

POPULATION DIVISION
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Foreword

The *Population Bulletin of the United Nations* presents brief articles relating to population which, by their nature, do not require separate publication. Material for the *Bulletin* is selected in the light of the interests and needs of Governments, international organizations, research institutions and individuals engaged in social and economic research, as well as the public interested in population.

The first seven issues of the *Population Bulletin* were prepared by the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat between 1951 and 1963. The *Bulletin* has now been reinstated as a United Nations publication in accordance with the endorsement and recommendation of the Population Commission at its eighteenth session, and, as in the past, it will be prepared by the Population Division.

It is expected that most of the articles to be published in future issues of the *Bulletin* will be prepared by the United Nations Secretariat in pursuance of the programme of work recommended by the Economic and Social Council and the Population Commission. Studies by consultants and reports of meetings organized by the United Nations, or excerpts from such studies and reports, may also be included. In addition, contributions will be solicited from the specialized agencies of the United Nations, the secretariats of the regional commissions and scholars.

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EXPLANATORY NOTES

The following symbols have been used in the tables throughout the report:

Three dots (...) indicate that data are not available or are not separately reported

A dash (—) indicates that the amount is nil or negligible

A blank in a table indicates that the item is not applicable

A minus sign (–) indicates a deficit or decrease, except as indicated

A full stop (.) is used to indicate decimals

A comma (,) is used to distinguish thousands and millions

A slash(/) indicates a crop year or financial year, e.g., 1970/71.

Use of a hyphen (-) between dates representing years, e.g., 1971-1973, signifies the full period involved, including the beginning and end years.

Reference to "tons" indicates metric tons, and to "dollars" (\$) United States dollars, unless otherwise stated.

Annual rates of growth or change, unless otherwise stated, refer to annual compound rates.

Details and percentages in tables do not necessarily add to totals, because of rounding.

NEW EMPHASES IN DEMOGRAPHIC RESEARCH AFTER BUCHAREST?

Léon Tabah *

PURPOSE

The objective of this article is not to prepare an inventory of needs for demographic research. That task has been done recently topic by topic.¹ Nor is it to review what some traditionally call the "state of the art", a kind of balance-sheet of procedures which specialists use. Rather, it is to discuss the extent to which demographic research appears to be affected by what has been a major event for the discipline, namely, the World Population Conference, held at Bucharest, Romania from 19 to 30 August 1974. At that conference, for the first time, representatives from virtually all Governments met to deal with world population problems.

The subject is approached less from the point of view of theoretical knowledge than from that of applied knowledge, stressing less the word "science" than the word "art", in the meaning which it has assumed since the thirteenth century, namely, that of a "body of knowledge and rules for action", a bundle of action-oriented processes more or less inspired by science.

It goes without saying that the author must, by the very nature of the subject, introduce his own value judgements and express views which are strictly personal and commit no one but him.

The problem is to determine the extent to which the general framework for demographic research, which is popularly termed the "paradigm" of the discipline²—that is, the articulated body of concepts, theories, techniques and values—has been modified or even challenged, following the conference at Bucharest, the essential characteristic of which was to introduce a political dimension into the field. Has one model been destroyed and another substituted? Did the introduction of politics cause an "epistemological rupture" which would lead to a reappraisal of the importance

and the scope of the discipline in the range of social sciences?

The general question may be subdivided into several others:

(a) Have new variables surfaced as others appeared obsolete? If so, to what extent have the rules of the art adopted so far been able to solve new problems appearing to politicians? Must not an entire series of concepts and techniques be reviewed?

(b) Does a reorganization appear indispensable in order to satisfy the wishes of the international political community? Should this reorganization tend to enlarge or to restrict the field? A new allocation of subjects within the discipline does not appear desirable, because all of the components cannot advance at the same pace indefinitely. If this is so, which ones must be promoted and which abandoned? Must the goals and the priorities be re-examined? Must the change be radical and must it entail a "return to square one", or should it be gradual, or nominal, because everything will resume as if nothing has happened?

(c) Demographers form a relatively small community, where communication is rather easy. Has their spirit been shaken? Are they going to change, or on the contrary do they still cling to archaic methods of thinking and acting? This conservative attitude will doubtless be seen among the most specialized, or among those who have acquired the most prestige in tasks that have led to a body of complex knowledge, and who, wishing to go even deeper, will, therefore, be reluctant to abandon it. Is not the change going to meet with a resistance from the establishment, ill-prepared to adapt itself to a new climate? And what about institutions that finance research when funds are becoming more and more scarce, and when the Conference has kindled a new interest in the problems of population and multiplied the appeals to them? Are the directions deriving from the Conference responsive to their expectations, do they fit with their own ideologies; or, disappointed, are the donors of funds going to change their minds and adopt other strategies? In some of his statements to the forum organized simultaneously with the Conference, the representative of a major foundation in the United States of America indicated an approach to the problem different from the one which has existed.

The interest and importance of these questions cannot be ignored and it was worth taking advantage of the Conference at least to pose them, even if one

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¹ International Union for the Scientific Study of Population, "Research needed in the field of population", *The Population Debate: Dimensions and Perspectives; Papers of the World Population Conference, Bucharest, 1974*, vol. I (United Nations publication, Sales No. E/F/S.75.XIII.4), part three, pp. 385-89 (hereinafter cited as *Population Debate*).

² T. S. Kuhn, *The Structure of Scientific Revolutions*, 2nd ed. (Chicago, Illinois, University of Chicago Press, 1970); M. De Vroey, "Une explication sociologique de la prédominance du paradigme néo-classique dans la science économique: économie et sociétés", Institut de science économique appliquée, série H.S. No. 14 (Paris, 1972).

thinks that their implications will be less than some would like to maintain, or even if the change in orientation was in any case latent. A periodic self-examination is always a salutary exercise.

LESSONS OF THE WORLD POPULATION CONFERENCE, 1974: BROADENING HORIZONS

It is necessary then to begin by drawing on the lessons of the World Population Conference held at Bucharest in 1974. This has been done many times by various authors;³ and, therefore, the discussion is limited to the main point. But, if one had to characterize this Conference in a few words, one would have to resort to "opening to the outside", "expansion" or even "breaking through". This impression is, indeed, that conveyed from several quarters, whether in the conclusions of the Conference or in the tone of the discussions. The major points made are as follows:

(a) The general philosophy of the Conference is interrelated with the notion that the population problem is so complex that it is linked with all the major problems faced by mankind, none of which can be considered separately. One would inevitably be led to false conclusions if one considered the particular problem of population independently of the larger framework in which it exists—that of the responses and the initiatives of society in the face of a rapidly changing world. It makes no sense to refer to demography in the abstract, without considering the sum of the conditions and macro-problems of the world. Also, population problems must henceforth be seen in their economic, social and cultural context, beyond the narrow limits of traditional demography. Demographic variables are now to be considered dependent upon economic and social development. Here, then, is the general principle which permeated the discussions. However, certain qualifications were imposed on this principle, and it was recognized that such changes in the demographic attitude can contribute to solving problems of development, especially when demographic pressures are strong or demographic structures aberrant;

(b) The Conference has enlarged the concept of population, giving it a political content. The real problem is not one of contraceptive techniques or antibiotics, but one of the organization of societies. The real dimensions of population problems are social and institutional. What must be reformed are societies, what has to be changed is life. But here again, no one questions that in matters of procreation, for example, by attempting to persuade couples while educating them, by succeeding in convincing them to adopt patterns of behaviour which are in their own interest, one can precisely contribute to modify society in the desired direction. In the background is the age-old idea that there is a reciprocal, circular link between the structure

of the family and the structure of society, that any action on the one necessarily affects the other; or the idea that a people's fertility, its state of health and its geographical distribution are matters more social than physiological or physical, and that, therefore, technical solutions, however indispensable, are not enough. As for point (a), attention must be focused on the organization of society as a whole, without denying that an action at the micro-level can and must contribute also to a solution at the macro-level;

(c) The Conference was without doubt the clearest manifestation on a global level of the idea of intervention in the field of population. No text is more complete on this point than the World Population Plan of Action which was adopted by 136 Governments;

(d) The Conference recognized the global nature of population problems, especially as they relate to natural resources, notably food; and it espoused for the first time the concept of a world strategy;

(e) The Conference took into consideration some variables whose links with population had not previously been exhaustively examined, such as natural resources and the environment. With respect to these variables, it was influenced by the other major problems which have recently surfaced on the international scene, and remained faithful to the integrated approach taken in all major United Nations forums;

(f) The Conference fully recognized the principle of birth control, not so much for demographic reasons but rather as a fundamental right of couples who must not be kept in ignorance on the subject. Remaining consistent, it recommended a free and informed access to birth control means and services, while emphasizing less the direct than the indirect means (reduction of infant mortality, improvement of the status of women, promotion of social justice, judicious regulation of the age for marriage, development of education, old-age pensions etc.). The implementation of these direct means, and even more so the indirect means, is primarily the responsibility of the State;

(g) Clearly, many aspects of demography concern personal life, and, therefore, should be sheltered from market forces and speculation. The population problem, for example, differs from those of food or raw materials, where stocks can be built up against future contingencies. There are no laws of supply and demand in population, and notions of monetary cost appear secondary in the face of non-quantifiable values. Thus, the Conference stressed the "values" that make human phenomena intrinsically different from others, by reinstating problems of social justice or international justice in their historical perspective and by concerning itself with inequities more at the international level than within national borders. It did this by appealing for international solidarity, by linking the changes in the patterns of consumption in rich countries to population policies chosen deliberately by Governments, or by stressing the need to apply human rights principles, for example, to the protection of migrants.

³ Including the present author. See L. Tabah, "The significance of the Bucharest Conference on population", *International Social Science Journal*, vol. XXVII, No. 2 (1975), pp. 375-84.

REACTION OF THE PROFESSION

The Conference in no way led to a radical rupture in relation to traditional thinking; one must, however, note that it repeatedly sought to widen, until they burst, the frontiers of the population concept.

The discussion has now reached the heart of the subject-matter: the extent to which the profession is ready to accept and to adapt itself to this all-embracing, global, multidimensional vision, which implies a profound change in which population problems are no longer given an exclusively technical and demographic meaning. In the past, the demographer posed and solved problems alone. The truths he arrived at were partial, but truths, none the less. While the philosopher or politician is preoccupied with the whole, the scholar is concerned with elements. Now he, too, is required to concern himself with the whole and to intrude into neighbouring fields. He was aware that the discipline had progressed considerably during the past decades. He was comfortable, settled in his paradigm, the fruits of which he shared with a few colleagues with whom dialogue was made easy by the limited scope of the research. And now what one asks of the scholar, who abhors confusion, is to broach not only demography but economics and sociology, to take into account the systems of values in force in the societies which he studies and to integrate such variables as environment, a field in which quantified indicators have been almost unavailable. Moreover, he feels his independence threatened because the structure of political power will henceforth have repercussions on the production of knowledge and introduce factors extraneous to the logic of science. One assures him that tomorrow, even though government intervention was unthinkable in the past, the scholars and technicians will have to concern themselves more with public affairs and will belong to a world of power, and that the allocation of funds and of time for research will be governed by the kind of knowledge produced. Lastly, one asks the specialist to change his perspective—which is going to require of him considerable effort—because the general statements made by the politicians at the World Population Conference will lead to a complete rethinking of certain conceptions which were overlooked at that meeting. Since that time, there has indeed been much talk among demographers about the sweeping nature of some of the statements made by politicians at the Conference.

One may then try to play the game and examine what, in this author's opinion, should be done to satisfy the wishes expressed by the Conference. After beginning with the problems of observation, the discussion turns to data processing, and, to that end, refers to some specific subjects.

PROBLEMS OF OBSERVATION

Just like related disciplines in the human sciences, demography is a discipline which does not allow the

investigator to indulge in experimentation as such: it is subordinate to the directed and controlled observation of facts, with little expectation of laboratory experimentation. The basic scientific act is the slow and careful accumulation of data upon which hypotheses are based before being confirmed by a limited number of laws.

The three basic sources of data collection are censuses, vital statistics and surveys. The first two, labelled "official", are intended to satisfy not only the needs of research, but those of the Government, which take precedence. They were initiated very early in some countries and they explain why demography has always had, even before a methodology was imposed, powerful means of observation. The third source, ever more important, consists of "provoked statistics", usually created from nothing, in order to respond to some specific objects of investigation.

Each of these sources is examined below to see to what extent they are adaptable to the need for enlargement called for by the Conference.

Censuses are usually of a comprehensive character; therefore, one can use the law of large numbers and even go beyond, as significant analysis in no way requires several million observations. But the list of census questions usually leads to variables which are limited in number and rather approximate, indeed trivial, which may not always satisfy the needs of the researcher. They do not lend themselves to the longitudinal analysis intended to follow the incidents related to each person, all the more so because the interval between data-gathering operations is generally 10 years. Censuses constitute, however, an essential tool for research because of the great, even immense, number of observations permitting cross-tabulations in several dimensions. A breakdown of population by characteristics leads to a fractioning of smaller and smaller elements which can still be analysed without jeopardizing the law of random fluctuations. If, for example, one considers the distribution by quinquennial age groups (17 groups), sex (2 possibilities), urban-rural (2 possibilities), active-inactive (2 possibilities), and only 8 geographical zones, one arrives already at a structure containing $17 \times 2 \times 2 \times 2 \times 8 = 1,088$ cells. No other tool produces such a wealth of detail, and yet only interrelationships between elementary variables have been introduced.

Some recommendations made by international forums must be reiterated: it is in no way necessary to use exhaustively all questionnaires; they can and even should be used in a limited way in any analysis dealing with from four to five simultaneous variables, especially because the cost of tabulations increases with the number of questionnaires. As all combinations are not necessary, the analyst must choose and indicate which of them will be essential. It is no doubt possible to draw much more from these censuses than has been done so far; but one cannot hope, however, to go very deeply into the interconnexions as the census questionnaire is limited to avoid any negative effect on the

quality of the answers already inadequate. To mention only one example, the reported level of education is often questionable, even in European countries which have a long history of these operations.

Many similar things could be said for vital records: limited number of variables; doubtful quality of responses; but large number of observations which can only be partially exploited.

It would be unreasonable to expect an adequate improvement in the statistics of vital records in most of the third world for a least a decade and other methods of observations will prove to be urgently needed.

This observation leads to the topic of representative field surveys. These surveys represent a real hope for progress. They are in no way a routine activity and depend almost entirely upon the initiative of the research body and, even more so, upon its possibility for financing. Surveys can gather an abundance of variables (sometimes excessive), in general of a great diversity and quality, depending upon a theoretical plan of research. This is not the case either with censuses or with vital records. In surveys, however, it is the number of observations which is inadequate for making full use of the information. It is impossible to analyse simultaneously the data according to more than two or three dimensions without fragmenting excessively the sample and without taking from it, at the same time, all meaning. Although the so-called "multivariate" methods of analysis, which are extremely useful, sometimes make it possible to circumvent this difficulty, these methods of statistical analysis are never as satisfying as when one works on large samples. One may consider that nearly all of the problems dealt with by demographers and calling for a multidimensional analysis require samples on the order of at least 5,000 questionnaires. This is the case with the World Fertility Survey, which is discussed below. One immediately sees a prerequisite of the success of in-depth research: sufficient resources, which the Government is reluctant to provide because, unlike censuses and vital records, these surveys have no administrative purpose and do not constitute an operation long ago decided upon once and for all.

Here is the paradox: surveys collect more variables than one can analyse, at least simultaneously; but the processing of data gathered through censuses or vital records involves an excessive number of observations relating to very few variables.

