fig. 2. Age-specific death rates per 1000 per year for Sweden, England and Wales, Mexico, and the Moslem population of Algeria for various time periods from 1771 to 1954.

1958, only 3 years ago, it now seems likely that the population of the world will exceed the high projection before the year 2000. By the end of 1961 the world's population at least equaled the high projection for that date.

Although the United Nations' projections appear to be too conservative in that even the highest will be an underestimate of the population only 40 years from now, some of the numerical increases in population implied by these projections will create problems that may be beyond the ability of the nations involved to solve. For example,

the estimated increase in the population of Asia from A.D. 1950 to 2000 will be roughly equal to the population of the entire world in 1958! The population of Latin America 40 years hence may very likely be four times that in 1950. The absolute increase in population in Latin America during the last half of the century may equal the total increase in the population of *Homo sapiens* during all the millennia from his origin until about 1650, when the first colonists were settling New England.

Increases in population of this magnitude stagger the imagination. Present

trends indicate that they may be succeeded by even larger increases during comparable periods of time. The increase in the rate of growth of the world's population, shown by the data in Table 1, is still continuing. This rate is now estimated to be about 2 percent per year, sufficient to double the world's population every 35 years. It requires only very simple arithmetic to show that a continuation of this rate of growth for even 10 or 15 decades would result in an increase in population that would make the globe resemble an anthill.

But as was pointed out above, the world is not a single unit economically, politically, or demographically. Long before the population of the entire world reaches a size that could not be supported at current levels of living, the increase in population in specific nations and regions will give rise to problems that will affect the health and welfare of the rest of the world. The events of the past few years have graphically demonstrated the rapidity with which the political and economic problems of even a small and weak nation can directly affect the welfare of the largest and most powerful nations. Rather than speculate about the maximum population the world can support and the length of time before this number will be reached, it will be more instructive to examine the demographic changes that are taking place in different regions of the world and to comment briefly on their implications.

Decline in Mortality

The major cause of the recent spurt in population increase is a world-wide decline in mortality. Although the birth rate increased in some countries—for example, the United States—during and after World War II, such increases have not been sufficiently widespread to account for more than a small part of the increase in the total population of the world. Moreover, the increase in population prior to World War II occurred in spite of a widespread decline in the birth rate among persons of European origin.

Accurate statistics do not exist, but the best available estimates suggest that the expectation of life at birth in Greece, Rome, Egypt, and the Eastern Mediterranean region probably did not exceed 30 years at the beginning of the Christian era. By 1900 it had increased to about 40 to 50 years in North America and in most countries of northwestern Europe. At present, it has reached 68 to 70 years in many of these countries.

By 1940, only a small minority of the world's population had achieved an expectation of life at birth comparable to that of the population of North America and northwest Europe. Most of the population of the world had an expectation of life no greater than that which prevailed in western Europe during the Middle Ages. Within the past two decades, the possibility of achieving

a 20th-century death rate has been opened to these masses of the world's population. An indication of the result can be seen from the data in Fig. 2.

In 1940, the death rate in Mexico was similar to that in England and Wales nearly 100 years earlier. It decreased as much during the following decade as did the death rate in England and Wales during the 50-year period from 1850 to 1900.

In 1946–47 the death rate of the Moslem population of Algeria was higher than that of the population of Sweden in the period 1771–80, the earliest date for which reliable mortality statistics are available for an entire nation. During the following 8 years, the drop in the death rate in Algeria considerably exceeded that in Sweden during the century from 1771 to 1871 (11).

The precipitous decline in mortality in Mexico and in the Moslem population of Algeria is illustrative of what has taken place during the past 15 years in Latin America, Africa, and Asia, where nearly three out of every four persons in the world now live. Throughout most of this area the birth rate has changed very little, remaining near a level of 40 per 1000 per year, as can be seen from Fig. 3, which shows the birth rate, death rate, and rate of natural increase for selected countries.

Even in countries such as Puerto Rico and Japan where the birth rate has declined substantially, the rate of natural increase has changed very little, owing to the sharp decrease in mortality. A more typical situation is represented by Singapore, Ceylon, Guatemala, and Chile, where the crude rate of natural increase has risen. There has been a general tendency for death rates to decline universally and for high birth rates to remain high, with the result that those countries with the highest rates of increase are experiencing an acceleration in their rates of growth.

