

AN APPRAISAL OF POPULATION THEORIES WITH AN INTRODUCTION TO THE THEORY OF EPIDEMIOLOGIC TRANSITION

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INTRODUCTION

The formulation of population theory is of utmost importance in providing a concise, systematic view of patterns of population change and in offering a plausible or scientifically acceptable general principle or body of principles to explain population phenomena. Population theory can also serve as a basis for possible prediction and a guide in policy formulation. It must be noted, however, that demography has been strongly oriented toward observation and empirical data rather than theory, so much so that some writers have been inclined to deny the existence-or the possibility of-a unified theory of population.¹ These writers propose that what we have is rather a collection of more or less fragmentary theories of society that beat somewhat tangentially on one or another population phenomenon. Such a view is, however, too extreme. Unmistakable interest in theory building, both in demography and in related disciplines-especially economics, sociology, mathematics, biology, and more recently epidemiology-can be cited. Admittedly, existing population theories tend to be conflicting rather than cumulative, and much work remains to be done in perfecting them.

In this overview, a convenient scheme of classification is adopted and a brief presentation of each group of theories is given as a basis for disclosing gaps in the existing knowledge of this vital area of population study. The scheme of classifying the major population theories is as follows:

- A. Pre-Malthusian heritage.
- B. Malthusian and related theories.
- C. Marxist and socialist theories.

- D. Biomathematical theories.
- E. Theory of optimum population.
- F. Transition theories (demographic and epidemiologic).

PRE-MALTHUSIAN HERITAGE

In ancient literature may be discovered the intellectual seeds of some present-day theories of population. Chinese philosophers, especially Confucius, conceived of a numerical balance between population and environment.² The concept of «checks» was also recognized. More importantly, the concept of optimum population, fully spelled out only in the twentieth century, finds its roots in the Chinese, and later in Greek, writings. In his *Laws*, Plato (427—347 B.C.) outlined an ideal state with an optimum number of citizens who should be neither too few nor too many, the limiting factors being the land, «how much of it is sufficient to feed how many temperate people—for there is no need—and how many would be able to defend themselves not altogether without resources against bordering tribes».³

The concept of population cycles is founded in the *prolegomena* of Ibn Khaldun (1332—1406), a Muslim historian and social scientist who presented a detailed theory of cyclical variations of population and their relationship to economic, political and social psychological conditions.⁴ He described how states pass through a population cycle, from high fertility and low mortality in their youth to declining fertility and a higher mortality in their later stages. According to Hutchinson, Ibn Khaldun went beyond «the conventional statment of the political and literary advantages of a large population and emphasized its economic significance. In so doing he introduced a new range of considerations into the discussion of population.»⁵

European writers during the Middle Ages and the Enlightenment were essentially pronatalist, believing that population growth in itself was a good thing and a mark of divine favor. The mercantilist and cameralist schools of political economy in particular emphasized the economic, political, and educational advantages of a large and growing population and favored various measures to stimulate population growth.⁶ Some writers, however, did voice concern about unlimited population growth, and Botero of the sixteenth century, among others, set forth some of the arguments including the possibility of checks to population growth—arguments which were later developed by Malthus.⁷ This latter school of thought, although perceptive, did not gain

popularity, and at the close of the eighteenth century the prevailing opinion was that continuing human progress would make possible the establishment of a just and happy society and that the world's population posed no obstacle to this achievement. Among the advocates of this opinion were Godwin and Condorcet, in challenge of whose ideas Malthus wrote in 1798 «An Essay on the Principle of population as It Affects the Future Improvement of Society with Remarks on the Speculations of Mr. Godwin, Mr. Condorcet, and Other Writers.» *

THE MALTHUSIAN THEORY

Malthus began the first edition of his essay with two postulates: that «food is necessary to the existence of man» and that «the passion between the sexes is necessary and will remain in nearly its present state.» He then argued that, «The power of population is indefinitely greater than the power in the earth to produce subsistence for man,» and that, «population when unchecked increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio. A slight acquaintance with numbers will show the immensity of the first power in comparison of the second.» He estimated the time needed for doubling of population if it were not impeded by lack of subsistence to be about 25 years. Since checks play a great role in limiting unusual population growth, Malthus devoted about one-third of the first essay to an examination of the operation of positive and preventive checks. Malthus considered as positive checks those factors that increase the death rate and thus destroy life already begun, including :

«The vicious customs with respect to women, great cities, unwholesome manufactures, luxury, pestilence and war. (These were restated in the sixth edition as ...) unwholesome occupation, severe labor and exposure to the seasons, extreme poverty, bad nursing of children, great towns, excesses of all kinds, the whole train of common diseases, and epidemics».