A middle ground is proposed with what are called "micro-censuses", which are nothing more than sample surveys carried out on very large samples (on the order of 200,000-300,000 families in the Federal Republic of Germany) with a questionnaire, or rather a form. The information obtained in such micro-censuses is more diverse than that of censuses, although it is limited to factual data and excludes questions of attitude and opinion; but the forms are filled in less carefully than is the case with traditional types of surveys which require greater participation on the part of the investigator. Progress in relation to the censuses is,

however, considerable. Thus, the micro-census of 1966 in the Federal Republic of Germany, for example, permitted the establishment, without recourse to a complex mathematical device and with a small margin of error, of curves of family size according to the husband's earnings (negative relation); and, at the same time, the wife's earnings when she is economically active (U curve), the latter being of the greater interest. Similarly, it has been possible to analyse the economic activity rate of a cohort of married women by duration of marriage and the number of children under 18 living at home, showing how married women enter, leave and return to economic activity according to the events occurring within the family.⁴ One is unable to see how it could have been possible to arrive at such results with samples numbering in the thousands. Very large surveys offer possibilities for analyses which surveys based on a few thousand could never provide and it is useless to expect this result from censuses. Success depends essentially upon the nature of the questionnaire, which must be relatively modest compared with the usual psycho-sociological surveys, as it must be presented to many people by a group of investigators, itself very large, and with limited contact between the investigator and the respondent. It is necessary to ensure that sampling errors shall not exceed errors of observation.

The most sophisticated sampling procedure is the "household survey", which is performed on large samples. This type of survey allows for a greater completeness and a better quality of demographic statistics than is possible through censuses or vital records, without, however, pretending to substitute for those two operations a new recording system. It is possible to have available a quantum of information not only of better quality but more diverse, notably because it is possible to subdivide the main sample into subsamples according to particular topics (marital and reproductive history of women, employment and unemployment, migration, etc.).

In developing countries, the procedure sometimes takes the form of repeated surveys among the same households, usually at intervals of from three to six months. Phenomena are best explained if one considers that the events of populations are a series of discontinuous yet interdependent events. In attempting to isolate the time variable, one nears ideal laboratory conditions and arrives at a better position to establish cause and effect relationships. For analyses of sensitive problems, this method of continuing observation proves to be unquestionably superior to surveys involving only one visit, and therefore retrospective, even when they include questions involving the past. According to this method, one could say that the observer tries to deter-

⁴ L. Tabah, "Rapport sur les relations entre la fécondité et la condition sociale et économique de la famille en Europe; leurs répercussions sur la politique sociale" (CDE (71) T.III) in Council of Europe, Second European Demographic Conference, Strasbourg, 31 August-7 September 1971. Summary in English.

mine events before they happen so as to record and monitor them; and it is of greater use for explaining phenomena than those for which the sole purpose is to reconstitute the past of a group of persons who lived through an event, and which it is difficult, if not impossible, to replace in the situation that prevailed at the time of the phenomena. An analysis of the chain of cause and effect is obviously easier and more satisfying when one isolates the event in the context of the circumstances which produced it, and when one follows its evolution, rather than between events or even beyond the process. A multiround survey not only permits an observation of the changes of status and new events, but enriches the knowledge that one may have of the population, without overloading the questionnaire, by distributing the total number of questions among the different visits, throughout the entire sample or on only a fraction of it.

Geographical mobility

It is certainly difficult to retrace the entire series of movements, or at least to ask questions concerning each link. It would be enough to know some details relating to either period of time (the past five years, for example); or the current residence, the former residence, the amount of time at each and the last occupation in the former residence. These questions would yield good indications permitting a cataloguing of current migratory movements according to the period of residence, the place of origin, activity both past and current, fertility, changes in the composition of the family in relation to its movements etc. If the size of the sample permitted, one could do studies on several dimensions, distinguishing waves of migrants.

This technique presents numerous difficulties which cannot be discussed here due to space limitations, because the sample itself changes by reason of population movements between survey rounds. It should be mentioned, however, that in the formulation of the questionnaire, in order to facilitate the recollection of events, one should try whenever possible to cause the person surveyed to rely on a fixed point which can provide a time reference for other events. One could, for example, relate the history of marriages and births to that of movements from place to place.

Some topics lend themselves to a detailed examination through the techniques of single-round or multi-round household surveys:

(a) *Formation of families.* It would be possible to inquire into the history of marriage, births, deaths, using the method of historical demography;

(b) *Education.* It would be possible to gather data that school statistics cannot provide since they are done at the institutional rather than the individual level, such as the current situation of children in school compared with that of the preceding year. It would become possible to obtain information by sex and age on the number entering school, the number promoted and left behind and the number leaving school, in rela-

tion to other variables in the questionnaire (socio-economic level, type of residence, etc.). Even in industrial countries, there is an almost total lack of this information. Specific questions can also be asked about the time interval between departure from school and entrance into the labour force, as well as on first employment (the average time required in order to find a first job, relationships between level of education and the kind of job obtained);

(c) *Occupation and occupational mobility.* One can ask questions similar to census questions (thereby permitting comparisons) about the current occupation; but, at the same time, adding questions about the duration of current occupation and about previous occupation. These two questions permit one to draw relationships between changes in jobs and other changes, such as residence.

Analysis of such types of data is essential for building, on solid bases, projections that include not only demographic but social and economic variables, such as regional projections, educational projections and projections on the availability of work in the various regions. The data can also provide elements that can be used to project the economically active population by sector of activity, which, in turn, is useful in calculating the demand for labour, one of the most sensitive areas of economic forecasting.

Actually, the objectives of such household surveys are not limited to the preceding major areas and one will be able to extract from the sample a number of very interesting by-products, such as:

(a) A study of a subsample of the aged in urban and rural areas and of persons of pre-retirement age (for example, 55-56 years old);

(b) A study of family structure: composition of families, distinguishing the primary nuclear family (parents-children) and the extended family (grandparents, collateral relatives) in different social classes;

(c) The relationship between population and housing;

(d) A special study of large cities;

(e) A subsample of persons born abroad;

(f) A detailed study of youth, as a subsample, for the purpose of analysing their departure from the educational system and their entry (or non-entry) into the work force;

(g) Working women in relation to fertility (history of marriages and births in relation to leaving and returning to the work force).

Such surveys could be repeated every five years in order to facilitate longitudinal analyses.

In fact, many ministries and research institutions in fields related to demography will find in this type of survey the information that they have lacked for socio-economic planning.

The greatest drawback of such sample surveys is obviously their cost, which is, however, less than that of censuses. They also require a body of investigators trained in this type of special operation, not easily found in the international market; and it is not often

that a country has technicians who are capable of mastering the diverse technical difficulties of the different phases of the operation. International co-operation is essential.

One might add some general considerations related to data collection by survey:

(a) It is necessary to caution the investigators against the tendency to accumulate material which will never be used. One does not always follow the principle that everything collected must be with a view towards analysing it. It too often happens that expensive surveys are undertaken and their results not fully exploited. One formulates excellent hypotheses—sometimes even brilliant ones—and draws up astute questions, while being incapable of taking full advantage of all the data collected;

(b) Overwhelmed by the collected data, the investigator abandons it in order to move on to something new rather than devote himself to the painstaking task of analysing the data which he collected. One might ask how many surveys have never been analysed or at best only superficially;

(c) No survey should be developed unless the investigator has in mind the type of analysis which will be performed. Too often, in fact, the survey is initiated without a clear perception of what is required to be drawn from the data;

(d) One should avoid permitting too long a time to lapse between the collection and dissemination of findings because most often the data are "perishable" with a life of only a few years;

(e) A study of different types of errors often is neglected;

(f) There will always be interest in comparing the survey findings with those obtained from an independent source. For a comparison of the findings with vital statistics, for example, one could turn to Chandra Sekaran and Deming's⁵ method for comparison.

Historical demography

This subject should not be closed without a few lines on historical demography, a field not in vogue for several years, because demography, like all disciplines, also has its fashions. Many investigators—indeed, some of the best—indulge in it: some because they want to stay clear of publicly debated issues and feel more comfortable in a field where the separateness of the investigator and the subject of his investigation is maintained; others because they find it an easier route to achieving a reputation in a scientific field than by addressing themselves to current world problems. The legitimate interest generated is considerable, especially in the wake of the imaginative work done by Louis Henry.

⁵ C. Chandra Sekar (now Chandrasekaran) and W. Edwards Deming, "On a method for estimating birth and death rates and the extent of registration", *Journal of the American Statistical Association*, vol. LXIV, No. 245 (1949), pp. 101-15.

Certainly, many things from the past do not deserve to die and one cannot deny it is useful to know the past to understand the present. The work of the "historical" demographer falls between that of the historian, who studies a unique, non-recurring event at a point in time, and that of the sociologist, who attempts to establish relationships between recurrent events with a view towards action. In moving backwards to the study of former populations, he is motivated by a desire to grasp the past with a view towards understanding the present, to highlight categories and regulations, even if the present and the future lead to a drastically new future, even if one knows that events do not repeat themselves as seasons and that the theory of demographic transition is not a valid pattern for all and for ever, and that it is singularly unwise to extrapolate indefinitely.

This process is attractive to the extent that the investigator tries to understand demographic evolutions and to place them in their social and institutional context, because birth and death rates are not isolated events since the investigator asks in the past tense questions relating to the present and the future.

The study of demographic history should be encouraged; it has not yet revealed all that can be expected. In particular, it must not be restricted to the study of fertility and mortality. Problems of migratory movements and of the processes of urbanization in different countries and at different periods of time also must be considered.

However, one cannot but think that the 1970s merit more attention than the 1770s, that travel in space is more promising than travel in time, because the traveller can plan his own journey. That is, observation can be planned today with a view towards responding to precise research objectives; but things from the past are just that, namely, dead and buried. It is certainly good for the apprentice demographer to reflect on eighteenth-century European demography, but more importantly on the major problems of today.

Thus far, the lessons of history have always been needed to provide one with bearings in political and social activity. Everything indicates that at the current time, the historical experience will not prove adequate because evolution is becoming so rapid, one change follows another so quickly that past experience can no longer help as it once did.

SOME MAJOR PROBLEMS

It is not enough to collect data and figures. The main work of the demographer, like that of all other social scientists, is to explain the data, to organize them, to classify similar and different occurrences and to identify the trends because events do not follow each other according to an apparently whimsical pattern. He must, above all, endeavour to explain a demographic phenomenon by a social fact and to explain population events within their social and institutional contexts. Consider the following aspects.

Setting up a demographic observatory

One of the first tasks will be to follow, step by step, the continuously unfolding demographic situation, especially at this time when one can expect rapid changes. The demographer's role must then, first, consist in observing population data in a broad context, that is to say, without being limited to fertility but including each of the variables as set forth in the World Population Plan of Action. As the changes from one year to another are minimal and hardly perceptible, subject to variations that may come from the quality of information, it is difficult to evaluate these variations on a year-to-year basis only.

There exists at the United Nations a mechanism involving Headquarters as well as the regional commissions and the specialized agencies, the purpose of which is to serve as a sort of "demographic observatory", or "control tower", which scans objectively but attentively the surface of events, in order to analyse them and to disseminate among the public an analysis couched in terms that are as sober and clear as possible and devoid of technical language.

Agreements should be reached with national bureaux of statistics to quickly provide their sets of indispensable data.

Reproduction

If there is one area in which progress has influenced the fate of populations, it is the biomedical sciences, owing to improvements in contraceptives and in the methods of abortion—truly a technological revolution.⁶ A wide range of means is already available and although innovations in this field are to be expected and must be promoted, it is probable that the future lies in a panoply of means rather than in one panacea.

The demographic effects are still at their inception, but are already considerable, even if one is incapable of measuring with the desired accuracy and even if some observers show a certain impatience and want to accelerate the course of events. In a few years, populations who were unprepared to resort to even the simplest contraceptive methods used by Europeans over the centuries have adopted these new means. Although the imperfection of birth control devices clearly cannot explain the high fertility level in third world countries, one cannot deny that technology, progress and knowledge can accelerate an otherwise inevitable evolution.

The implications are equally notable in industrialized countries, even if these countries have been practising birth control effectively for centuries, but with means which today seem archaic and uncomfortable. Certainly, history shows that a society which wants to limit births always finds the means to do so; but it will

⁶ World Health Organization, "Research on the biomedical aspects of fertility regulation and the operational aspects of family planning programmes", in *Population Debate*, vol. II (United Nations publication, Sales No. E/F/S.75.XIII.5), part eight, pp. 560-72.

be easier and more certain and afford less frustration and constraint if it has available more advanced technology and appropriate services.

The interest is not solely demographic. It touches also on the health and stability of the person and of the couple for whom this approach is a source of unity indispensable to its full development. These techniques permit a more conscious and responsible parenthood, this being a major principle of the World Population Plan of Action; the underlying rationale is that procreation is not the sole objective of conjugal acts and that fertility should not be left to chance. It has been shown, notably by the World Health Organization, that the benefits of regulated fertility extend to all members of the family, and particularly to the children.⁷

For some 20 years, fertility has been the subject of a large number of studies, involving not only demography, but biology, sociology, economics, psychology and even genetics.⁸ This is an example of a multidisciplinary approach to which bare "lip service" has often been paid and which seldom has been applied. The extent to which progress has been made along socio-economic and cultural lines, free from interference, is particularly due to the longitudinal analyses which followed P. K. Whelpton's work. All of this work has contributed to progress, not only in the field of demography but in other fields, such as survey methodology. Such work has also contributed to a better knowledge of the third world and especially as a result of the very specific Knowledge-Attitude Practice (KAP) surveys (poorly named because they go far beyond contraception). Without breaking really new ground, this research often has contributed to a better understanding of daily life in poor countries.

These surveys are so numerous and of such value that one cannot claim to have considered all of them. This type of exercise will become more and more difficult as time passes. Recently, an effort at systematization was begun with the World Fertility Survey,⁹ a vast undertaking of comparative surveys based on large samples (on the order of 5,000-10,000 women), and containing exceedingly precise questions which will considerably increase the knowledge of a variety of demographic and cultural conditions in these populations.

Suggested areas for study

Good progress is being made in the area of fertility studies. Some suggestions for continuing efforts are given below.

Need for synthesis of data

There is greater need than ever to rationalize the data and to provide a synthesis of it because the avail-

⁷ World Health Organization, "Health and family planning", in *Population Debate*, vol. II, part eight, pp. 461-79.

⁸ Charles F. Westoff, "Population and the family: overview", in *Population Debate*, vol. II, part six, pp. 313-19.

⁹ International Statistics Institute, *The World Fertility Survey: The First Three Years, January 1972-January 1975* (The Hague, 1975).

able material is considerable and has not yielded all the expected benefits. A balance must be found between the resources for collecting data and the insufficient resources allocated for analysing them.

This attempt would be facilitated by a "thesaurus" and a computerization of available documentation (Population Information System).

A mechanism for the analyses of the results of the World Fertility Survey must be set up right away if this material is not to suffer the fate of other research, wasted or under-utilized, or left standing for so long as to have lost all possible value. The material is so extensive that it lends itself not only to a global comparative analysis, but to a number of studies on specific subjects, similar to those which have already been undertaken since the first such survey in Indianapolis (United States of America) in the 1940s, which showed the proper course to follow in many respects.

Need for study of social and cultural background

A study of the demographic, sociological and cultural environment of populations who are the object of a fertility survey should also be undertaken. Without this complementary research, all conclusions and comparisons would be deceptive. To reap the full significance of the collected information and to facilitate data processing, the fertility analysis has to be integrated with an analysis of the social and cultural structure, the facts observed must be placed in the proper context, and the variables of the questionnaires must not be considered the only basis for study. Attention must focus not only on demographic events as such, but on the conditions that made them possible.

Efforts should be made to clarify the independent variables in fertility surveys. Very often, these variables are mentioned quite abstractly under such headings as "industrialization", "urbanization", "modern sector" or "traditional sector". Such abstract terminology in no way suggests the complex of social, cultural and economic changes which a population undergoes throughout the course of its existence. Similarly, with respect to education, the question which presents itself is to know what education is about: traditionally, primary education, secondary education etc.; or less formal education, less "European-oriented", providing a broader view, a greater degree of participation in community life, particularly as regards women. Education is a lever for behavioural changes in respect both of responsible parenthood and of global development. But it is no longer evident that it must rely on European standards to achieve this objective. It is necessary to try not to rely on formulae of little significance. Surveys intended to explore certain themes extensively, such as the relationship between fertility and education, or between fertility and the progress of modernization, or customary traditional norms, must be considered. It can be particularly interesting to determine the extent to which traditional obstacles, especially in a rural environment, can be eliminated; or, on the contrary, are impervious to change. Similarly, studies must

be made of the so-called "collective consciousness", the motivation that compels people while they think they act freely—that is to say, those things which one must acquire in order to modify behaviour—in the context of fertility. Attitudes and motivation, in fact, can only explain patterns of behaviour within the framework of a determined social environment, or of a generally accepted way of thinking. To take but one example, in China, it is the "consciousness of the masses" and not the force of law or of the police which makes every man remain chaste until 28, every woman until 25—at least in the towns—and which did away with adultery, prostitution and even with the motorists' desire to go through red lights. This collective moral pressure upon the individual is totally lacking in other populations, goes in the opposite direction or is less felt. Here, then, is a good topic for studies.