Regional Levels

The absolute level of fertility and mortality and the effect of changes in them upon the increase of population in different regions of the world can be only approximately indicated. The United Nations estimates that only about 33 percent of the deaths and 42 percent of the births that occur in the world are registered (12). The percentage registered ranges from about 8 to 10 percent in tropical and southern Africa and Eastern Asia to 98 to 100 percent in North America and Europe. Nevertheless, the statistical staff of the United Nations, by a judicious combination of the available fragmentary data,

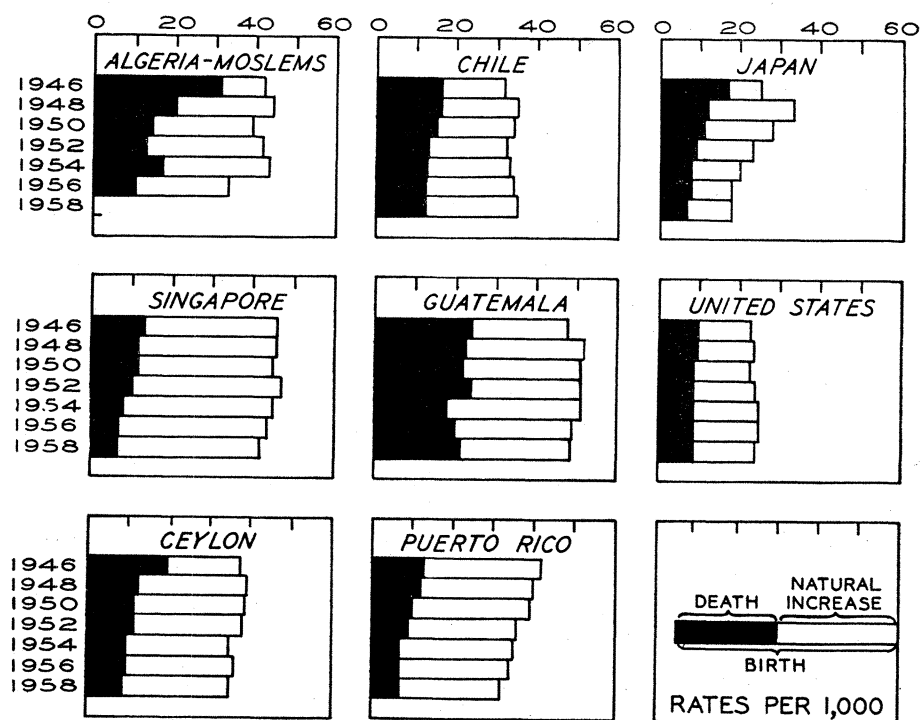


Fig. 3. Birth rate, death rate, and rate of natural increase per 1000 for selected countries for the period 1946–58.

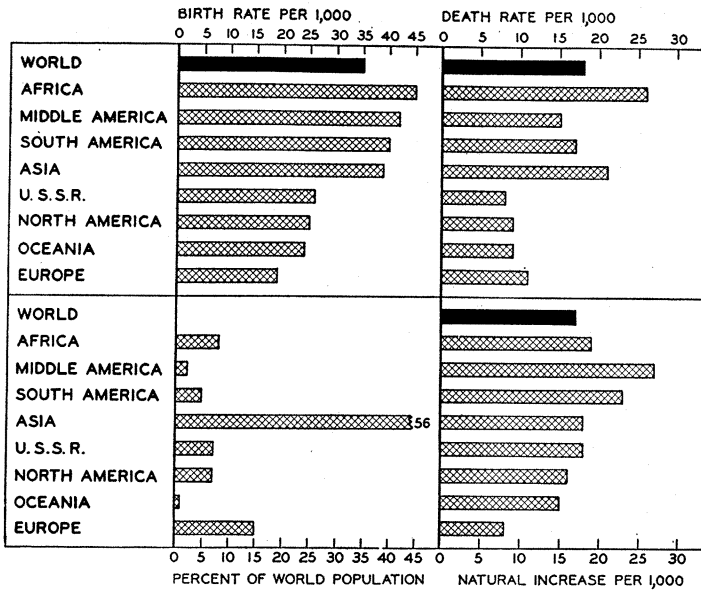
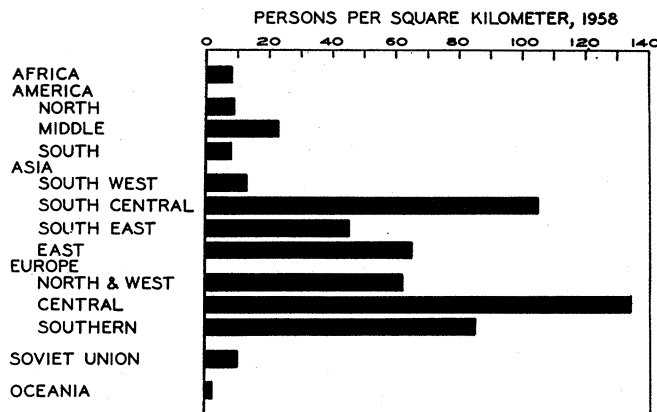


Fig. 4 (left). Percentage of the 1958 world population, birth rate, death rate, and rate of natural increase, per 1000, for the period 1954-58 for various regions of the world.