He believed that the positive checks arose basically from the pressure of population on subsistence. The «preventive checks» include all factors that would reduce the birth rate. In his opinion postponement of marriage and abstinence in marriage were the chief preventive checks.

This very forceful, challenging and provocative essay was followed by other slightly milder, but much more detailed editions to which

Malthus added much of his reading and experience during travels and discussions after the publication of the first essay. The seventh and last edition was published in 1834 shortly after Malthus' death. The following propositions represent his general position on population growth and form the main theme of his theory :

1. Population is necessarily limited by the means of subsistence.
2. Population invariably increases where the means of subsistence increase, unless prevented by some very powerful and obvious checks.
3. These checks, and the checks which repress the superior power of population and keep it on a level with means of subsistence, are all resolvable into moral restraint, vice and misery.

Thomlinson cites four especially important weaknesses in the theory.¹⁰ First, Malthus placed undue emphasis on the limitation of the supply of land. It was not possible for him to predict the nineteenth century revolution in agricultural methods, such as crop rotation, chemical fertilizers, plant and animal breeding, and improved livestock feed. Second, Malthus did not adequately recognize the potential for improvement in the standard of living through industrialization, technological innovation, transportation and superior distribution techniques. Third, he did not take into consideration the developments in international trade and transport with possibilities of importing raw materials and exploitable labor supply and of opening new markets for the export manufactured products. Related to this is the possibility of immigration from crowded Europe to the New World. Finally, Malthus' religious beliefs prevented him from grasping the possibility of widespread use of contraception; he believed only in moral restraint. To this might be added another shortcoming of the theory in the continued use of the arithmetic and geometric ratios to illustrate his point that the rate of population growth was as a rule faster than that of the growth of subsistence. If these ratios actually prevailed, population would increase to 64 times its original size in 150 years, while subsistence would increase to only seven times its original amount. This, of course, is inconceivable.

Despite these shortcomings, Malthus' theory continues to be a most provocative, thorough, and widely discussed work in the field of demography.¹¹

Other non-socialist nineteenth century theories

About the time of Malthus; and throughout the greater part of the nineteenth century, many non-socialist theories relating to

population were introduced. Some examples may be very briefly stated here. (a) Sadler believed that the natural law of population growth was exactly contrary to that proposed by Malthus, that the fecundity of human beings is, *coeteris paribus* (all other things being equal), in inverse ratio to the condensation of their numbers.¹² (b) Doubleday held that man's increase in numbers was inversely related to his food supply, meaning that fecundity decreases with betterment of nutrition¹³. Recently de Castro extended this theory and suggested that a high protein content in the diet reduces fecundity, while a low protein content raises it.¹⁴ (c) Spencer belived in the existence of an inverse relationship between fecundity, on the one hand, and mental labor and personal development on the other.¹⁵ He proposed that the deficiency of reproductive power among upper class girls, who are better fed and receive no worse physical treatment than their impoverished peers, may reasonably be attributed to the overtaxing of their brains, which has a serious effect on their physique. It must be stated that there is no scientific or statistical foundation for these three theories. (d) Gini developed a complicated theory of population changes as they affect the evolution of society. He believed that evolutionary changes in society were based on biological adaptation in man. One of these biological changes was a reduction in man's fecundity in successive generations.¹⁶ (e) Dumont developed a theory of social capillarity. He believed that members of society tend to mount to higher levels in the social environment by a process similar to the physical capillarity of fluids. In so doing, their productivity changes and their fertility decreases.¹⁷