It appears that the short-coming of fertility surveys has been an insufficient attention to cultural factors, which, as Coale¹⁰ has shown, have, none the less, played an important role in the European demographic resolution. This factor explains, among others, the failure of attempts to implement birth control programmes not adapted to social, economic and cultural structures. To be complete, fertility research should be supplemented by studies on all of the intimately related elements which are subtly linked and often difficult to perceive, and which make up the culture of a society. Closer contacts with specialists in cultural anthropology would be desirable.

Need to ensure validity of responses

Efforts should be made to measure the validity of responses to survey questions. To what extent is the respondent honestly answering them? Preliminary studies also must be made on the thought put into responses, particularly when questions concern attitudes, and on the consistency of responses.

Need for repeated "light" surveys

In addition to "heavy" fertility studies (a battery of many questions given to thousands of people), a continued programme of "light" surveys, repeated frequently, containing a small number of questions related to attitudes and opinion, especially on the size of the ideal family, and where results would be readily available, must be considered.

The Symposium on Population and the Family, held at Honolulu, from 6 to 15 August 1973, recommended a micro-analysis scale for the study of problems of the family and fertility.¹¹ This procedure appears all the more desirable because families often perceive their economic and social problems, those concerning reproduction or education, as being rather different from those of society at large. They are seldom aware of the interdependence between their individual interests and

¹⁰ Ansley J. Coale, "The demographic transition", *Population Debate*, vol. I, part two, pp. 346-56.

¹¹ "Report of the Symposium on Population and the Family", *Population Debate*, vol. II, annex III, pp. 700-12.

those of the community. It would be particularly interesting to study the decision-making process in the family as it develops.

Research should take into consideration the variety of local conditions. There exist, in fact, some purely local situations which must be analysed as such, and the sum of which does not necessarily equal the situation of the country.

Need for extensive research on family evaluation

With the "clinical" type of survey concerning a limited number of cases (about 100) which is directed towards a detailed analysis of patterns of behaviour and involves "directed" questionnaires applied by psychologists, it should be possible to orient further research or to interpret the results of previous surveys.

Research on the interdependent nature of the structure of parenthood and the movement through the life cycle would be desirable. Relating the two typologies, demographic parameters and family structures, is of the greatest interest for assessing the upheavals that affect family formation and family structures as the demographic transition advances.¹² This research could be done using simulation models.

Simulation models are equally appropriate for the study of reproduction in a natural or Malthusian situation¹³ In these models (which take into account fecundability, effectiveness of contraception; and abortion according to age, parity etc.), a hypothetical group of women is exposed to certain possibilities, or "risks", during their fecund life: marriage; conceptions; births; intra-uterine infant deaths; sterility; widowhood; divorce; remarriage; death. Calculations then permit a reconstruction of the theoretical total population to determine, according to the chosen hypotheses, its demographic characteristics. A specific interest is attached to population trends according to anti-natalist practices. Some questions put to the computer would be to determine, based on these complex variables, what effects contraception used by different families would have on the rate of fertility and population growth or those of different models of marriage on fertility. This tool is very flexible and of great interest for choosing a population policy. Unfortunately, little use of it has been made in the conditions prevailing in the third world.

Research on family planning

One of the most difficult tasks facing demographers in the next few years will be to develop methods for

¹² Norman B. Ryder, "Reproductive behaviour and the family life cycle", *Population Debate*, vol. II, part six, pp. 278-88.

¹³ See, for example, M. C. Sheps and E. B. Perrin, "The distribution of birth intervals under a class of stochastic models", *Population Studies*, vol. XVII, No. 3 (1964), pp. 321-31; J. C. Ridley and M. C. Sheps, "An analytic simulation model of human reproduction with demographic and biological data components", *Population Studies*, vol. XIX, No. 3 (1966), pp. 297-310; I. Holmberg, *Fecundity, Fertility and Family Planning: Application of Demographic Micromodels*, vol. I, Demographic Institute report No. 10; vol. II, No. 11 (Gothenburg, Sweden, University of Gothenburg, 1968); A. Jacquard, "La reproduction humaine en régime malthusien", *Population*, vol. 22 (1957), pp. 897-920.

determining the part that family planning plays in the birth-rate trends of a country. The possible methods are necessarily indirect and only partially suited to the objective. The problem is all the more urgent because family planning activities will no doubt expand considerably in the next few years in the third world, and Governments called upon to make a substantial investment will necessarily turn to the specialist to balance costs and benefits, as with any other investment.

Research on the subject of family planning is an integral part of demographic research because the plans for family planning must be adapted to cultural norms and socio-economic structures if they are to be effective. The methods for assessing their efficiency come from traditional demography (attrition tables of a cohort subject to increments and decrements elaborated by R. G. Potter and C. Tietze).¹⁴ This research also relates to births averted at the national level, or to the extent to which contraception is systematically applied, to the rate of continuity of contraception, to the characteristics of users, to the dissemination of information, to the administrative structure¹⁵ and to the advantages and costs of a family planning programme. This computation is more difficult to arrive at than that for a single, simple project like the construction of a factory. The guiding principle in this field has to be that the objective (reduction in the rate of increase, assurance of responsible parenthood) must be attained at the least cost.

The problems and documentation related to family planning are so great that here, too, it is useful to develop a programme for computerizing the information.

The political problems arising out of family planning in the third world must also be considered. Too often, these programmes are perceived as being imposed by and for the benefit of the outside. Even the *élite* believe this to be true. This is an objective truth, a social fact meriting attention, and a survey among the *élite* can provide significant, useful information.

Mortality and morbidity

One of the oldest concerns of demographers has been that of mortality and not fertility. The first table of the survivorship function, developed by Edmond Halley, the renowned astronomer and discoverer of the comet named after him, was devised for the town of Breslau for the period 1687-1691, upon data furnished by his friend Leibnitz. In addition to being one of the first applications of the scientific method to the population problem, it is also one of the first devoted to human phenomena. What appears to have inspired

¹⁴ See, for example, R. G. Potter, "The multiple decrement life table as an approach to the measurement of use effectiveness and demographic effectiveness of contraception", in International Union for the Scientific Study of Population, *Contributed Papers, Sydney Conference*, 21-25 August 1967 (Liège, 1967), pp. 869-83; and C. Tietze and R. G. Potter, "Statistical evaluation of the rhythm method", *American Journal of Obstetrics and Gynecology*, vol. 84, No. 5 (1962), pp. 692-98.

¹⁵ J. R. Ross and others, *Findings from Family Planning Research*, Reports on Population/Family Planning, No. 12 (New York, The Population Council, 1972).

Halley and Leibnitz was the search for "invariants", as in astronomy and physics.

Over the course of the past few decades, fertility rather than mortality has attracted the primary interest of demographers: first, because in the third world it is the behaviour of the fertility curve which controls global demographic evolution; secondly, because demographers feel that fertility can be more directly influenced by their intervention than mortality, the reduction of which depends upon medical science and upon general progress. Their role in mortality is limited to the measurement of the phenomenon, whereas in fertility they often go beyond a simple description of reality and actively participate in the social realm, through the "active research" that involves the researcher.

However, the desire to limit an excessive population growth in certain countries must not close the door to a different fight against nature. What is striking here is that the picture has become less promising than it was 10 years ago. Developed countries have witnessed a deceleration of progress; and even for the older age groups, a deterioration of the situation, which, however slight, is nevertheless symptomatic. In the third world, progress also is slower than anticipated. Considerable differences exist between countries, and within countries, differentials more striking than in any other demographic variable, constituting one of the most obvious manifestations of social injustice. No doubt, the task must bear as much on the protection of life, and particularly on the lives of those who are the most vulnerable, as on the potentials for life—that is, birth—and their necessary regulation. Mortality certainly has aspects of concern to politicians.

In fact, the study of mortality can become much more attractive if no longer limited to the mathematical relation of the survivorship function, sometimes to the fifth decimal, according to sex and age, but extended to the social and environmental conditions of the phenomenon.

Fields of inquiry are not lacking, but they depend upon the quality of available information. Among such fields are:

(a) Social mortality differences according to causes of death, such as that undertaken in England since W. Farr (1851), in the United States of America, and, more recently, in France, stressing infant and peri-natal mortality;

(b) Study of the interdependence between different causes of death;

(c) Effect of the disappearance of certain endemic diseases on mortality in the third world;

(d) Interrelationship between mortality and morbidity, still little known because of the difficulties in collecting data (household surveys prove to be of little value);

(e) Interrelationship between infant mortality and fertility. It has often been said that the drop in mortality preceded the drop in fertility. The observation is

not questionable but the workings of the phenomena are still not known;¹⁶

(f) Influence of nutrition on mortality;

(g) Specific study of increasingly frequent causes of death, such as death from accidents;

(h) Specific study of mortality and morbidity in certain professions.

International migrations

The problems of international migrations are of great complexity and, doubtless, it is not enough to summarize their nature by simply saying that international movements of populations are a reflection of complementary imperfections and that they benefit the country of origin as much as the country of destination. Those who leave their country often do so because they cannot be integrated into the political and socio-economic environments; and these movements can constitute a safety-valve which permits the release of demographic pressures, although they rarely constitute a real way to eliminate these pressures. In the receiving countries, migration can be a partial remedy for a shortage of unskilled labour; or, on the contrary, can bring in labour too qualified to become absorbed by the economy of developing countries, thus attracting unskilled labour as well as "brains". A few countries lure migrants to colonize inadequately used land.

Be that as it may, international migrations are no longer as important a factor as in the past in the redistribution of populations across countries and continents. Furthermore, the currents of migration have changed direction. North America and Oceania continue to take in immigrants, but there has been a reversal in the trends of migratory movements between major regions. Europe, which lost 5.4 million inhabitants from 1946 to 1957 as a result of migrations has, due to an influx of immigrants from Africa and some other areas, almost returned to a state of equilibrium. Latin America, which has long been an area to which people immigrated and which had an increase of a million people between 1946 and 1957, is becoming an area from which people are emigrating. Africa and Latin America, with relatively light population density but with high growth rates, are becoming regions from which people are emigrating; while Europe, with heavy population density and low growth rates, is becoming a receiving land.

A seminar¹⁷ was recently held on the subject of demographic research on international migrations. Some suggestions made by the seminar are as follows:

¹⁶ *Report of the Seminar on Infant Mortality in Relation to the Level of Fertility*, Bangkok, 6-12 May 1975; sponsored jointly by the Committee for International Co-ordination of National Research in Demography (CICRED), the United Nations and the United Nations Fund for Population Activities (Paris, CICRED, 1975).

¹⁷ Comité international de coordination des recherches nationales en démographie, "Recherche démographique en liaison avec les migrations internationales", *Population Debate*, vol. I, part two, pp. 249-58; report of the seminar on this subject organized by CICRED at Buenos Aires, 5-11 May 1974.

(a) Measure migratory flows through the use of censuses, samples, and records of entry and departure, whenever possible;

(b) Study migratory "histories" by cohorts, which implies knowledge about the length of stay of migrants;

(c) Conduct research on the decision to migrate;

(d) Study the structure (political, economic, demographic etc.) of the country of departure and its influence on migratory movements;

(e) Improve knowledge of the economic aspects of migration;

(f) Establish a direct relationship between international migration and other demographic variables (effects on nuptiality, fertility of migrants etc.);

(g) Establish a relationship between international migration and economic and social changes;

(h) Study problems of the assimilation and integration of migrants and the "tolerance" of receiving countries;

(i) Study the motivation for return migration;

(j) Examine legislation in the area of international migrations;

(k) Determine the effect of the "brain drain";

(l) Study the problems related to the protection of migrants and their families (housing, freedom of association, acquisition of citizenships in the host country etc.)

Internal migrations and rural development

Many of the social and economic problems that a developing country must confront are aggravated by accelerated urbanization. Migrants to cities, pressured by actual population growth and agricultural stagnation, or simply attracted by an urban life-style, are confronted by limited employment opportunities in the cities and by the inadequacy of the urban infrastructure, which cannot keep pace with their rate of growth. Surely, in the third world, the "green revolution" has facilitated, in some regions, a certain degree of retention of rural populations, although it involves increased automation, sometimes leads to the elimination of small holdings and tends to enlarge the gap between rich and poor. This is the classical situation where progress involves both creation and destruction, a process which will have to be mastered to a greater degree. Turning back the clock, however, is unthinkable.

Research in the third world must, above all, tend towards a combined strategy of urban and rural development concerning industrial location policies, rural housing and a reduction of the gap between urban and rural incomes in order to limit migration to cities. It is likewise necessary to study the pattern of rural settlements, in the framework of a wider agricultural policy directed towards increasing agricultural productivity.

Much of the previously suggested research directed towards international migration also applies here: calculations of flows according to the characteristics of migrants; studies on the decision to migrate; and so forth.

Population and development

In the absence of a general direction for research, the interrelationships between demographic evolution and development have been extensively talked about but clear conclusions have not yet emerged.

The field is ill-defined and it is easy to get lost in it. Moreover, as the subject enlarges, it escapes the profession and one knows that social science researchers often behave like members of the same species which by eating each other ensure the survival of their kind.

In the absence of Ariadne's thread, one is reduced to a trial-and-error method, on both the theoretical and the practical level. If there is one field where research must be organized, this is it. This point is reaffirmed in the conclusions. Some possible approaches, along the lines of the Conference at Bucharest, are described below.

Projections

Nearly all the work of demographers is intended to provide the basis for sound projections. In other words, they are almost totally necessary for the future. The method of projections dates back to the dissertation Euler made in 1760 to the Royal Academy of Arts and Sciences, and has not much progressed whatever the mathematical presentation or the number of variables introduced. It is little more than an extrapolation of independent variables, mainly because the knowledge of the present and relationships between variables is very imperfect. All futurologists should ponder on this sentence from Marcel Proust: "We represent the future as a reflection of the present projected into an empty future; whereas it is often the very immediate result of causes most of which escape us". Recent debates¹⁸ show that even for Europe, which is better equipped with statistics than other areas, specialists are incapable of predicting demographic fluctuations for as short a period as five years, and perhaps not even that. In fact, it is the failure to recognize the interconnexions between variables in the past or present which impedes the ability to make satisfactory projections, and the need to accumulate the so-called "feedbacks" is stressed below.

Whatever their short-comings, one cannot deny that in an era where planning is widespread, there is a great interest in being able to make projections and to have at least contingent calculations. Indeed, international forums were at the origin of the first projections when in 1925 the League of Nations concerned itself with determining the number of men who were capable of bearing arms. Subsequently, the calculations became more complex: calculation by sex and age; diverse derived projections bearing on the entry into and departure from the work force; and on urban and rural pop-

¹⁸ "Record of the United Nations/United Nations Fund for Population Activities Post-World Population Conference Consultation among Countries of the ECE Region", Geneva, 7-11 July 1975 (ESA/P/AC.5/5 and Corr. 1).

ulation, agrarian and non-agrarian population and urban agglomeration; educational projections, projections on housing (and on population living in new housing projects), and sometimes on the sophisticated relations between the different networks of projections. Recently, projections of households have been added; such projections are of great use in economics, notably to forecast consumption.

It soon proved indispensable for the United Nations system (the Population Division of the Department of Economic and Social Affairs and the specialized agencies) to make mutually co-ordinated calculations, i.e., calculations based on the same hypotheses, to arrive at consistent global results.

All of these calculations are of interest from two points of view:

(a) For short-, medium- and even long-term planning, although unfortunately they have so far been little used by planners;

(b) To serve as a basis for population policies. The aim of these calculations can be, through a comparison of two perspectives which differ by only one variable, to determine the effect of that variable. What one is looking for is not so much a means of predicting the future population and its structure as a way to evaluate the "weight" of a single variable in a situation perfectly predetermined by the way it is set up. The calculation is a type of simulation used to point up a variety of futures, allowing for a margin of uncertainty in which decision-makers are able to make choices. It can also serve to inform, or rather alert, public opinion and Governments of the possible course of events in the absence of a determined social or demographic policy. One can cite numerous examples of this type during the past decade.