Fig. 5 (below). Number of persons per square kilometer in various regions of the world in 1958.



has been able to prepare estimates of fertility and mortality for different regions of the world that are generally accepted as a reasonably correct representation of the actual but unknown figures. The estimated birth rate, death rate, and crude rate of natural increase (the birth rate minus the death rate) for eight regions of the world for the period 1954-58 are shown in Fig. 4.

The birth rates of the countries of Africa, Asia, Middle America, and South America average nearly 40 per 1000 and probably are as high as they were 500 to 1000 years ago. In the rest of the world—Europe, North America, Oceania, and the Soviet Union—the

birth rate is slightly more than half as high, or about 20 to 25 per 1000. The death rate for the former regions, although still definitely higher, is rapidly approaching that for people of European origin, with the result that the highest rates of natural increase are found in the regions with the highest birth rates. The most rapid rate of population growth at present is taking place in Middle and South America, where the population will double about every 26 years if the present rate continues.

These regional differences in fertility and mortality are intensifying the existing imbalance of population with land area and natural resources. No matter

how this imbalance is measured, that it exists is readily apparent. Two rather crude measures are presented in Figs. 4 and 5, which show the percentage distribution of the world's population living in each region and the number of persons per square kilometer.

An important effect of the decline in mortality rates often is overlooked—namely, the increase in effective fertility. An estimated 97 out of every 100 newborn white females subject to the mortality rates prevailing in the United States during 1950 would survive to age 20, slightly past the beginning of the usual childbearing age, and 91 would survive to the end of the child-

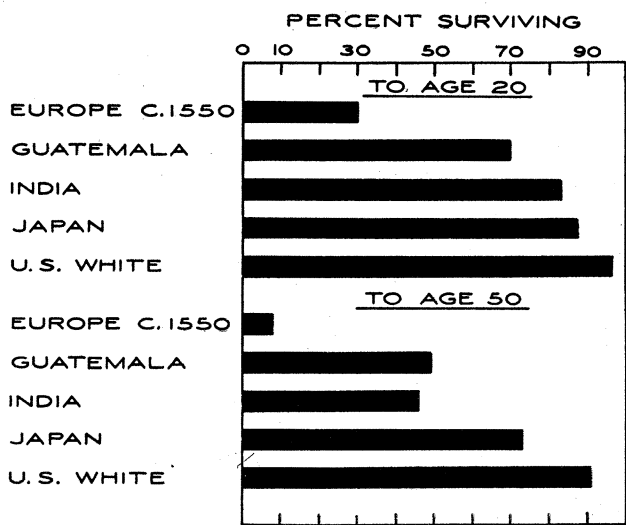


Fig. 6. Percentage of newborn females who would survive to the end of the reproductive period according to mortality rates in Europe around A.D. 1500 and in selected countries around 1950.

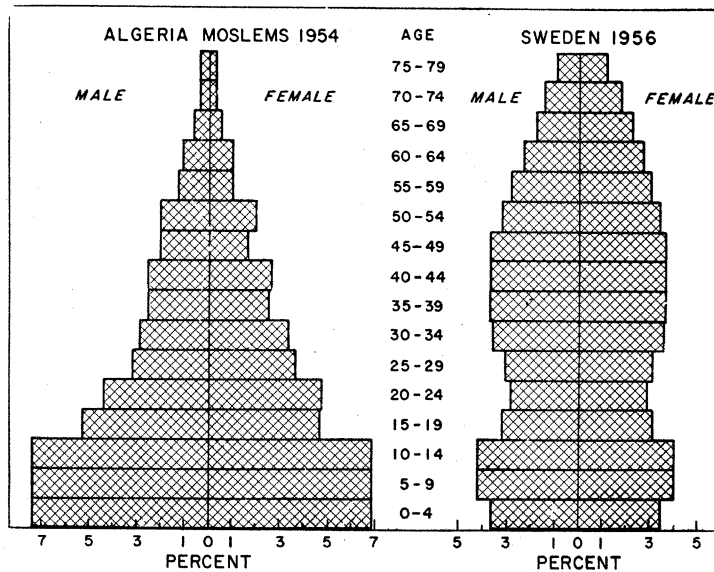


Fig. 7. Percentage distribution by age of the population of Sweden in 1956 and the Moslem population of Algeria in 1954.

bearing period (Fig. 6). These estimates are more than 3 and 11 times, respectively, the corresponding estimated proportions for white females that survived to these ages about four centuries ago.