SOCIALIST AND MARXIST THEORIES

The socialist school of thought does not believe in the existence of an overpopulation problem or in a universal law of population. Its advocates accuse capitalist economic systems of the evils attributed by non-socialist theoreticians to apparent population problems. Pre-and para-Marxian socialists rejected Malthus and believed that capitalism is essentially responsible for population pressure, which could be relieved by (a) elimination of inequities in the land ownership system and tax structure with the assumption that land reform would enable men to support large families comfortably (George, 1879), (b) a better wage system (Loria, 1882), or (c) establishment of a strong social organization with opportunity for equality and the development of individuality (Nitti, 1894).¹⁸

Karl Marx attributes the appearance of overpopulation to the deliberate creation of a surplus labor force by the capitalist class. With the threat of unemployment, workers can be more readily exploited. Marx also indicated that, under capitalism, a temporary excess of «surplus capital» over the working population would raise wages and thus reduce mortality and raise the marriage rate, so that the working population would increase. Relative overpopulation would be augmented also by technological unemployment due to this capital surplus. Marx rejects Malthus' theory especially the stress on biological causation of population pressure and poverty. Marx proposed that relative overpopulation of the sort associated with the capitalist mode of production would disappear when capitalism was superseded by a collective mode of production. He launched a very bitter attack on Malthus and described the first essay of Malthus as :

*«A school-boyish, superficial, and personate declamatory plagiarism from Defoe, Sir James Steuart, Townsend, Franklin, Wallace, and others and did not contain a single sentence thought out by Malthus himself. It was nothing but partisan interest which directed so much attention to this pamphlet ... it should be further noted that Malthus was a parson in the Church of England.»*¹⁹

These socialist themes were reiterated by the followers of Marx, including Lenin, Stalin, and Gertsyk ;²⁰ also, as late as 1959, Smulevich was still writing of distortions of population problems in bourgeois literature and the insolubility of population and public health problems within the framework of capitalism.²¹ Rather than considering contraceptive methods and other family planning procedures, communism considers itself the only remedy for the overpopulation problem because it alone can guarantee to produce employment as fast as, or faster than, man can reproduce.

BIOMATHEMATICAL THEORIES

Some attempts have been made to apply mathematical and biological laws of demography. Quetelet pioneered in this approach in 1835 ; he held that the obstacle to population growth increase in direct proportion to the square of the rate of increase. Thus, in the absence of social change, a population tends to grow more and more slowly.²² Three years later Verhulst suggested that a symmetrical, theoretical curve, which he named logistic, was suitable to describe the course of population growth.²³ This work was forgotten until the 1920's when it was independently rediscovered by Pearl and

Reed, biological investigators who found that the logistic curve provides an accurate description of animal and plant populations living in a limited and constant environment.²⁴ As Pearl put it «*Growth occurs in cycles. Within one and the same cycle and in a space yearly limited area or universe, growth in the first half of the cycle starts slowly but the absolute increment period of time increases steadily until the mid-point of the cycle is reached. After that point the increment period of time becomes smaller until end of the cycle, ».*

Pearl went further to fit the logistic curves to human populations, including the United States, City of New York, City of Baltimore, and Algeria. In 1949 Cowgill, assuming that growth cycles may be observed in many varied populations and assuming an S-curve shape of growth, tried to examine mechanics by which such growth takes place²⁵. He derived four types of population cycles which can theoretically lead to a logistic curve type of population growth. The cycles were described as follows :

Cycle I. (The Primitive Cycle) : While the birth rate remains stationary, the death rate falls, then rises again to terminate the cycle.

Cycle II. (The Modern Cycle) : This cycle is characterized by both falling birth rates and falling death rates; but in the initial stage the death rate more rapidly than the birth rate only to be overtaken by a more rapidly falling birth rate in the later stages of the cycle.

Cycle III. (The Future Cycle) : This cycle is initiated by a rising birth rate and brought to a close by a recession of the birth rate, while the death rate remains stable.

Cycle IV. This cycle is also initiated by a rising birth rate but is terminated by a subsequent rise in the death rate.

The logistic law, as a general theory applicable to all types of population growth, was not universally accepted, although critics have looked upon it primarily as an empirical formula which sometimes describes the course of population growth under restricted conditions. One difficulty with logistic theory lies in the unpredictability of the asymptotes, particularly the upper asymptote.