Given the uncertainty of the future, projections should be reviewed periodically, say, every five years.

Studies of interrelationships between variables

One condition of progress in the area of projection, which remains a priority, is the work being done to identify relationships between population data and socio-demographic variables by assigning them observable numerical values in order to reduce the independence of demographic parameters used in projections. It is precisely there that a research organization is needed, as the relationships between variables are so numerous. Mention has often been made of the need for a data bank on matters concerning population. It appears desirable to go further and to store information concerning the quantified relationships between the variables, for example, on the relationship between economic activity of women and fertility, between economic activity of women and migration, household income, education etc. Relationships may involve two, three parameters, even more.

Certainly, it is possible that researchers will use these feedbacks indiscriminately, applying to one population relationships found in others where the characteristics are entirely different. Properly used, however,

this data bank would be of great value in helping to establish those limited laws mentioned earlier.¹⁹ Taping these feedbacks would be essential as soon as the amount of information is sufficient and, in fact, literature is already so full of this type of information that the idea of a thesaurus is already practicable.

As was stated at the United Nations Symposium on Population and Development, held at Cairo from 4 to 14 June 1973, the knowledge of socio-economic and cultural factors influencing demographic change is better than the knowledge of the inverse, that is, of the effect of demographic change on socio-economic factors.²⁰ This appears surprising because the first type of research is relatively more expensive, relying on survey methods, than the second, information about which can be computed in a research bureau and is therefore cheap. And, nevertheless, both are of great interest for the politician and the decision-maker. It would be advisable to correct this imbalance. Certain aspects of this huge field, in particular, questions of food, hygiene and employment, are, to a large extent, taken up by the specialized agencies of the United Nations.

Specific study of typical populations

What should be done, taking account of a typology of countries according to their demographic and economic situation (which remains to be determined) is to choose some typical populations for which reliable statistics are available, and where fertility is on the decline, in order to evaluate concretely the weight of the demographic variable in the past, present and future. What would have happened if demographic evolution had been different? What will happen in the future if policies are not adapted to specific demographic trends from the point of view of investments for community facilities, food, environment, consumption of new materials, foreign trade etc.? Take an example: many third world countries traditionally had been exporters of food products and have now become importers of these same products. What part has population growth played in this reversal?

In those population types for which fertility has declined in recent years, it would be useful to highlight the origin of socio-economic and cultural factors which can account for the change in the behaviour of couples.

Integration of the population factor in economic planning

The need to integrate the demographic variables in economic planning is often mentioned, and a specific recommendation to this end was adopted at The World Population Conference at Bucharest. One must begin by recognizing that a methodology is totally lacking and the first task must consist in filling this gap. Demogra-

¹⁹ See, in particular, the work done by the International Labour Office within the framework of the World Employment Programme.

²⁰ "Report of the Symposium on Population and Development", *Population Debate*, vol. II, annex I, pp. 677-86.

phers find themselves, in effect, in a situation similar to that in which economists found themselves 20 years ago when their research lacked a method for economic planning. This is common today.

The integration of the demographic factor in planning is not an easily accomplished task because planning is not merely putting together a group of projections. The establishment of a closer interdependence between human and physical factors does not consist in juxtaposing or even combining separate projections.

A really integrated system is essential for facilitating decision making at the different levels where the strategic directives are applied to quantify the terms of technical choices both in the economic sector and in regard to population.

Effects of social structure and its changes

Thus far, little attention has been paid to the study of the effects of social structures, and their changes, on demographic behaviour; and, inversely, to the study of the effects of changes in demographic behaviour on social structure, particularly in developing countries. It is said that the first stage of economic take-off in the third world results in a deepening of the income gap. To what extent has this phenomenon retarded the demographic transition? Conversely, to what extent have successful family planning campaigns in the traditional sector accelerated the demographic transition? True economic development, like demographic transition, necessarily implies a change in the traditional sector, which is the most important and the most basic. Many questions exist which require answers.

Research on the economic theory of family formation

The interest of researchers in concretely quantifying the economic effects of fertility changes at the macro-level is indicated above. It is equally interesting to study, at the micro-level, the advantages benefiting families and to examine the range of interactions between the macro- and micro-levels.

The analysis is similar to the traditional cost-benefit analysis of an investment project, which is intended to compare inputs with benefits in a time framework.²¹ The problem with this research is that it regards chil-

²¹ This technique was developed by Enke, Zaidan, Demeny, Liebenstein and Easterlin, after the pioneering work of A. Lotka, C. Mortara and A. Sauvy. See, for example, S. Enke, "Speculations on population growth and economic development", *Quarterly Journal of Economics*, vol. 71, No. 1 (1957), pp. 19-35; G. Zaidan, *The Cost and Benefits of Family Planning Programmes*, World Bank Staff Occasional Papers, No. 12 (Washington, D.C., 1972); P. Demeny, "The economics of government payments to limit population: a comment", *Economic Development and Cultural Change*, vol. 9, No. 2 (1961), pp. 641-44; H. Liebenstein, *Economic Backwardness and Economic Growth* (New York, John Wiley and Sons, 1957); and R. Easterlin, "Effects of economic growth on the economic development of developing countries", *Annals of the American Academy of Political and Social Science*, No. 369 (January 1967), pp. 98-108. For an excellent synthesis, see W. C. Robinson and D. E. Horlacher, *Population Growth and Economic Welfare*, Reports on Population/Family Planning, No. 6 (New York, The Population Council, 1971).

dren as goods, whereas non-economic aspects, such as the effective value of children, interfere and are by definition non-quantifiable. There are no market laws which apply to births. Couples take into account emotional considerations that have little in common with the benefits or drawbacks that may affect society. One's gain can be the other's loss. Moreover, generation gaps can appear: what one generation wants may not suit the following, which sees itself as inescapably the heir to a situation with burdensome consequences. For example, the current growth in population in industrialized countries is due to the "baby boom" in the years following the Second World War.

Technical problems also arise, specifically those deriving from the realization of costs and benefits which have not yet been overcome. Research must, however, be continued.

Demographic and social fluctuations in industrialized countries

For the past 40 years, it has appeared that fluctuations in the birth rate in industrialized countries were linked to changes in the social climate. During the great depression of the 1930s, the net reproduction rate fell to about 0.8 in Sweden, France and the United States of America. In the United States, the rate climbed to 1.71 in 1959-1961; but in the past few years, it again dropped to less than 1. One may ask whether these changes, more or less parallel, are controlled by common factors, such as the great depression, the years of reconstruction following the Second World War; and the crisis of the affluent society, which, since 1964 especially in Europe, but also in the Union of Soviet Socialist Republics and in the United States, has apparently resulted in a drop in fertility. The current decline of fertility appears, however, to have preceded the perception of the current crisis. One can assume that demographic behaviour is becoming increasingly sensitive to changes in the social climate as couples acquire greater control in their procreation, and they are increasingly guided by economic and social conditions in the decision to have children. One cannot doubt that the immigration policies of receiving countries are also linked to the whims of the economic situation.

Large economic and social fluctuations, accompanied by changes in behaviour of the population, are thus reflected in changes of demographic structures, particularly by age, whose feedback must be studied at the economic level: public investments; employment; social security; housing; etc.

One must also ask oneself what the long-term effects can be of sudden changes in birth rates, such as the industrialized countries have experienced during the past 10 years.

Population and environment

The problems relating to population and environment are relatively new for the demographer and concentrate on two aspects—health and spatial policy.

A World Health Organization symposium was held in Paris in June 1974 to consider the first aspect. According to its report, hundreds of millions of people lose their lives or their health because of diseases existing in the environment in which they live. Inadequate use of an ill-assimilated technology, soil deterioration, water pollution and urban congestion coincide with an unprecedented improvement of living and health conditions at an increasing cost. What is gained on one side is lost on the other. Trade-offs are inevitable.

Any study in this field is difficult because statistical data are inadequate and any comparison with the past is, therefore, almost impossible. Moreover, a long period sometimes separates the onset of a disease from the time it actually becomes observable. Sometimes, also, one includes noxious effects that are not new, such as those of tobacco, whereas the real problem is the aggravation of certain phenomena, such as the increased air pollution which in certain cities accounts for the serious and continuing deterioration of the respiratory system.

A need exists to begin to establish criteria for measuring the ways in which man is changing the environment and then to establish cause and effect relationships.²²

Another concern for demographers is to examine the objective, measurable changes in the physical environment which result from population growth and its poor geographical distribution. To what degree does a relationship exist between demographic evolution and the increase of nuisances? What will be the relative effect of industrial and population growth on the environment of the region? Two aspects, namely, industrial location and population distribution, must be considered because some intrinsically pollutant industrial activities become tolerable if they are adequately located. Non-economic considerations regarding physical planning may lead to the conclusion that the optimal geographical distribution of population and purely economic considerations may not run parallel.²³ This is a sensitive area in which demographers can make a useful contribution.

Population policies

Population policies are a relatively new field of study, but one in which considerable interest has recently been aroused in response to a growing need for intervention in demographic processes. A wish to see demographic trends and structures conform more to the needs of and plans for society is becoming an integral part of a general aspiration for an even more complete mastery over the human factors of development. Nevertheless, this field of study, more than any other, encounters obstacles because it often touches on national susceptibilities, sometimes impinges upon pre-

vailing ideologies, and, moreover, seeks to affect the more private aspects of people's lives.

An attempt can be made to identify the principal research steps required to study population policies from the time of their inception to their eventual disappearance, i.e., most often to their success or failure. A first step would be to consider government perception of relationships that exist between demographic and non-demographic processes.²⁴ How and when does this perception appear? What statistical relationship exists between what is perceived and what actually exists? How is this perception modified and why? A second step would be to identify problems resulting from an imbalance of demographic and non-demographic processes. What methods for analysis are used to this end? What value systems are considered? How does the identification of demographic problems influence, or how is it influenced by, the total problem of development? A third step would be to formulate and implement population policies directed towards solving these problems. Who are the actors—individuals or institutions—who participate in this formulation? Since any policy implies a choice, which are the criteria used to allocate the resources needed to implement those policies? The implementation of these policies faces various obstacles linked to red tape, and to cultural and social resistance, which themselves deserve attention. A fourth step would be to analyse the methods for evaluating population policies. How are population policies evaluated, what criteria are used, what hypotheses are proposed concerning the existence or non-existence of relationships between demographic and non-demographic processes?

By merely listing these few points, it appears that population policies, i.e., action-oriented demography, are heavily dependent upon other social sciences and, specifically, upon those which help to clarify the relation between population and development. The amount of work to be done in developing the hypotheses, concepts and methods is enormous and the difficulties considerable. However, an analysis of the existing data, using already available means, would contribute to clarifying the processes related to the formulation of population policies and would no doubt contribute to the establishment of a national plan for ordering the research priorities.

FINAL COMMENTS: NEED FOR WORLD-WIDE SCIENTIFIC THOUGHT

Demography is a changing discipline because of the general evolution of human sciences, but also as a result of a renewed world-wide interest in the questions of population, arising out of the major problems which confront the world; and, lastly, as a result of the continued permeation of political factors into all areas of knowledge. Its scope has enlarged considerably; the

²² "Report of the Symposium on Population, Resources and Environment", *Population Debate*, vol. II, annex II, pp. 687-99.

²³ Jean Labasse, *Development and Pollution*, lecture series on population (Liege, International Union for the Scientific Study of Population, 1974).

²⁴ United Nations Secretariat, "Population policies and programmes", *Population Debate*, vol. II, part nine, pp. 583-605.

need for new research is greater than ever. The World Population Conference has merely accelerated a latent evolution.

In future, attempts to explain population phenomena must go beyond the discipline itself, as the explanation is of a sociological, economic, biological and even political nature, and not purely demographic. The demographer can neither analyse nor predict the evolution of population without a knowledge of society. He must integrate data on population with social data. Otherwise, his work will be of no bearing or consequence.

One of the results of this evolution is that the demographer will have to have greater knowledge of the relationships existing between the disciplines and, to this end, substitute for a high degree of specialization a collaboration with researchers in other fields of knowledge. He must doubtless also acquire a direct knowledge of the societies and environment that he is studying. He must also, without the risk of losing precision, scientific integrity and dignity, force himself to become active by participating in the direction and preparation of concrete operations. Lastly, he must attempt to explain the results of his work in a language which can be communicated to and readily understood by everyone and must not discourage information specialists with boring documents.

Applied research cannot be the exclusive aim of this work. For the renewal of any discipline, fundamental research remains indispensable, though the latter must deal with concrete and everyday problems.

A process of reorganization of research is in order

because it would be unlikely for all sectors to advance at the same pace. Bottle-necks have already appeared, particularly in the relationships between population and development, a field which should interest more researchers; while other sectors, of more limited interest for the future, still attract numerous talents. A sensitive problem arises. Research can no longer, as in the past, be moved by spontaneous forces, especially as its cost increases. A determined effort is necessary to establish new directions, while endeavouring not to jeopardize the freedom, scientific neutrality and the structures of the disciplines.

There is not always coincidence between the direction in which sciences move and that which is most beneficial for society. One should leave a great degree of latitude to the investigators, because any discipline should remain open and not stifle innovation. But would it not be desirable to give some orientation to a type of research which is so important and which relates to the very infrastructure of society; and, at the same time, to guide the decisions of the "sponsors", i.e., Governments, international bodies and private foundations? Would it not be desirable to foster a world-wide scientific harmonization and a permanent forum where professionals, men and women, could meet to discuss desirable courses of action for the discipline and their applications, and also to stimulate rigorous thought? It is not enough to know if and how a particular discipline should be helped; a determination should be made of the sector and the approaches that should be promoted.

ORDERS OF MAGNITUDE OF THE WORLD'S URBAN POPULATION IN HISTORY

John V. Grauman *

It is common knowledge that urban populations have never grown so large nor with such speed as in the modern epoch. But little precision can be given to this view unless the new magnitudes can be charted against urban population estimates for historical periods. Aside from their merely historical interest, historical estimates should also make it possible to say both when the new cycle in the transformation of the human habitat seriously gathered speed and how much more urbanized the world has become as compared with other epochs of civilization. The timing of the onset of the modern urban revolution should also help in pin-pointing more exactly the causes which may then have provided the impetus for that development. In the present article, it cannot be claimed that this question is satisfactorily resolved; but the attempt may stimulate efforts by others to bring the matter into sharper focus. It is noteworthy that, thus far, few such attempts have been made.

One isolated instance has been found in which population estimates concerning human settlements of varied size encompass the space of millennia.¹ The source provides no clue as to how these estimates have been made, nor do they appear to be intended to provide more than a very rough scheme of reference. Taking 5,000 inhabitants as the lower size limit for settlements which can be regarded as "urban",² the following course of events can be deduced from the figures given in table 1.

If one takes these figures literally, then the world population was already more urbanized at the beginning of the present era than by the year 1850, and the level of urbanization reached about A.D. 1000 was not to be surpassed until late in the nineteenth century. While not impossible, this suggested course of developments raises serious doubts.

Two studies—one by Davis and Hertz,³ and the

TABLE 1. TOTAL POPULATION, POPULATION IN SETTLEMENTS WITH 5,000 OR MORE INHABITANTS AND PERCENTAGE OF THE LATTER IN TOTAL POPULATION, 2500 B.C.—A.D. 1950

(Population in millions)

Year	Total population	Settlements of 5,000 or more	Percentage in such settlements
B.C.			
2500.....	101	3	3.1
2000.....	110	4	3.8
1500.....	120	4	3.4
1000.....	132	3	2.3
500.....	146	9	6.7
B.C./A.D.			
0.....	165	17	10.3
A.D.			
500.....	195	13	6.7
1000.....	245	28	13.5
1500.....	395	30	8.3
1650.....	545	30	5.9
1750.....	728	33	4.8
1800.....	906	56	6.2
1850.....	1,160	110	9.5
1900.....	1,610	290	18.0
1950.....	2,493	783	31.4

SOURCE: As estimated in C. A. Doxiadis and J. G. Papaioannou, *Ecumenopolis, the Inevitable City of the Future* (Athens, 1974).

other by Hoyt⁴—have been found in which the urban population of the world has been estimated back to 1800, in terms of settlements with at least 5,000 inhabitants. As is shown below, the estimate by Hoyt has probably been well pondered.