In contrast, about 70 percent of the newborn females in Guatemala would survive to age 20, and only half would live to the end of the childbearing period if subject to the death rates prevailing in that country in 1950. If the death rate in Guatemala should fall to the level of that in the United States in 1950—a realistic possibility—the number of newborn females who would survive to the beginning of the childbearing period would increase by 36 percent; the number surviving to the end of the childbearing period would increase by 85 percent. A corresponding decrease in the birth rate would be required to prevent this increase in survivorship from resulting in a rapid acceleration in the existing rate of population growth, which already is excessive. In other words, this decrease in the death rate would require a decrease in the birth rate of more than 40 percent merely to maintain the status quo.

As can be seen from Fig. 3, the birth rate in countries with high fertility has shown little or no tendency to decrease in recent years. Japan is the exception. There, the birth rate dropped by 46 percent from 1948 to 1958—an amount more than enough to counterbalance the decrease in the death rate, with the result that there was a decrease in the absolute number of births. As yet there is very little evidence that other countries with a correspondingly high birth rate are likely to duplicate this in the near future.

Another effect of a rapid rate of natural increase is demonstrated by Fig. 7. About 43 percent of the Moslem population of Algeria is under 15 years of age; the corresponding percentage in Sweden is 24, or slightly more than half this number. Percentages in the neighborhood of 40 percent are characteristic of the populations of the countries of Africa, Latin America, and Asia.

This high proportion of young people constitutes a huge fertility potential for 30 years into the future that can be counterbalanced only by a sharp decline in the birth rate, gives rise to serious educational problems, and causes a heavy drain on the capital formation that is necessary to improve

the level of living of the entire population. A graphic illustration of this may be found in the recently published 5-year plan for India for 1961–66, which estimates that it will be necessary to provide educational facilities and teachers for 20 million additional children during this 5-year period (13).

Historical Pattern in Western Europe

Some persons, although agreeing that the current rate of increase of the majority of the world's population cannot continue indefinitely without giving rise to grave political, social, and economic problems, point out that a similar situation existed in northwestern and central Europe during the 18th and 19th centuries. Increasing industrialization and urbanization, coupled with a rising standard of living, led to a decline in the birth rate, with a consequent drop in the rate of increase of the population. Why should not the rest of the world follow this pattern?

There is small likelihood that the two-thirds of the world's population which has not yet passed through the demographic revolution from high fertility and mortality rates to low fertility and mortality rates can repeat the history of western European peoples prior to the development of serious political and economic problems. A brief review of the circumstances that led to the virtual domination of the world at the end of the 19th century by persons of European origin will indicate some of the reasons for this opinion.

Around A.D. 1500 the population of Europe probably did not exceed 100 million persons (perhaps 15 to 20 percent of the population of the world) and occupied about 7 percent of the land area of the earth. Four hundred years later, around 1900, the descendants of this population numbered nearly 550 million, constituted about one-third of the world's population, and occupied or controlled five-sixths of the land area of the world. They had seized and peopled two great continents, North and South America, and one smaller continent, Australia, with its adjacent islands; had partially peopled and entirely controlled a third great continent, Africa; and dominated southern Asia and the neighboring islands.

The English-, French-, and Spanish-speaking peoples were the leaders in this expansion, with lesser roles being

played by the Dutch and Portuguese. The Belgians and Germans participated only toward the end of this period of expansion. Among these, the English-speaking people held the dominant position at the end of the era, around 1900.

The number of English-speaking persons around 1500, at the start of this period of expansion, is not known, but it probably did not exceed 4 or 5 million. By 1900 these people numbered about 129 million and occupied and controlled one-third of the land area of the earth and, with the non-English-speaking inhabitants of this territory, made up some 30 percent of the population of the world.

This period was characterized by an unprecedented increase in population, a several-fold expansion of the land base for this population, and a hitherto undreamed of multiplication of capital in the form of precious metals, goods, and commodities. Most important of all, the augmentation in capital and usable land took place more rapidly than the growth in population.