Another mathematical concept was introduced in 1929 by Amoroso and was known as the concept of «demographic elasticity.»²⁶ In one sentence it represents the relationship between the logarithmic derivative of the population, considered as a function of time, and the

corresponding logarithmic derivative of an index of economic activity. This concept was later elaborated upon and reformulated by Vinci and Vianelly .

THEORY OF OPTIMUM POPULATION

An important question of great significance in population policy was stated by Knut Wicksell in 1901.²⁸

«Under given conditions what population density is most advantageous to a nation? Is the actual population under the given conditions too large, the right amount, or too small; and in what criteria is the answer to be determined?».

In other words, what characterizes and determines an optimum population?

Spengler defines the term optimum population as denoting a population of such a size that, given this population, a specified indicator of welfare is maximized. This indicator may be output, or consumption per capita, or some more complicated social welfare function.²⁹ Sauvy gives the following list as an example of ends to be achieved :

«Full employment, that is, work for all persons of working age ; Power, that is, the full range of means that can be set to work to obtain a collective end, whatever the end may be:

Long life and good health;

Knowledge and culture;

Aggregate welfare, or, put in a slightly different way, the aggregate income of the population;

Number of years lived by the population as a whole;

Average standard of living.»³⁰

We have seen that the notion of a population optimum was conceived by ancient philosophers in China and Greece, and much later by Wolff, Rousseau, Genovesi, Holbach, and others in the eighteenth century.³¹ The modern, more specific formulation was a logical development from theoretical foundations in classical economics. Such formulations were attempted early, without use of the term «optimum,» by Karl Winklerblech (Marlo), Sidgwick, and others³² before Edwin Cannan gave a more systematic expression in *Elementary Political*

Economy, where he stated:

«Under certain circumstances the productiveness of industry in a country or countries may be affected by an increase or decrease of the population of the country or countries in question. It is not true that an increase of population must always diminish the productiveness of industry, or that a decrease of population must always diminish it. The truth is that the productiveness of industry is sometimes promoted by an increase of population, and, sometimes by a decrease of population.

The only real «Law of Population» is simply this :

« At any given time the population which can exist on a given extent of land, consistent with the attainment of the greatest productiveness of industry possible at that time, is definite. »

Cannan did not use the term «optimum population» until 1928 in the third edition of *Wealth* in a section entitled «The Optimum or Best Possible Population.»³⁴ It is of interest that Cannan, in anticipation of a major criticism of the theory—namely that the concept of optimum is static—explained that optimum population size is not fixed but continually subject to change. This defense was to be strengthened by Gottlieb in 1945, who criticized the earlier models specifying an «optimum point.» and endorsed the later writers who emphasized, with justice, the consideration of an optimum «zone» or «area» rather than a «point.» Thus, we have the optimum «zone» of Gini (*Zona di optimum*), the «plateau» of Penrose, and the optimum «area» of Fairchild. Gottlieb tried also to defend the concept against other criticisms which he summarizes as follows:

« The formal validity of the (optimum) concept has been challenged, the accusations ranging from comparatively modest assertions that it is « essentially unscientific, » « old static analysis, » and of « only obstacle value » (« nur ideellen Wert ») to strident claims that the concept is a « vicious logical circle » or a « will-o-the-wisp, » « one of the most sterile ideas that ever grew out of our science » being merely an « intuitive » or a strictly value concept, » a « speculative construction of little importance for judging actual situations, » and « not really entitled to a place in the corpus of theoretical economics. »³⁵

Despite the severity of these criticisms, the concept has been promoted through the writings of Wolfe, Carr-Saunders, Keynes, Robbins, Ferenczi, Gottlieb, Sauvy, Spengler, and others.³⁶ David, Lindsay, and Huang have shown great interest in reformulating the concept further and in empirically testing the basic propositions³⁷.