The estimate by Davis and Hertz was probably a result of compilations made for various dates, with evidence more plentiful for recent than for earlier dates, especially as regards the smaller urban settlements. This can be deduced as one compares the particular estimates for 1800, 1850, 1900 and 1950, each of which distinguishes urban settlements of three different size categories (table 2).

If one accepts these figures, the world population in 1800, somewhat in excess of 900 million, would have been urbanized only to the extent of 3.0 per cent, no more than the urbanization level suggested by Doxiadis and Papaioannou for as early as 2500 B.C. But it can be plainly demonstrated that the estimates of Davis and Hertz are deficient for 1800 in respect of settle-

⁴ Homer Hoyt, "The growth of cities from 1800 to 1960 and forecasts to the year 2000", *Land Economics*, vol. 39 (May 1963), p. 170.

* Population Division of the Department of Economic and Social Affairs, United Nations Secretariat. This article was finished shortly before the author's death on 19 April 1976.

¹ C. A. Doxiadis and J. G. Papaioannou, *Ecumenopolis, the Inevitable City of the Future* (Athens, 1974). Reference is made to the table on pp. 400-01.

² The reasons that 5,000 inhabitants might be taken as the somewhat arbitrary lower size limit for settlements to qualify as "urban" are briefly discussed below.

³ Kingsley Davis and Hilda Hertz, tables presented in an unpublished work and reproduced in Philip M. Hauser, ed., *Urbanization in Asia and the Far East*, SS.57.V.7.A (Calcutta, United Nations Educational, Scientific and Cultural Organization, 1957), pp. 56-58.

TABLE 2. POPULATION IN SETTLEMENTS WITH 5,000 OR MORE INHABITANTS, AND IN THREE SIZE CATEGORIES OF SETTLEMENTS, 1800-1950

(Population in millions)

Year	All settlements, 5,000 or more	Settlements within size groups		
		5,000- 19,999	20,000- 99,999	100,000 or more
1800.....	27.2	5.5	6.1	15.6
1850.....	74.9	24.5	22.9	27.5
1900.....	218.7	70.8	59.3	88.6
1950.....	716.7	214.5	188.5	313.7

SOURCE: As estimated by Kingsley Davis and Hilda Hertz, tables presented in an unpublished work and reproduced in Philip M. Hauser, ed., *Urbanization in Asia and the Far East*, SS.57.V.7.A (Calcutta, United Nations Educational, Scientific and Cultural Organization, 1957), pp. 56-58.

ments smaller than 100,000, though the estimate for the 100,000 or more group may be acceptable. When the figures at the end of each 50-year period are divided by those at the beginning of each period, the following ratios are obtained:

Period	Settlements with population of:		
	5,000-19,999	20,000-99,999	100,000+
1800-1850.....	4.45	3.75	1.76
1850-1900.....	2.89	2.59	3.22
1900-1950.....	3.03	3.18	3.54

The sequence of ratios for the 100,000 or more group appears plausible enough when it is considered that the emergence of numerous cities of such size accelerated in the second half of the nineteenth century, as is well documented in other sources. But since "100,000 or more" is an open-ended group with no upper size limit, it is to be assumed that population in this group at all times grew significantly more rapidly than that of the other two groups which have both an upper and a lower size limit. According to Davis and Hertz, this situation would, indeed, have been true in 1850-1900 and 1900-1950; hence, the detailed estimates for 1850, 1900 and 1950 are at least consistent with one another. But it is exceedingly implausible that population in the two lower size groups should have grown so very rapidly during 1800-1850, when growth in the 100,000 or more group apparently was rather moderate. In relation to the several growth rates for 1850-1900 and 1900-1950, and the perhaps entirely acceptable 1800-1850 growth rate for the 100,000 or more group, one can assume that the 1800-1850 growth rate in each of the two smaller size groups should have been of the order of from 1.40 to 1.60, rather than the rates of 4.45 and 3.75 implied by Davis and Hertz.

Assuming the suggested rates of from 1.40 to 1.60 for the smaller size groups and working backwards from the estimates for 1850, one obtains these adjusted estimates for 1800 as compared with 1850:

Year	All settlements with population of 5,000+	Settlements with population of:		
		5,000- 19,999	20,000- 99,999	100,000+
1800.....	45.2-49.5	15.3-17.5	14.3-16.4	15.6
1850.....	74.9	24.5	22.9	27.5

Accordingly, the urban population of the world (settlements of 5,000 or more) could have totalled between 45 million and 50 million in 1800, assuming that it was nearly 75 million in 1850 and that, in other respects, the Davis and Hertz estimates were more reliable. The estimate for 1800 might have to be still somewhat larger if it is also assumed that even for 1850, Davis and Hertz somewhat underestimated the population of small towns, which is at least possible.

By coincidence, the range of "from 45 million to 50 million" for the world urban population in 1800 was also estimated by Hoyt in a subsequent publication. This estimate should, perhaps, be taken rather seriously since he undoubtedly extrapolated from the results of incomplete compilations by means of a mathematical rule. It is to be noted this estimate was published in 1963, soon after his 1962 publication in which the rank-size rule was used very extensively.⁵

United Nations estimates of the world's urban population made thus far go back only to 1920.⁶ For that year, an urban population of 360 million was estimated; and for the year 1930, a world figure of 450 million. By interpolation, the world's urban population may have totalled 400 million in 1925, a figure that is also used further on. As concerns the United Nations estimates, which are for "urban" population as variously defined in different countries, note should be taken also of their close coincidence with the Davis and Hertz estimate—settlements of 5,000 and more inhabitants—for 1950. For that year, Davis and Hertz estimated 716.7 million; the United Nations estimates, as most recently revised, total 716.8 million.

LOWER SIZE LIMIT USED TO REPRESENT URBAN SETTLEMENTS

Currently, there is a great diversity, from country to country, in the criteria used for statistical purposes to distinguish "urban" from "rural" localities.⁷ It is not feasible to discuss here the numerous respects in which the definitions vary, the reasons for their diversity and the consequences for resulting census totals or other estimates of urban population. The very meaning and content of urbanization are currently undergoing marked changes. New concepts have emerged which displace the earlier ideas, and actual developments diverge between the countries of earlier industrialization and the currently developing countries. In earlier times, urban settlements were, on the whole, more clearly set apart from the rest of the human habitat, especially in those times when cities had special charters and privi-

⁵ For estimate of 45 million-50 million, see *ibid.* For rank-size rule, see Homer Hoyt, *World Urbanization, Expanding Population in a Shrinking World*, Technical Bulletin 43 (Washington, D.C., Urban Land Institute, 1962).

⁶ *Growth of the World's Urban and Rural Population, 1920-2000* (United Nations publication, Sales No. E.69.XIII.3), p. 48.

⁷ "Statistical definitions of urban population and their uses in applied demography", *Demographic Yearbook, 1972* (United Nations publication, Sales No. E/F.73.XIII.1).

leges, and when they were surrounded by walls and moats.

Despite this variation of modern conditions, as mentioned above, the world total of estimates of "urban" population (as variously defined in each country) for 1950 coincides very closely with another estimate independently made for the world population in settlements with 5,000 or more inhabitants. In other words, there are probably some compensating overlaps. If all countries were to adopt a strictly uniform definition, namely, 5,000 inhabitants within localities whose outer contours are defined by the same standards, the resulting "urban" population total would be somewhat larger than actually reported in some countries and somewhat smaller in other countries. The matter has been studied in further detail by Davis,⁸ who shows that, for the most part, urban populations are being distinguished as those of settlements above a lower size limit varying from 2,000 to 10,000 inhabitants.

In remote history, places deserving the description of "urban" probably evolved from previous villages in which several activities serving a number of functions were locally combined. The population estimates of urban paleontologists may be highly debatable; but, on the whole, those most ancient cities, already identified as such, are also believed to have had at least 5,000 inhabitants.⁹

It must be recognized that such a size criterion is strictly physical and geographical, referring as it does to a measurable number of people residing within the contours of a zone inhabited at some measurable density. Probably more important for the history of culture is the sociological criterion of "urbanism", which manifests itself in multiple and co-ordinated social roles and economic functions; and, at the same time, in the evolution of corresponding mental attitudes. The intensity of such features can vary from person to person irrespective of the place of residence: physically urban areas may well comprise population segments whose prevailing mentality is still rather rustic, although numerous inhabitants of villages and open countryside may already have absorbed a somewhat "urbane" culture. No doubt, the sociological content of settlements with 5,000 or more inhabitants, as distinct from other settlements, varies from place to place and it must also have varied in the course of time.

Altogether, in historical times, all the regional populations were smaller than they currently are. Outside the urban places they also lived at a lower density. Communications over great distances were so rare that most people knew little about the more distant places. In the circumstances, the "urbane" as well as "urban" character of a small city in the vicinity stood out in much sharper relief than does even a very large city

today. An equal level of physical urbanization, in historical periods, could have represented a markedly greater degree of sociological differentiation. In the absence of measures of degrees of qualitative distinction, the present article can only consider the strictly physical aspect of urbanization.

HISTORICAL CITY POPULATION ESTIMATES

The basic source for the present study is the population estimates for long lists of cities, ordered by size and compiled for various historical dates, recently published by Chandler and Fox.¹⁰ These estimates have resulted from many years of systematic research covering all parts of the world, and most of history. Wherever possible, a list of at least 75 cities was brought together which, at the given date, were presumably larger than any other cities wherever they may have been situated. This new source of data, and the use of some suitable mathematical formula, now offers for the first time an opportunity to estimate the combined urban population of the world (settlements of at least 5,000 inhabitants) over the course of numerous centuries.

The reliability of estimates thus obtained will depend upon two assumptions. First, the city estimates presented by Chandler and Fox must be regarded as reliable. Secondly, the formula applied to derive the combined urban population must be considered to be fully appropriate. Obviously, neither of these two conditions can be taken for granted.

The task of identifying and estimating the sizes of the 75 largest cities at any time in history, often based only on the scantiest evidence, is formidable to say the least. Their chief merit consists in the systematic coverage achieved rather than in the accuracy of each individual estimate. Certainly, there will be historical demographers who may take issue with a great many of the figures arrived at by Chandler and Fox. Errors committed in the individual instances will, of course, tend to be compensated to a considerable extent in the aggregate if there persists, throughout the work of those authors, an almost equal likelihood of over-estimate and underestimate. Certainly, they have made every effort to eliminate bias, as can be seen from their explanatory text; but it is less certain that they have been entirely successful. For instance, the undoubted rise of urbanization level in China under the Sung Dynasty (eleventh and twelfth centuries) fails to be reflected in the estimates for Chinese cities in that period. Although there may be flaws in some of the data, the fact remains that no other comparable compilation exists.

The series of city population estimates made by Chandler and Fox begins with the date 1360 B.C., presumably because for that date the first attainment of 100,000 was estimated for a city—Thebes in Egypt.

⁸ Kingsley Davis, *World Urbanization, 1950-1970; Volume II: Analysis of Trends, Relationships, and Development*, Population Monograph Series, No. 9 (Berkeley, University of California, 1972).

⁹ Gideon Sjoberg, *The Preindustrial City: Past and Present* (Glencoe, Illinois, Free Press, 1960), pp. 27-37.

¹⁰ Tertius Chandler and Gerald Fox, *3000 Years of Urban Growth* (New York and London, Academic Press, 1974), in particular, tables on pp. 300-40.

For those very early times, however, the authors could only bring together the estimates for rather few cities. The first date for which estimates for at least 50 cities are assembled is 430 B.C., then 44 cities in 200 B.C., and numbers of cities fluctuating from 60 to 70 in A.D. 100, 361, 622 and 800. Beginning with A.D. 900, the estimates are generally for 75 cities. Subsequent dates are the years 1000 and 1100, followed by half-century intervals up to 1800, and by quarter-century intervals since that time. Exceptionally, the list of cities for 1800 extends to 536 items, presumably all the cities then in existence which then had at least 20,000 inhabitants; and for 1900, an even longer list of cities—namely, 850—is provided, the smallest of which had 37,000 inhabitants. Use can be made of these long lists for 1800 and 1900 to check results obtained by a method when only the first 75 cities are included, as is shown below. This check is significant because for most of history only the 75 largest cities are kept in evidence.

For each date, the cities are ranked according to their presumable population size but, except for relatively recent dates, the lists also include numerous cities for which no population figure was provided. The resulting gaps can be safely interpolated since the present article is concerned not with each individual city, but with the aggregates of combined city population. It can also be stated that for many cities, in fact for most at some of the earlier dates, the given population figures are considerably rounded. Again, in the aggregate of estimates, the rounding errors probably tend to compensate one another. However, in the method of estimation described below, some influence may be exerted by the rounding error in the smallest city for which a population figure is shown.

It remains to be examined how the Chandler and Fox estimates for the larger and middle-sized cities compare with those of Davis and Hertz.

First, with respect to the category with 100,000 or more population, the following data can be noted. Davis and Hertz estimated a combined population of 15.6 million in 1800, 27.5 million in 1850, 88.6 million in 1900 and 313.7 million in 1950. For 1800 and 1850, these estimates agree well with those of Chandler and Fox, namely, 15.2 million and 28.4 million. Chandler and Fox, however, explicitly estimate the populations of agglomerations, as determined by contours of dense settlement regardless of administrative boundaries, whereas no such specification has been given for the Davis and Hertz estimates. This, no doubt, is the reason why, with the modern growth of suburbs, the Davis and Hertz estimate for 1900 (88.6 million for cities of 100,000 or more) falls short of the Chandler and Fox estimate (103.9 million for agglomerations of such size). Likewise, and no doubt for the same reason, the Davis and Hertz estimate for 1950 (313.7 million) falls short of the most recent United Nations estimate for that date (392.0 million in agglomerations, including suburbs, of 100,000 or more). The fact to be noted is that for cities of 100,000 or

more, the Davis and Hertz estimates for 1800 and 1850 can be taken quite seriously.

As concerns the category with 20,000-99,999 inhabitants, the comparison can be made only for 1800. Here, as has been suggested, Davis and Hertz fell far short, with an estimate of only 6.1 million (see the preceding text) which should be brought at least to the level of from 14.3 million to 16.4 million. The Chandler and Fox series, however, comes to a total of 18.3 million; hence, perhaps an even larger adjustment should have been made. One is led to believe that the world's urban population (settlements of 5,000 or more) in 1800 could have somewhat exceeded the combined figure of 50 million.

Because Davis and Hertz fell so far short, as concerns the smaller cities in 1800, one is led to suspect that they fell at least slightly short also in 1850. In that year, the world's urban population could have easily amounted to 80 million, as compared with the 74.9 million suggested by Davis and Hertz. Based on more recent and plentiful data, the accuracy of their estimate for 1900 need not be questioned at this point, in so far as most of the city suburbs—not included in their estimates for the larger cities—also constituted at least urban localities of 5,000 or more inhabitants. Suburban entities smaller than these settlements, yet part of larger agglomerations, may have been omitted; hence, in 1900 also, Davis and Hertz may still fall slightly short. But the roughness of many of the data which had to be included makes this, perhaps, too fine a consideration.

Tentatively, at this stage, the world's urban population may be put at 50 million in 1800, 80 million in 1850, 225 million in 1900 and 717 million in 1950. The development of other estimates, derived from the long Chandler and Fox series, depends upon the use of a mathematical method which is briefly discussed below.