A situation equally favorable for a rapid improvement in the level of living associated with a sharp increase in population does not appear likely to arise for the people who now inhabit Latin America, Africa, and Asia. The last great frontier of the world has been closed. Although there are many thinly populated areas in the world, their existence is testimony to the fact that, until now, these have been regarded as undesirable living places. The expansion of population to the remaining open areas would require large expenditures of capital for irrigation, drainage, transportation facilities, control of insects and parasites, and other purposes—capital that the rapidly increasing populations which will need these areas do not possess.

In addition, this land is not freely available for settlement. The entire land surface of the world is crisscrossed by national boundaries. International migration now is controlled by political considerations; for the majority of the population of the world, migration, both in and out of a country, is restricted.

The horn of plenty, formerly filled with free natural resources, has been emptied. No rapid accumulation of capital in the form of precious metals, goods, and commodities, such as characterized the great 400-year boom enjoyed by the peoples of western-Euro-

pean origin, is possible for the people of Africa, Asia, and Latin America.

Last, but not least, is the sheer arithmetic of the current increase in population. The number of persons in the world is so large that even a small rate of natural increase will result in an almost astronomical increment over a period of time of infinitesimal duration compared to the duration of the past history of the human race. As was pointed out above, continuation of the present rate of increase would result in a population of 50 billion persons in another 150 years. A population of this magnitude is so foreign to our experience that it is difficult to comprehend its implications.

Just as Thomas Malthus, at the end of the 18th century, could not foresee the effect upon the peoples of western Europe of the exploration of the last great frontier of this earth, so we today cannot clearly foresee the final effect of an unprecedented rapid increase of population within closed frontiers. What seems to be least uncertain in a future full of uncertainty is that the demographic history of the next 400 years will not be like that of the past 400 years.

World Problem

The results of human reproduction are no longer solely the concern of the two individuals involved, or of the larger family, or even of the nation of which they are citizens. A stage has been reached in the demographic development of the world when the rate of human reproduction in any part of the globe may directly or indirectly affect the health and welfare of the rest of the human race. It is in this sense that there is a world population problem.

One or two illustrations may make this point more clear. During the past decade, six out of every ten persons added to the population of the world live in Asia; another two out of every ten live in Latin America and Africa. It seems inevitable that the breaking up of the world domination by northwest Europeans and their descendants, which

already is well advanced, will continue, and that the center of power and influence will shift toward the demographic center of the world.

The present distribution of population increase enhances the existing imbalance between the distribution of the world's population and the distribution of wealth, available and utilized resources, and the use of nonhuman energy. Probably for the first time in human history there is a universal aspiration for a rapid improvement in the standard of living and a growing impatience with conditions that appear to stand in the way of its attainment. Millions of persons in Asia, Africa, and Latin America now are aware of the standard of living enjoyed by Europeans and North Americans. They are demanding the opportunity to attain the same standard, and they resist the idea that they must be permanently content with less.

A continuation of the present high rate of human multiplication will act as a brake on the already painfully slow improvement in the level of living, thus increasing political unrest and possibly bringing about eventual changes in government. As recent events have graphically demonstrated, such political changes may greatly affect the welfare of even the wealthiest nations.

The capital and technological skills that many of the nations of Africa, Asia, and Latin America require to produce enough food for a rapidly growing population and simultaneously to perceptibly raise per capita income exceed their existing national resources and ability. An immediate supply of capital in the amounts required is available only from the wealthier nations. The principle of public support for social welfare plans is now widely accepted in national affairs. The desirability of extending this principle to the international level for the primary purpose of supporting the economic development of the less advanced nations has not yet been generally accepted by the wealthier and more advanced countries. Even if this principle should be accepted, it is not as yet clear how long the wealthier nations would be willing

to support the uncontrolled breeding of the populations receiving this assistance. The general acceptance of a foreign-aid program of the extent required by the countries with a rapidly growing population will only postpone for a few decades the inevitable reckoning with the results of uncontrolled human multiplication.

The future may witness a dramatic increase in man's ability to control his environment, provided he rapidly develops cultural substitutes for those harsh but effective governors of his high reproductive potential—disease and famine—that he has so recently learned to control. Man has been able to modify or control many natural phenomena, but he has not yet discovered how to evade the consequences of biological laws. No species has ever been able to multiply without limit. There are two biological checks upon a rapid increase in number—a high mortality and a low fertility. Unlike other biological organisms, man can choose which of these checks shall be applied, but one of them must be. Whether man can use his scientific knowledge to guide his future evolution more wisely than the blind forces of nature, only the future can reveal. The answer will not be long postponed.

References and Notes

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