TRANSITION THEORIES

Theory of demographic transition: For the last few decades, demographers have been using with great enthusiasm a threefold classification of population types called «demographic revolution.» The first to describe these types was Warren Thomson in 1929. Later, in 1945 Frank Notestein, unaware of Thomson's contribution, described almost the same types of population and gave them the following descriptive titles: incipient decline, transitional growth, and high growth potential.³⁸ Both writers elaborated further on these concepts in subsequent papers.⁴⁰ Other writers have joined the work on formulation of the theories.⁴¹ Patterned along the historical changes in Western Europe during the last two centuries, this concept assumes a series of related trends within both the vital and industrial revolutions, as briefly stated below:

(a) *Populations of incipient decline:* Notestein initially describes these populations as those in which fertility has fallen below the replacement level or those in which it is near and rapidly approaching that level. This describes the final stage of transition in the «West.» Included in this group are the populations of Northern, Western, and Central Europe, the United States, Australia, New Zealand, and—more doubtfully—those of Canada and Southern Europe.⁴²

It might be added that this type of demographic balance has typically occurred within the conditions of a high degree of literacy, heavy urban concentration (or modernization), advanced industrialization, and emancipation of women.⁴³

(b) *Population of transitional growth :* These population as initially described by Notestein are those in an earlier stage of demographic evolution. Birth and death rates are still high and growth is rapid, but the (later) decline of the birth rate is well established. This typically describes the middle stage of Western transition. It is given this name because the processes of modernization have already begun to reduce fertility and mortality in ways that are very likely to bring rapid growth. The regions now in this stage include Eastern Europe, the Soviet Union, Japan, and parts of Latin America.⁴⁴

(c) *Populations of high growth potential* : These are populations which have scarcely begun their demographic transition. Mortality is high and variable and is the chief determinant of growth, while fertility is high and thus far has shown no evidence of a downward trend. In these populations rapid growth is to be expected just as soon as technical developments make possible a decline in mortality. Typically this stage is characteristic of medieval Europe before the industrial revolution. The contemporary representatives of this stage «are the least homogeneous of all, having as their only central characteristics the fact that the birth rates haven't thus far given no clear indication of a downward trend. Their death rate is generally high, but some of them are declining rapidly, others little, and it is possible that some are rising. Some of the populations are growing rapidly, others and for all we know may be declining. More than half of the world's population falls into this class, which includes virtually all of the Far East, except Japan, most of Africa north of the Union, much of Latin America, most of the Middle East.»⁴³ These populations have a young average age and are characterized generally by a low level of technological development.

As initially conceived, these three types were based upon prediction and assumed sequences, which made them a target of criticism. The major criticism is that transition theory was developed inductively on the basis of the observed experience of Western European nations following the industrial revolution. As a valid theory, it would supposedly be able to predict the demographic change in other countries. As Micklin puts it :

*«It was expected that as the lesser developed societies become increasingly urbanized and industrialized, they too will be characterized by: (1) declining mortality rates, and (2) declining fertility rates, the end result being drastically reduced rates of growth observed in those countries which have earlier gone through the transition. Such has not been the case.»*⁴⁶

It should be noted that the initial description of population types was very vague, and that Notestein in later publications has made a great effort indeed to elaborate on these types so that they can be applied to the current population groupings in the world. So did Warren Thomson and many other demographers.

Critics have also taken issue with the tripartite typology. Joseph Davis, for example, indicates that the three neat categories of peoples

which Thomson and Notestein had developed/are an unsatisfactory analysis of such future population growth, and that if they are not abandoned subcategories are urgently needed; listings of nations also require reconsideration.⁴⁷ Other writers have tried to increase or decrease the number of categories. Blacker, for example, has specified five stages, Hatt and his coworkers postulated seven types of population balance, and recently Wilber suggested eight.⁴⁸ On the other hand, Ryder compressed the classification into two stages, which differentiate between efficient and inefficient forms of population replacement.⁴⁹ Von Nort and Karon do away with any types, and, with an intention to increase the specificity and precision of the theory, they reformulated it as follows:

«That mortality and fertility are so related to urbanization and industrialization that low levels of the vital rates are associated with high levels of modernization, and that high levels of the vital rates are associated with low levels of modernization, and further that medium levels of modernization will serve to depress mortality more rapidly than fertility.»⁵⁰

Theory of epidemiologic transition : The interest of epidemiology in population dynamics as a distinct area for conceptualization and field research is fairly recent. The formulation of a theory of epidemiologic transition was conceived by the author in 1967 and a preliminary account of the theory was published in 1969. A basic paper was published in 1971.⁵¹ The following is a brief description of historic population change in the West based on some concepts of the epidemiologic transition. For this discussion, epidemiology will be defined as the discipline concerned with the occurrence and distribution of health, disease and death, and their determinants in population groups.