THE RANK-SIZE RULE

A model often referred to in studies of the population as distributed among localities of diverse size is the so-called "rank-size rule". The same rule is also said to have applications in astronomy, as concerns the comparative frequency of stars of given orders of magnitude. It also resembles the principle of the Pareto curve which finds applications in calculations of the distribution of incomes. According to the simplest form of this rule, when cities and other localities in a large area are listed in the order of their rank in size, the second city tends to be one half the size of the first, the third city one third that size and so forth. In short, the size of each city tends to be in inverse proportion to its rank. This rule is commonly attributed to Zipf,¹¹ but has been widely debated and there is no agreement as to the reasons why so many observations tend to

¹¹ G. K. Zipf, *National Unity and Disunity. The Nation as a Biological Organism*, Bloomington, Ind. (Principia Press, 1941).

bear it out.¹² In particular, it is most commonly found that the size distribution of some of the largest cities can be quite irregular and that the law of inverse proportionality asserts itself increasingly and more clearly among smaller cities, or among localities of comparatively high rank orders.¹³ The size distribution of the world's cities larger than 100,000 in 1950, 1960 and 1970 has been examined by Davis,¹⁴ who found that, except in the largest and smallest urban size groups, the rule tended to be borne out well enough to justify the derivation of presumable numbers of localities and the populations contained therein in several size groups smaller than 100,000, incidentally bearing out that, despite variable national definitions, the current combined "urban" population of the world probably differs little from that contained by localities of 5,000 or more.

The population of cities, ranked by size order, can be plotted on double-logarithmic graph paper, with a horizontal scale representing the rank of each city, and a vertical scale representing its size. If the rank-size rule, in its simplest form, actually applies, the graph of successive cities should follow precisely a diagonal descending at a 45° angle. The slope of such a graph can be considered the "unity slope", as it is measured by the tangent of the angle which, in the case of 45°, is unity. A gentler slope, measured by the tangent, would be less than unity and a steeper slope more than unity. Actual observations, however, often tend to follow a curve which begins with a gentle slope that steepens gradually as it proceeds to cities of smaller and smaller size, possibly tending towards "unity slope" at the limit.

This reasoning is illustrated in figures I-IV. In each figure, a diagonal is also drawn from the position of the largest city downward which represents exact "unity slope". What has just been said is borne out in the figures. Among the largest cities, the distribution is somewhat irregular and the prevailing slope is comparatively gentle. Considerable regularity can be seen at

¹² *The Determinants and Consequences of Population Trends* (United Nations publication, Sales No. E.71.XIII.5), pp. 215-17.

¹³ The simple rank-size rule can be expressed by the formula

$$n_r = \frac{C}{r}$$

where n_r = the population of city n ; r is its rank; and C is the population of the largest city. In this form, the rule has a number of convenient mathematical properties. Because of a typical deviance of size distribution among the largest cities, some modified formulae have also been suggested, such as

$$n_r = \frac{C \left(1 + \frac{n-1}{10} \right)}{r}$$

See J. C. Russell, "Late ancient and medieval population", *Transactions of the American Philosophical Society*, vol. 48, part 3 (June 1958), p. 69. This formula becomes equivalent to the simple formula $n_r = \frac{C}{r}$ at the limit where $n = \text{unity}$.

However, different effects would result if in the above-mentioned expression ($n-1$) were to be divided by some denominator other than the arbitrary 10.

¹⁴ K. Davis, *op. cit.*

least from the fiftieth city downward. The slope steepens progressively until it is almost, but never quite, parallel with the "unity slope" of the diagonal.

It should be pointed out that these observations are for the world as a whole. Observations for individual countries, of course, can often be quite different.

One observation, important in the present context, can be made when the graphs of the four figures are compared with one another. In figure I, which is for 1800, the slope is still markedly gentler than unity down to the smallest cities shown (the data comprise 536 cities); but in figures II-IV, which are for 1900 and more recent years, the slope among the comparatively smaller cities is noticeably steeper. What emerges from these graphs, and especially from figure I, is that the unity slope cannot be taken for granted where the size distribution of cities for the entire world is concerned; and although the slope probably steepens for comparatively small cities, it can remain markedly less than unity for a large part of its range.

In the following discussion, most estimates of urban population (5,000 or more) will have to be derived from a list of the 75 presumably largest cities and, in particular, from the population estimate given for the seventy-fifth city. For the first 75 cities, the combined population is obtained directly from the Chandler and Fox estimates (with interpolations where there are gaps). The population of all settlements smaller than the seventy-fifth, yet larger than the minimum size of 5,000 inhabitants, can vary in accordance with the slope which will have to be assumed.

If the "unity slope" can be assumed, the population (in thousands) of all cities smaller than smallest given, yet larger than 5,000, is obtained as

$$nS(\log_e S - \log_e 5)$$

where S = the size of the smallest city shown (in thousands); n = the rank order of that city, usually 75 (though sometimes also a different figure); 5 = the smallest urban settlement, assumed to have the minimum of 5,000 inhabitants.

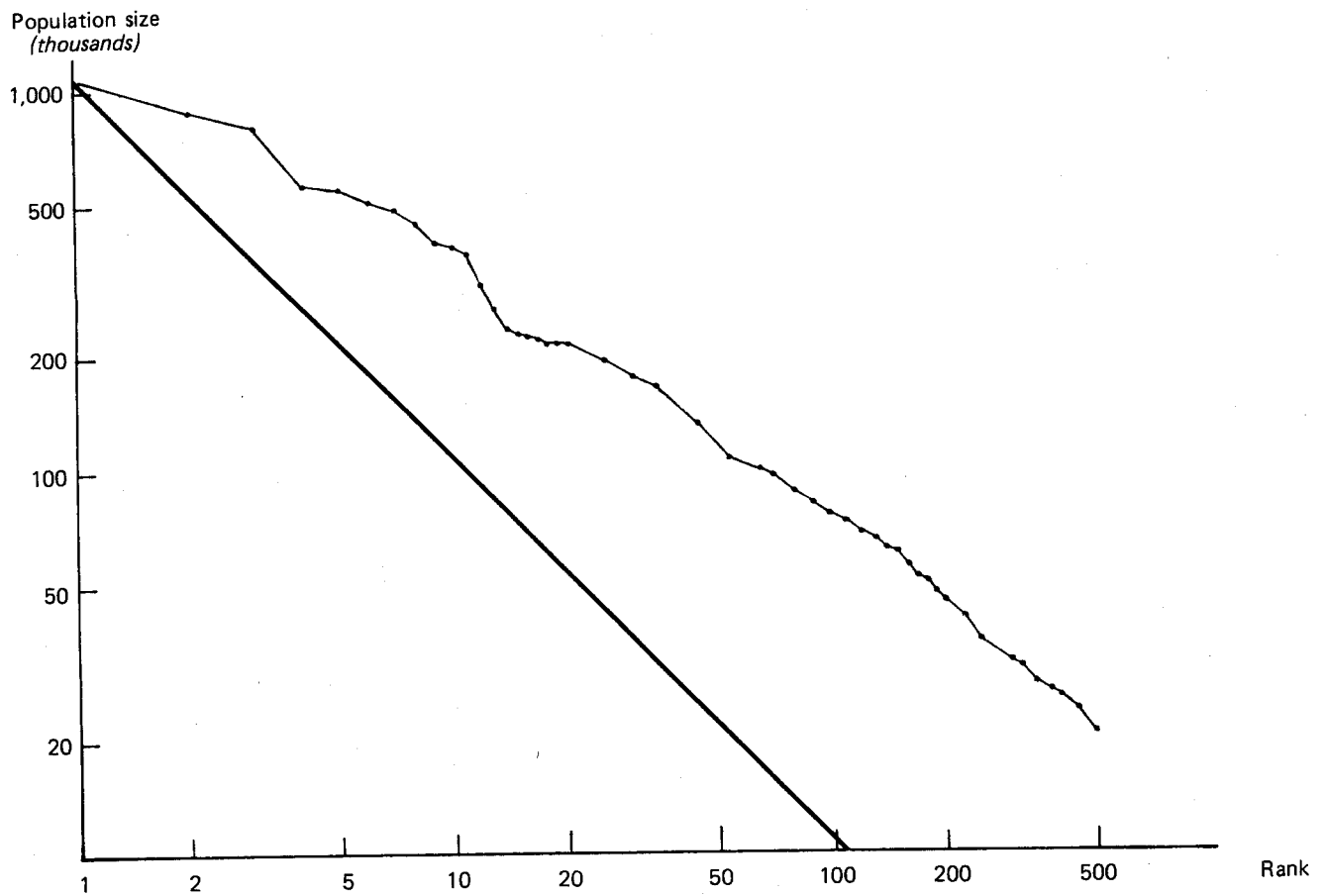
If some other slope has to be assumed, the formula becomes more complicated, namely

$$\frac{nS}{1-r} \left[\left(\frac{S}{5} \right)^{\frac{1-r}{r}} - 1 \right]$$

where, in addition to the above specifications, r = the slope, to be taken at some value smaller than unity.

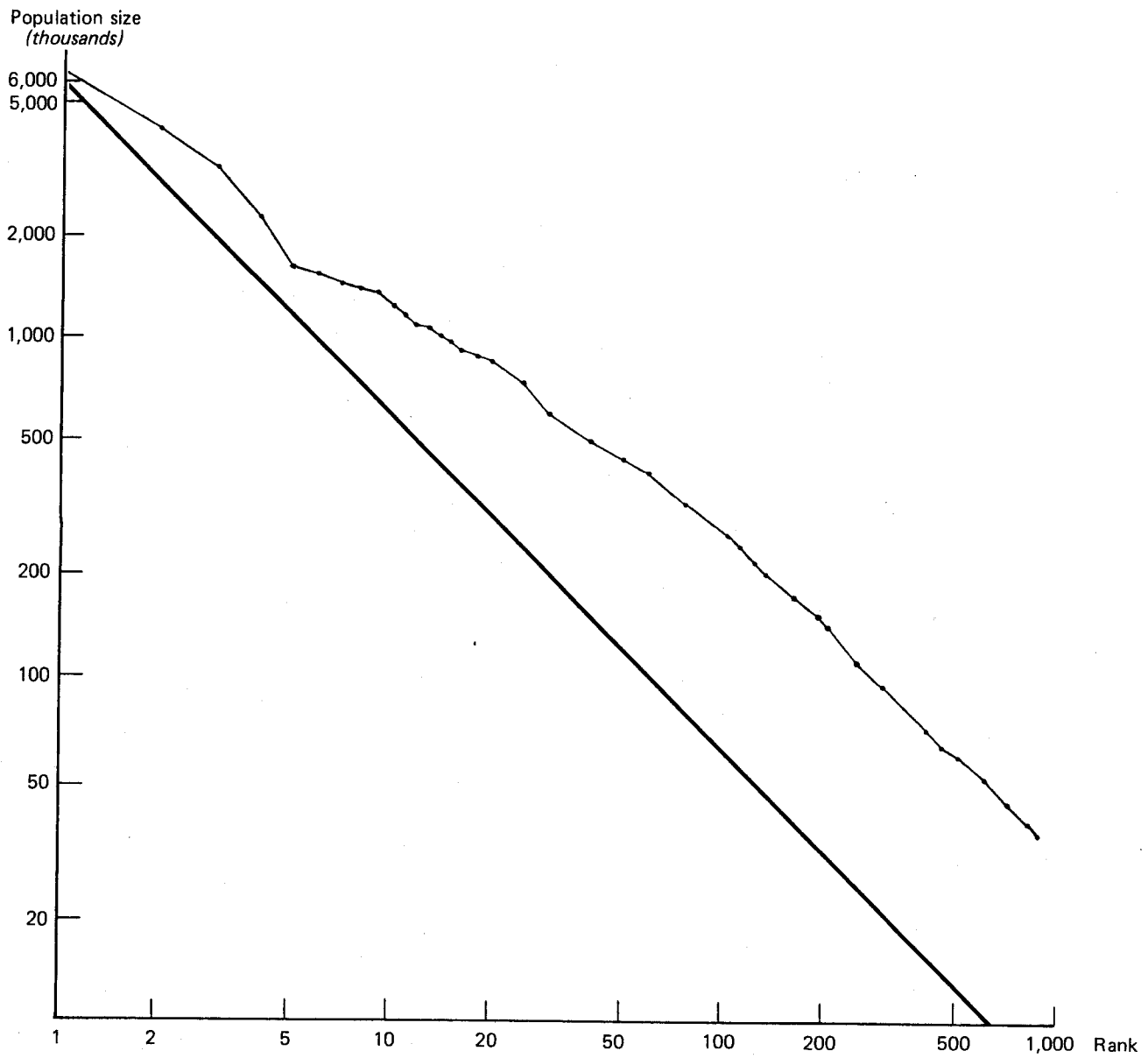
An attempt has been made to calculate values of r as found among the largest cities (usually 75) for which city population estimates were actually provided, as a possible basis for speculating on what the value of r might be among cities of smaller size. But, as calculated from these samples of cities, the apparent values of r fluctuated so widely as to prohibit any significant inference. This approach towards estimating the combined urban population, therefore, had to be abandoned.

Figure I. Distribution of cities with more than 20,000 inhabitants,
by size rank and population size, 1800
(Double-logarithmic scale)



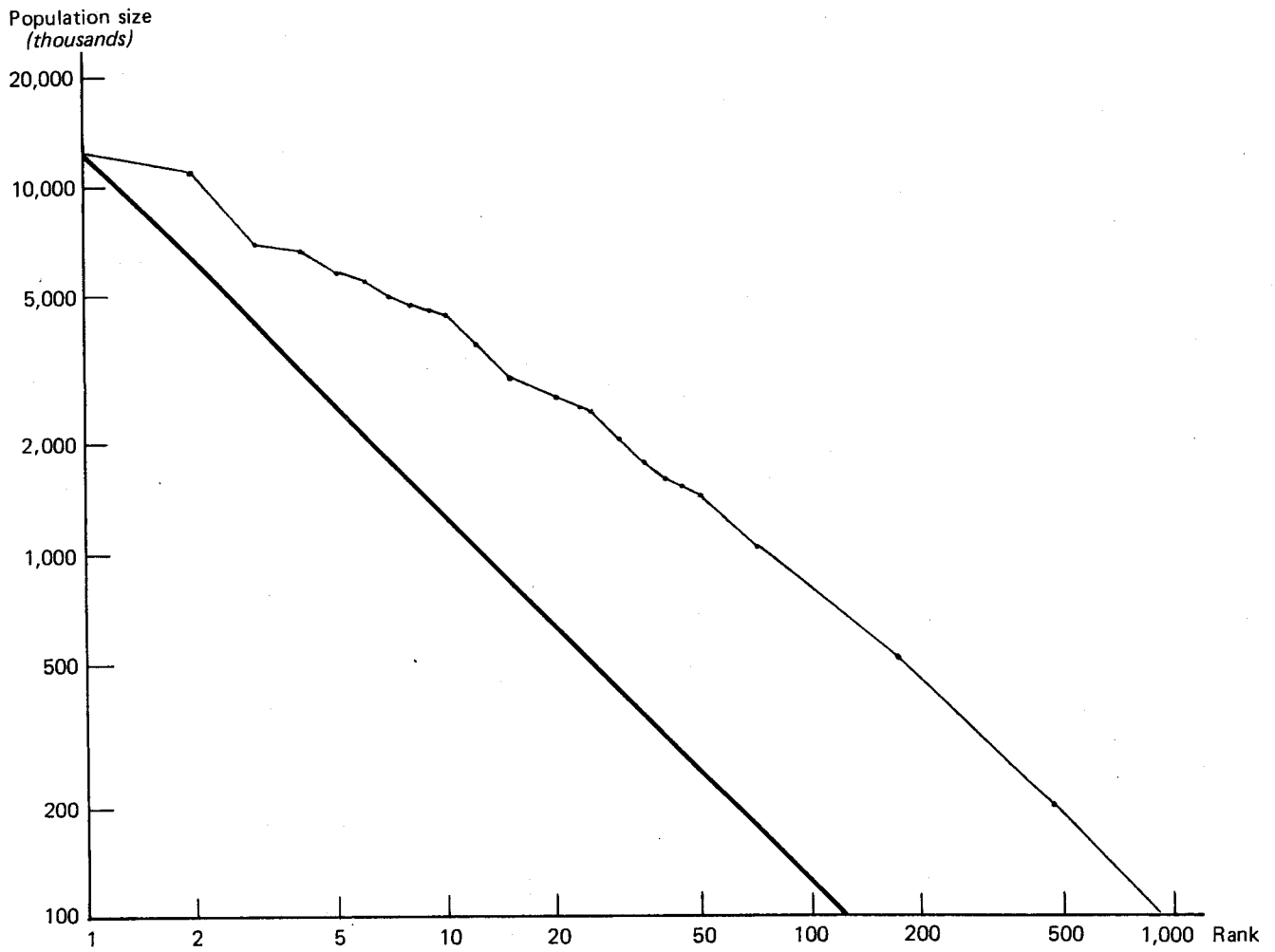
SOURCE: Tertius Chandler and Gerald Fox, *3000 Years of Urban Growth* (New York and London, Academic Press, 1974).

**Figure II. Distribution of cities with more than 37,000 inhabitants,
by size rank and population size, 1900**
(Double-logarithmic scale)



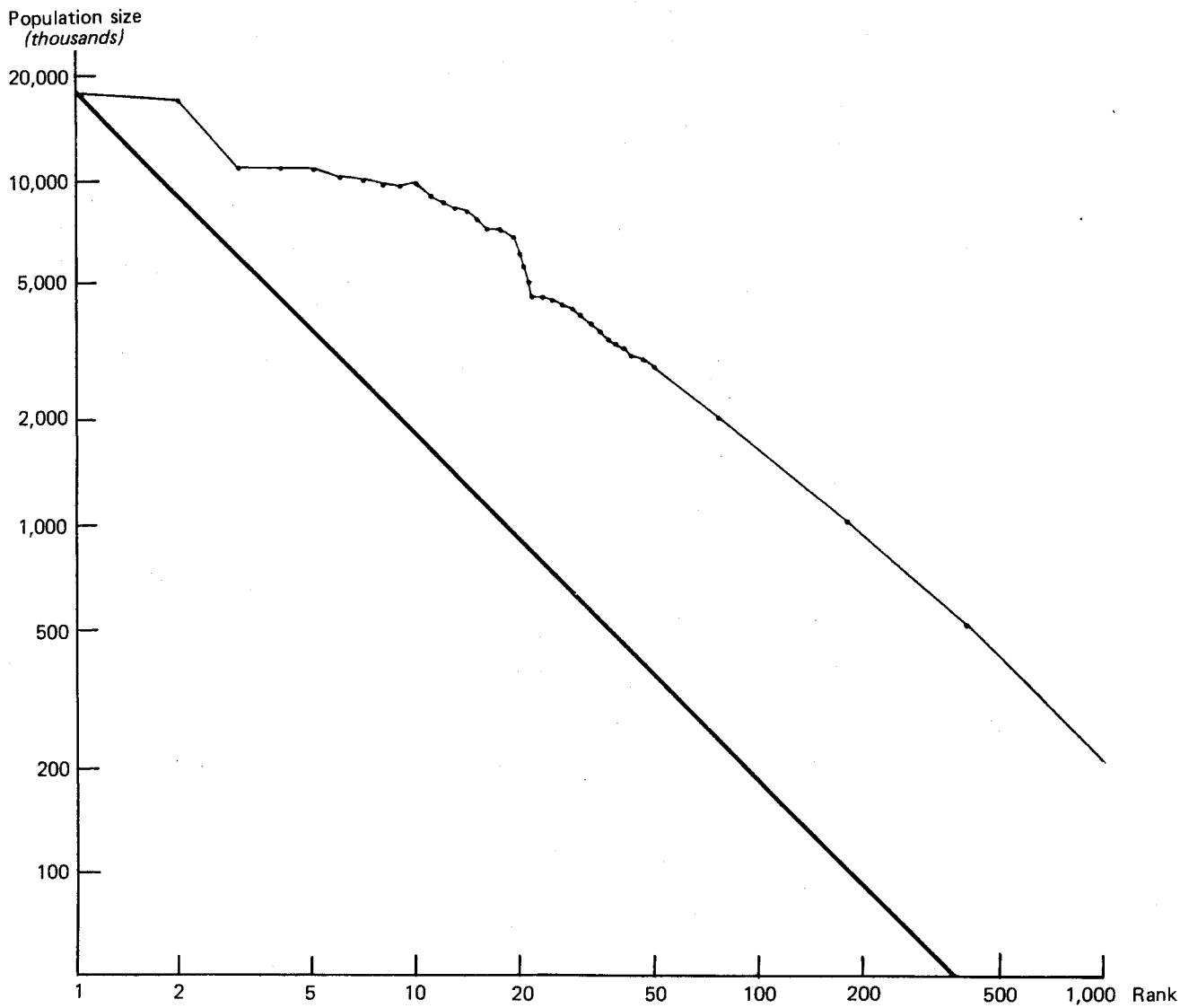
SOURCE: Tertius Chandler and Gerald Fox, *3000 Years of Urban Growth* (New York and London, Academic Press, 1974).

Figure III. Distribution of cities with more than 100,000 inhabitants,
by size rank and population size, 1950
(Double-logarithmic scale)



SOURCE: Estimates of the United Nations Secretariat.

Figure IV. Distribution of cities greater than 200,000 inhabitants,
by size rank and population size, 1975
(Double-logarithmic scale)



SOURCE: Estimates of the United Nations Secretariat.

Judgement as to appropriate values for r , therefore, could be formed only on the basis of observations for 1800 and 1900, two dates for which Chandler and Fox provided much longer lists of cities ranked by population size.

Range of results obtainable by application of the rank-size rule to the city population estimates of Chandler and Fox

Thus, one is left free to assume any reasonable value for r , the slope of the size distribution, for cities smaller than those shown by Chandler and Fox. The cities shown, 75 or fewer for each date, are taken as given, and to the sum of their population is added an estimate for the combined population of all other urban settlements with 5,000 or more inhabitants. Assembled in table 3 below are the population (in millions) of the group of cities shown and the estimates of the entire urban population which result from assuming r to be equal to 1.0, 0.9, 0.8 or 0.7. It may be seen that large differences can result from variations in the assumption or r , and that the relative range of differences widens as one comes to more recent dates.

COMPARISON OF RESULTS OBTAINED FROM LIMITED AND EXTENSIVE DATA IN 1800 AND 1900

The foregoing figures for 1800 and 1900 have also been calculated from the data for the 75 largest cities only, the number of cities for which Chandler and Fox have provided data for most other historical dates. The same source, however, also provides a list of the 536 largest cities in 1800, and of the 850 largest in 1900. This list makes it possible to compare the results derived from 75 cities with those derived from more extensive lists. In addition, independent estimates of the world's urban population have also been suggested after a critical examination of the estimates of Davis and Hertz, and of Hoyt, also for those two dates. The alternative estimates of the world's urban population (5,000 or more) are shown in table 4.

Where the extended list of cities was used, only a smaller residual of urban population had to be estimated; hence, the estimates from the extended list vary less than those from 75 cities only. But there is also the additional possibility that beyond the seventy-fifth city, the slope among additional cities within the ex-

TABLE 3. ESTIMATES OF WORLD'S URBAN POPULATION, DERIVED FROM VARIED ASSUMPTIONS OF THE SLOPE OF CITY SIZE DISTRIBUTION, 430 B.C.-A.D. 1925

(Millions)

Year	Population of cities shown	Population of all settlements of 5,000 or more, with r variously assumed			
		$r = 1.0$	$r = 0.9$	$r = 0.8$	$r = 0.7$
B.C.					
430.....	3.7	7.1	7.9	9.2	11.3
200.....	4.3	7.3	8.0	9.1	11.0
A.D.					
100.....	6.2	11.4	12.6	14.7	18.2
361.....	5.0	10.3	11.7	13.8	17.4
622.....	5.7	11.7	13.2	15.5	19.6
800.....	6.5	13.1	14.8	17.7	22.6
900.....	7.1	13.2	14.7	17.1	21.2
1000.....	7.0	13.2	14.7	17.1	21.3
1100.....	6.8	14.3	16.2	19.2	24.5
1150.....	6.8	15.2	17.4	21.0	27.4
1200.....	7.0	14.6	16.6	19.2	25.3
1250.....	7.0	14.3	16.2	19.2	24.4
1300.....	7.4	14.5	16.3	19.2	24.3
1350.....	7.4	14.8	16.7	19.7	25.0
1400.....	8.0	16.6	18.8	22.4	28.9
1450.....	8.4	17.1	19.4	23.0	29.6
1500.....	8.7	17.7	20.1	24.0	31.0
1550.....	9.6	20.1	23.1	27.8	36.4
1600.....	11.4	23.7	27.1	32.8	43.3
1650.....	12.7	23.9	27.1	32.1	41.4
1700.....	13.2	27.0	31.1	37.7	50.1
1750.....	13.4	28.8	33.4	40.9	55.2
1800*.....	16.0	35.2	41.2	51.2	70.5
1825.....	18.7	41.8	49.1	61.7	86.5
1850.....	25.4	57.8	68.8	88.1	127.3
1875.....	36.1	90.3	110.5	147.3	225.7
1900*.....	63.9	176.6	224.0	315.3	526.4
1925.....	104.0	301.3	392.1	574.8	1,023.3

SOURCE: Tertius Chandler and Gerald Fox, *3000 Years of Urban Growth* (New York and London, Academic Press, 1974).

* Based on 75 cities, though source also gives a longer list of cities.

TABLE 4. ALTERNATIVE ESTIMATES OF WORLD'S URBAN POPULATION, 1800 AND 1900

(Millions)

Year	Population of cities shown	Population of all settlements of 5,000 or more, with r variously assumed			
		$r = 1.0$	$r = 0.9$	$r = 0.8$	$r = 0.7$
<i>Derived from 75 largest cities only</i>					
1800.....	16.0	35.2	41.2	51.2	70.5
1900.....	63.9	176.6	224.0	315.3	526.4
<i>Derived from extended list of cities</i>					
1800.....	33.7	48.6	51.2	55.9	62.9
1900.....	133.3	196.2	211.6	235.4	264.8
<i>Independent estimates</i>					
1800.....	50.0	...	...	...	...
1900.....	225.0	...	...	...	...

tended list still is less steep than that among the residual cities beyond the extended list. For instance, the same figure of 51.2 million results in 1800 by assuming a constant slope of 0.8 from the seventy-fifth city downward, and likewise by assuming a slope of 0.9 for additional cities beyond the extended list. Although this pattern of distribution may, indeed, have been true in 1800 (assuming the data can be trusted sufficiently), it does not follow that the same pattern is valid also for other moments of time. For instance, in 1900, even on the assumption of $r = 0.9$ throughout the distribution beyond the seventy-fifth city, the estimate derived from 75 cities (224 million) exceeds that derived from the extended list (211.6 million).

This apparent shift in the pattern of city size distribution, between 1800 and 1900, makes it necessary to refer again to the independent estimates already suggested, namely, about 50 million and 225 million. If estimates have to be derived on the basis of 75 cities only, then, apparently, it is nearly correct to assume that $r = 0.8$ in 1800 but that $r = 0.9$ in 1900. This observation makes it uncertain what values of r should be assumed for other dates in history.

Reference can also be made to independent estimates of the world's urban population in 1850 (about 80 million) and in 1925 (about 400 million), as previously discussed. On the basis of 75 cities, the urban population in 1850 could have been 68.8 million if $r = 0.9$, and 88.1 million if $r = 0.8$; hence, a correct value of r for the year 1850 could have been approximately 0.833. Noting that with constant r the apparent increase in the world's urban population would have accelerated very greatly between 1800-1825 and 1825-1850, a moderation in this acceleration could be consonant with r remaining near the value of 0.8 also in 1825, then increasing to 0.833 in 1850, reaching, perhaps, about 0.867 in 1875 (result of interpolation) and about 0.9 in 1900. In 1925, according to the independent estimate, r could have remained at 0.9. The argument is speculative, but it does appear to bring out an important fact. A significant transition probably occurred, roughly between 1825 and 1900, in the pattern of size distribution among the world's urban settlements. If there was such a transition in the particular time period,

what implications does this have for the choice of a value of r at historical dates earlier than 1800?

The period of 1825-1900 was, indeed, unique in numerous respects. Where the growth of cities, large and small, is concerned, factors of special relevance may have been the increasing organization of worldwide and long-distance trade, and the development of new transport vehicles using heavy power engines (steam) the efficient operation of which required expensive installations. The effect may very well have been an alteration in the mutual relationships among cities of varied size, with heightened potentials for growth concentrated particularly in large and very large cities. Such developments, quite conceivably, may explain the apparent shift of r from 0.8 to an eventual 0.9. This line of reasoning suggests that the slope of the distribution at dates earlier than 1800 should have been closer to 0.8 than 0.9, as in earlier times long-distance trade and transport used cheaper vehicles which had more limited geographical scope. Smaller towns and cities, then, may have had a degree of relative local and regional importance, not overshadowed to quite such an extent by the influence of larger but more distant cities. Comparative stabilization of r near a value of 0.9 since 1900 is also plausible, owing to the more extensive use of additional transport vehicles requiring less heavy equipment (combustion engines, electricity).

It should be recognized, nevertheless, that the precise value of r could have fluctuated considerably in the course of world history. In certain times, the emergence of large empires with effective centralized controls could have raised the prominence of comparatively few rather large cities at the expense of comparative stagnation in smaller regional centres. In other times, the political map of the world was fragmented by numerous smaller kingdoms and republics; and even within these minor provinces, a degree of autonomy could have been maintained which further disrupted the unity of the economic space. In such periods, there could have been a relative preponderance of numerous locally significant, yet comparatively small, cities. When all the historical knowledge is brought together, it may become possible to suggest that a larger value of r could have been appropriate in certain epochs, and a smaller value

TABLE 5. WORLD'S URBAN POPULATION ESTIMATED WITH A PARTICULAR ASSUMPTION AS TO THE SLOPE OF CITY SIZE DISTRIBUTION, AND WITHIN ASSUMED MARGINS OF ERROR, 430 B.C.—A.D. 1925

(Millions)

Year	Assumed r	"Medium" estimate	Margin of error (percentage plus or minus)	Limiting estimates	
				"Low"	"High"
B.C.					
430.....	0.8	9.2	20	7.4	11.0
200.....	0.8	9.1	20	7.3	10.9
A.D.					
100.....	0.8	14.7	15	12.5	16.9
361.....	0.8	13.8	15	11.7	15.9
622.....	0.8	15.5	15	13.2	17.8
800.....	0.8	17.7	15	15.0	20.4
900.....	0.8	17.1	15	14.5	19.7
1000.....	0.8	17.1	15	14.5	19.7
1100.....	0.8	19.2	15	15.4	23.0
1150.....	0.8	21.0	15	17.8	24.2
1200.....	0.8	19.2	15	16.3	22.1
1250.....	0.8	19.2	15	16.3	22.1
1300.....	0.8	19.2	15	16.3	22.1
1350.....	0.8	19.7	14	16.9	22.5
1400.....	0.8	22.4	13	19.5	25.3
1450.....	0.8	23.0	12	20.2	25.8
1500.....	0.8	24.0	11	21.4	26.6
1550.....	0.8	27.8	10	25.0	30.6
1600.....	0.8	32.8	9	29.8	35.8
1650.....	0.8	32.1	8	29.5	34.7
1700.....	0.8	37.7	7	35.1	40.3
1750.....	0.8	40.9	6	38.4	43.4
1800.....	0.8	51.2	5	48.6	53.8
1825.....	0.8	61.7	4.5	58.9	64.5
1850.....	0.8333	80.3	4	77.1	83.5
1875.....	0.8667	120.3	3.5	116.1	124.5
1900.....	0.9	224.0	3	217.3	230.7
1925.....	0.9	392.1	2.5	382.3	401.9

in certain other epochs. Taking the world as a whole, however, it remains possible that increases in the degrees of urban centralization in some regions were sometimes balanced by more dispersed developments in some other regions; hence, for the world as a whole the hypothetical fluctuations in the value of r may not have been so wide.

It cannot be pretended that all the relevant historical knowledge bearing on this particular point is currently available. One is, therefore, reduced to making the rather arbitrary assumption that r equalled 0.8 at all times up to 1825, that it then shifted progressively to attain 0.9 in 1900, and that it may have remained at the latter magnitude since 1900. The resulting estimates, however, must be assigned varying margins of error; and their relative size must be more considerable in earlier epochs, for which the underlying city population estimates are more questionable, than in the more recent centuries. The assumption of error margins, in its turn, is also quite arbitrary.