By definition, therefore, population change (in size, composition, and distribution) and the dynamics of such a change become the concern of epidemiologists. This is even more so since the behavioral pattern of the population phenomena—the phenomena of fertility, mortality, and migration—is essentially epidemiologic.

In order to bring this concept into focus the tripartite typology already used in demographic transition theory will be employed here to describe in capsule form the historical experience of the West in the last two centuries. As shown in Table 1, transition occurred not only in the demographic variables, but also in many of their

determinants exemplified by social, societal, economic, and energy transitions. These transitional changes were associated with epidemiologic changes in health, disease, and death and their determinants. The dynamic association between the epidemiologic variables and each set of the other variables was acting in both directions, with the epidemiologic phenomena sometimes being the dependent and at other times the independent variables.

TABLE 1
Macro-Transitions in the West

	PRE-INDUSTRIAL	EARLY WESTERN	MODERN WESTERN
DEMOGRAPHIC TRANSITION (Thomson- Notestein)	High growth potential	Transitional growth	Incipient decline
SOCIETAL TRANSITION (D. Reisman)	Tradition- directed society	Inner-directed society	Other-directed society
ECONOMIC TRANSITION (C. Clark)	Primary economic sphere (agrarian)	Secondary economic sphere (early industr.)	Tertiary economic sphere (industrialized)
ENERGY TRANSITION	Primitive, manual agricul- ture	Early energy transition	Developed energy transition
EPIDEMIOLOGIC TRANSITION (A.R.Omran)	Age of Pestilence and Famines	Age of Receding Pandemics	Age of Degenerative and man-made disease

1. Age of Pestilence and Famine :

Space does not allow diagrammatic representation of the complex dynamics of the interaction among all the variables. For the purpose of illustration, we will describe a pre-industrial society in Europe which is traditional, economically underdeveloped, premominantly agrarian (with primitive or manual agriculture), whose women are unemancipated, uneducated, devitalized by repeated pregnancies and the care of a large family, and with medieval medical and healing practices. In such a society are found the cultural, demographic, physical, and biological prerequisites for the epidemic prevalence

of infectious and deficiency diseases. Thus, this country is in the stage of the epidemiologic transition called the «Age of Pestilence and Famine.» These types of diseases are notorious for a high case-fatality rate, especially in the absence of specific therapies, such as antibiotics, and efficient medical care. Therefore, mortality will be maintained at a high level ; in response to high mortality, fertility is also sustained at a high level. This situation corresponds to the first stage of the demographic transition, called «population of high potential growth,» because once the death rate does decline, population growth will be very rapid.

Examples of the diseases that have plagued the population of Western Europe—indeed, that of most of the Old World—for many centuries are plague, typhus, yellow fever, cholera, smallpox, grandpox (syphilis), malaria, diarrhea, diphtheria, and typhoid. The impact of these diseases on the mortality rate was great and even resulted in partial depopulation. For example, one-fourth of the population of Europe died in the Black Death of the fourteenth century, and one-sixth of the population of England died in the Great Plague of 1664. Tuberculosis played also an important role in mortality dynamics.

Diseases of undernutrition which were once encountered in Europe are anemia, pellagra, scurvy, beriberi, and rickets. Famines (such as the potato famine in Ireland) were also common and contributed to the high death rate. Even in the absence of outright starvation, chronic malnutrition is a major factor in predisposing to infections and in enhancing their fatality rate. Epidemics, famines, and occasional wars constitute positive «Malthusian checks,» which restrained the population of Europe from rapid growth.

2. *Age of Receding Pandemics* : With changes in each of the sets of variables, as shown in Table 1, a stage was reached when improvements in social & economic conditions, increased urbanization, modernization, better education, industrialization, improvement in the status of women, and some sanitary and medical progress were achieved. These factors precipitated changes in the epidemiology of many of the then-existing diseases. The so-called great pandemics and epidemics became less and less frequent, thus gradually allowing the death rate to decline slowly; thus the period is called the «Age of Receding Pandemics.» Since during that time the population was still oriented to a high mortality, their fertility remained high, resulting in persistent, rapid population growth. This period of epidemiologic change corresponds to the second stage of the demographic transition, the transitional

stage, in which the population increases very rapidly, especially during the early part of the stage. Toward the latter part of this stage, to some extent because declining mortality becomes very obvious, a culture of birth control is slowly adopted which leads to controlled fertility.

3. *Age of Degenerative and Man-Made Diseases* : During a modern stage characterized by high levels of modernization, industrialization, urbanization, emancipation of women, cultural aspiration, education, ultramodern medical and public health practice as well as death and birth control, the infectious and deficiency diseases retreat as leading causes of death. Since such diseases are killers of the young, their decline results in a great increase in life expectancy. In areas where this transitional stage has been reached, life expectancy is at least 70 years, which is the Biblical «three-score and ten» long cited in history as a limit to man's stay on earth. Infectious and deficiency diseases have now been replaced by heart disease, malignancy, accidents, mental illness, metabolic disturbances, and industrial diseases, making this the «Age of Degenerative and Man-Made Diseases.» It corresponds to the third stage of the demographic transition, «incipient decline,» in which both the birth rate and the death rate are very low, with a possibility that the birth rate may drop even lower than the death rate, at which point a decline in population could occur.

Other models of the epidemiologic transition : The epidemiologic transition in the West is only one model of the transition from high mortality and fertility to low mortality and fertility. A second model, the accelerated model, occurred in Japan, where the decline in fertility was much accelerated by the use of induced abortion. A third model, the contemporary one, has been occurring in the developing countries.

A major difference between the Western model and the contemporary or delayed model of transition is that the first is socially dependent, hence slow in keeping pace with the stage of development. The second is socially independent and medically dependent instead. Hence, it is more rapid in evolution. This can be explained by the behavior of the death rate in response to changes in the epidemiology of causes of death. In the West prior to the discovery of specific, decisive and effective preventive and curative measures, the change from the infectious disease pattern to the degenerative disease was very slow and occurred in response to slowly developing changes in social and cultural patterns, as well as slowly improving public health, sanitary and medical practices. In the contemporary or delayed model, rapid declines in mortality followed World War II in response to «imported» disease control and eradication programs, environmental

control efforts, and use of new discoveries such as penicillin and DDT. Programs of this sort have typically been the work of international humanitarian or philanthropic organizations, which have provided massive medical and public health programs to developing nations at little or no local cost. The most prominent disease control and eradication program has been the anti-malaria campaign. Malaria has been eradicated from many areas of the world, and many other diseases have been or soon will be either eradicated or brought under control through similar mass-campaign approaches. The result is a very rapidly declining death rate independent of the stage of social and economic development of the country, while the birth rate is sustained at a very high level. In other words, we are witnessing in many of the developing nations a twentieth century mortality rate leading a medieval birth rate. The result is an unprecedentedly high rate of natural increase in the population.

A third model, the accelerated transition model, occurred in Japan. It began as a classical model during the latter part of the nineteenth century, with slow changes in mortality and fertility. Mortality decline increased in the twentieth century, and a slow decline in fertility occurred between 1920—1947, mostly as a result of increased use of contraception and delayed marriage. The fertility decline was substantially accelerated after 1947 by the liberal use of induced abortion.

CONCLUSION

This paper has provided a brief historical survey of population theories, including some evaluation of each. The demographic transition theory has also been considered, as a background to the theory of epidemiologic transition.

The description given here of the epidemiologic transition has set forth three stages that a society may pass through during the course of the transition—the Age of Pestilence and Famine, Age of Receding Pandemics, and Age of Degenerative and Man-Made Diseases. Different types of societies will experience these stages in slightly different ways, hence the three models of the transition—classical, contemporary and accelerated. Much more research is needed in order to elaborate the theory of epidemiologic transition as a workable explanation of population change, to establish more firmly models to describe it, and to investigate how the theory may be applied to various specific countries.

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