SUGGESTED ESTIMATES OF WORLD'S URBAN POPULATION, 430 B.C.—A.D. 1925

Table 5 shows assumed values of r for each date, the corresponding "medium" estimate of the world's urban population, the assumed percentage margins of error

(plus and minus) and the corresponding "low" and "high" estimates of urban population.

This series of estimates suggests that the world's urban population could have exceeded 10 million near the beginning of the Christian era, if not even a few centuries before. It could have reached 20 million at any time between A.D. 800 and 1450, 30 million at some time between 1550 and 1700, 40 million at some time in the course of the eighteenth century and about 50 million by 1800. By 1875, these 50 million could have doubled to more than 100 million; and between 1875 and 1900, the world's urban population could have doubled again. At the beginning of the twentieth century, it continued to grow with great speed.

HISTORICAL ESTIMATES OF TOTAL WORLD POPULATION

A historical series of the total world population has been put together by Durand, making use of two sources: one by Carr-Saunders; and another by Clark.¹⁵

¹⁵ John D. Durand, *Historical Estimates of World Population: An Evaluation* (Philadelphia, Pa., University of Pennsylvania, Population Studies Center, 1974); John D. Durand, "The modern expansion of world population", *Proceedings of the American Philosophical Society*, vol. 111, No. 3 (1967); A. M. Carr-Saunders, *World Population: Past Growth and Present Trends* (New York, Oxford University Press, 1936); and Colin Clark, *Population Growth and Land Use* (New York, St. Martin's Press, 1967), especially p. 64.

The most detailed series of historical estimates of total population is that prepared by Clark. Durand, however, who also published in 1967, arrived at the conclusion that, at least for a period beginning with 1750, there has been a tendency to underestimate somewhat, and that the population estimates for 1750, 1800, 1850 and 1900 should be accordingly increased. In 1974, Durand extended this judgement also to a much longer time series, beginning with the Christian era; but the actual figures he suggested to replace estimates previously made were confined only to the year A.D. 0; and to the years 1000, 1500, 1750 and 1900. Carr-Saunders had previously published a series of world population estimates beginning with 1650, which can be reconciled with Durand's series (1967) when the figures for 1650 are pro-rated upwards by the ratio of the two figures for 1750. The Durand series, which begins with the year A.D. 0, is expressed by ranges rather than definitive figures, narrower, perhaps, than ranges of likely errors. These ranges are described as "indifference ranges", so defined that it cannot be determined whether the lower or the upper figure shown is the "most likely". They are relatively narrower in recent periods, for which there is more definitive information, than in earlier periods, for which there is much uncertainty.

A comparison of the Durand series with the Clark series for combined world totals indicates that at those dates which both series have in common, Clark's estimate is always near the lower limit of Durand's "indifference range". The implicit conclusion appears to be that Clark, as perhaps also various other historical demographers, could have had some bias towards underestimating, possibly owing to reluctance to go too far beyond available evidence. There remains, however, some likelihood that additional population groups could have existed who escaped all records of tax collection, household registration and so forth, that is, groups who lived in such fashion that evidence of their existence has been entirely lost. It would appear fair, therefore, to accept Clark's figures as the "low" estimates; and to add an "indifference range" of a similar width, as suggested by Durand, to arrive at the corresponding "high" estimates. Moreover, because of considerable uncertainty, it is preferable to express corresponding estimates only in rather rounded figures. It is in this way that use has been made of the Clark series up to 1600; of figures by Carr-Saunders for 1650 and 1700, pro-rated to agree with those of Durand for 1750; and of the Durand series from 1750 to 1950. For 1825 and 1875, estimates have been interpolated; for 1925, there is a United Nations estimate; and for 1950, the United Nations estimate is consistent with Durand.

In a few instances, the Clark series does not coincide with the exact dates for which estimates of urban population have been deduced from the Chandler and Fox data. In three cases, the years 361, 622 and 1350 used by Chandler and Fox, it is simply assumed that Clark's world population estimates for 350, 600 and 1340 remain unaffected by the time difference. Clark, however, provided no figure between A.D. 0 and 350; and, for

present purposes, an estimate of total world population for A.D. 100 also is needed. It is known that during the first century of the Christian era, population grew considerably, at least within the confines of the Roman Empire; accordingly, it is assumed that the world estimate for A.D. 0 should be raised by about 5 per cent.

Although, in the course of time, population has increased, the accuracy of the knowledge concerning it has also improved and continues to improve; hence, relative margins of error diminish as one proceeds to more recent dates. For simplicity, the "indifference range" was maintained in a constant width of 100 million for all dates from 1200 onwards, an absolute range which has continued to be appropriate also to the much improved knowledge of current world population. With the increase in both population and the knowledge concerning it, the absolute size of the error range may, in fact, be kept nearly constant.

World urbanization levels, A.D. 100-1950

In table 6, the "indifference ranges" concerning total world population have been combined with the "medium" estimates of the world's urban population to yield percentages of urban in total population. A "high" estimate of total population yields a "low" percentage, and vice versa. For general guidance, a "medium" percentage is also provided.

If one accepts these estimates uncritically, one arrives at the somewhat disturbing view that ever since the beginning of the Christian era and up to 1800, the world's urbanization level could have fluctuated around 5 per cent within a rather narrow range (see last column in table 5), and that previous urbanization levels were not decisively surpassed until the second quarter of the nineteenth century. From what is known of the historical rises and falls of empires, and of the geographical expansion of city-oriented civilizations, this result is somewhat contrary to intuitive expectations. But there is no proof that this view is false. Declines of large cities, in certain epochs, could have been compensated by the growth of more numerous smaller cities. And while urban populations were growing, the rise of urban cultures could also have been paralleled by simultaneous rural developments which favoured a corresponding growth in the rural population. Growing rural populations, in their turn, could have furnished the means of subsistence for growing cities.

From the foregoing discussion, it should also be abundantly clear that these estimates have to be viewed with great caution. Perhaps a tendency to underestimate the total population in earlier epochs still persists among historians. Perhaps Chandler and Fox have over-estimated some of the earlier population sizes of historical cities. Perhaps, contrary to the reasoning given here concerning the rank-size rule, a steeper slope for the distribution of smaller cities could have been appropriate to estimate the combined urban population (5,000 or more) for some of the earlier dates. Several components of the summary estimates presented here could have been variously biased.

TABLE 6. ESTIMATES OF TOTAL WORLD POPULATION AND TOTAL URBAN POPULATION, AND PERCENTAGE OF URBAN IN TOTAL POPULATION, A.D. 100-1950

(Millions, except as otherwise indicated)

Year	Total population		Urban population Medium estimate	Percentage of urban in total population		
	High	Low		Low	High	Medium
100.....	350	280	14.7	4.2	5.2	4.7
361.....	315	250	13.8	4.4	5.5	5.0
622.....	300	235	15.5	5.2	6.6	5.9
1000.....	350	280	17.1	4.9	6.1	5.5
1200.....	485	385	19.2	4.0	5.0	4.5
1350.....	475	375	19.7	4.1	5.3	4.7
1500.....	525	425	24.0	4.6	5.6	5.1
1600.....	600	500	32.8	5.5	6.6	6.0
1650.....	650	550	32.1	4.9	5.8	5.4
1700.....	750	650	37.7	5.0	5.8	5.4
1750.....	850	750	40.9	4.8	5.5	5.1
1800.....	1,025	925	51.2	5.0	5.5	5.3
1825.....	1,150	1,050	61.7	5.4	5.9	5.6
1850.....	1,300	1,200	80.3	6.2	6.7	6.4
1875.....	1,475	1,375	110.5	7.5	8.0	7.8
1900.....	1,700	1,600	224.0	13.2	14.0	13.6
1925.....	2,025	1,925	400.0 ^a	19.8	20.8	20.3
1950.....	2,550	2,450	715.0 ^a	28.0	29.2	28.6

^a Estimate of the United Nations Secretariat.

Nevertheless, the present exercise does appear to suggest that throughout 18 centuries of the current era rather little change occurred in the level of world urbanization. In fact, between 1600 and 1750, the level of urbanization could even have decreased. Historians have, perhaps, given insufficient attention to the possibility that rural settlement, owing to government and business organization, could have expanded significantly at certain times in concurrence with the growth of cities. Though most of humanity throughout history has inhabited rural settlements, the historical facts on record are mostly those pertaining to cities. Knowledge of the history of rural settlement has remained scant.

Should it be true, on the whole, that the world's urbanization changed so little over such a long period of time, the upsurge of urbanization levels which began early in the nineteenth century is all the more remarkable.

Asia and Europe, 1000-1975

Urbanization probably began more than 4,000 years ago in the region currently constituting Iraq. From there, it spread first to other ancient centres of river civilization on the Nile, the Indus and the Yellow River of China. Urban cultures eventually came to encompass the globe; but, at all times, the bulk of the world's population has been shared by Asia and Europe. Table 7 shows the distribution, at any time, of the 25 largest cities distributed among five world areas. For historical reasons, Europe is here defined to include the area currently comprising Turkey and the Union of Soviet Socialist Republics.

It may be seen that most of the world's comparatively large cities were situated in south Asia until the tenth century of the Christian era. Another long period followed, from 1000 until about 1825, when compara-

tively large cities were particularly numerous in East Asia, namely, in China, Japan and Korea. From 1850 to 1950, the concentration of the world's largest cities was especially noteworthy in Europe; but eventually very large cities emerged rapidly also in North and South America, rivalling and most recently even overtaking those of Europe. Quite recently also, large-scale urbanization again became prominent in Asia. In historical periods, Northern Africa had a number of comparatively major urban centres. Currently, urbanization proceeds most rapidly in Africa, but not many African cities have yet attained a very large size.

Viewed in this perspective, it is clear that the modern upsurge of urbanization, currently world-wide, began in Europe. With interpolations too tedious to reproduce, it can be calculated that about 1890 more than one half of the world's urban population was situated in Europe, even excluding Russia and Turkey. During that period of European ascendancy, a world view prevailed which, in particular, differentiated between Europe and Asia, though it must be recognized that Asia is much larger and culturally much more diverse. But the leadership of Europe in world urbanization has been a passing phase. Not only has Europe already been overtaken in the sizes and numbers of cities, but various other things have happened as the twentieth century progressed, so that a world view still favoured at its beginning has already lost most of its previous relevance. Nevertheless, the contrasting developments, as between Asia and Europe, remain of historical interest.

Chandler and Fox provide separate tables of historical cities for each of the traditional continents,¹⁶ and the lists of cities are long enough for Asia and Europe to warrant the use of the rank-size rule in the manner

¹⁶ Chandler and Fox, *op. cit.*, pp. 10-78.

TABLE 7. DISTRIBUTION OF THE 25 LARGEST CITIES AMONG FIVE AREAS OF THE WORLD,
430 B.C.-A.D. 1975

Year	World total	South Asia ^a	East Asia ^b	Europe ^c	Africa	Americas
B.C.						
430.....	25	11	8	4	2	0
200.....	25	13	7	2	3	0
A.D.						
100.....	25	15	4	3	3	0
361.....	25	13	4	4	3	1
622.....	25	17	5	1	1	1
800.....	25	12	9	2	2	0
900.....	25	12	9	2	2	0
1000.....	25	7	10	4	4	0
1100.....	25	8	9	3	5	0
1150.....	25	8	9	3	5	0
1200.....	25	7	10	4	4	0
1250.....	25	5	10	6	4	0
1300.....	25	6	10	6	3	0
1350.....	25	10	9	3	3	0
1400.....	25	7	8	8	2	0
1450.....	25	7	9	8	1	0
1500.....	25	8	9	6	2	0
1550.....	25	8	9	8	0	0
1600.....	25	5	10	8	2	0
1650.....	25	10	9	5	1	0
1700.....	25	5	10	8	2	0
1750.....	25	5	11	8	1	0
1800.....	25	4	11	9	1	0
1825.....	25	4	11	9	1	0
1850.....	25	4	8	11	0	2
1875.....	25	4	3	13	1	4
1900.....	25	2	4	12	0	5
1925.....	25	2	3	13	0	7
1950 ^d	25	2	3	10	1	9
1975 ^d	25	7	5	5	1	7

^a Excluding China, Japan, Korea (area currently comprising the Democratic People's Republic of Korea and the Republic of Korea), Turkey and the Union of Soviet Socialist Republics.

^b China, Japan and Korea (comprising the area described above in ^a).

^c Including Turkey and the Union of Soviet Socialist Republics.

^d Estimates of the United Nations Secretariat.

already explained. Again, use was made as far as possible of the data for the 75 largest cities in each of the two continents.¹⁷ By coincidence and unexpectedly, it was found that the assumption of a slope (r) of 0.9 in the separate instances of Asia and Europe gave results consistent with those already calculated for the world as a whole (where up to 1825 r was assumed as 0.8), always leaving a somewhat plausible residual for the remainder of the world, other than Asia and Europe. This assumption, therefore, was used to calculate the urban and rural populations of Asia and Europe for all dates up to 1900. For 1925, 1950 and 1975, the estimates of urban population are those of the United Nations.

Estimates of the total populations of Asia and Europe (Europe including Turkey and the Soviet Union) were derived by interpolations utilizing conjointly the estimates of Clark and Durand in the manner already discussed. In table 8, only the centre of the range be-

tween "high" and "low" estimates is represented. It must be emphasized that most of these historical estimates are very rough indeed, and that they should be interpreted only with extreme caution.

The figures in this table show that in historical time, Asia had always had at least twice the total population of Europe, and by 1975, almost three times (Europe here considered to include Turkey and the Soviet Union). The urban population of Asia also was about twice that of Europe at any time between 1300 and 1750. Thereafter, the European urban population grew more rapidly, overtook that of Asia by about 1850 and grew so rapidly that, despite rapid growth also in Asia, by 1900 the urban population of Europe was twice that of Asia. In the twentieth century, the comparative trends were reversed; and recently, the urban population of Asia has again begun to outnumber that of Europe, including here also Turkey and the Soviet Union.

It appears, on the other hand, that in 1300, if not before, the level of urbanization was already somewhat higher in Europe than in Asia. But, with the error margins of such estimates, it is uncertain whether the differ-

¹⁷ Only 60 cities could be used for Europe in 1000 and 1200, dates for which the list of Asian cities was too short for the present purpose. For Asia, 56 cities could be used for 1300, and 67 cities for 1400.

TABLE 8. ASIA AND EUROPE: ESTIMATED TOTAL POPULATION, URBAN POPULATION, AND PERCENTAGE OF URBAN IN TOTAL POPULATION, 1000-1975

(Millions)

Year	Total population		Urban population		Percentage urban	
	Asia	Europe ^a	Asia	Europe ^a	Asia	Europe ^a
1000.....	...	50	...	3.5	...	7.0
1200.....	...	70	...	4.3	...	6.2
1300.....	200	90	11.0	5.7	5.5	6.5
1400.....	225	70	13.2	5.5	5.9	7.8
1500.....	250	80	15.0	6.7	6.0	8.4
1600.....	325	100	18.1	9.3	5.6	9.3
1700.....	425	150	20.3	11.1	4.8	7.4
1750.....	490	175	24.5	12.2	5.0	7.0
1800.....	620	220	28.4	16.7	4.6	7.6
1850.....	790	295	32.4	34.0	4.1	11.5
1900.....	910	440	61.6	124.9	6.8	28.4
1925 ^b	1,030	520	102.5	192.5	10.0	37.0
1950 ^b	1,347	593	215.0	292.2	16.0	49.3
1975 ^b	2,216	768	572.2	491.0	25.8	63.9

^a Defined to include Turkey and the Union of Soviet Socialist Republics.

^b Estimates of the United Nations Secretariat.

ence is fully significant. The apparent decline in the urbanization level of Europe between 1600 and 1700 may, perhaps, have to be associated with the consequences of the Thirty Years' War. In Asia, if the estimates are not severely misleading, there appears to have been an almost continuous decline in urbanization level from 1500 to 1850, despite steady increases in the size of the urban population. The rural population of Asia, it would appear, then grew more rapidly than the urban, but with the scant historical knowledge currently available, it would be difficult to ascertain the possible reasons for such a course of development. After 1850, most likely, urbanization levels in Asia began to rise significantly; but by that time, Europe was already considerably ahead of Asia. By 1900, Asia was about as urbanized as Europe had been in 1750; and as of 1975, the urbanization level in Asia can be compared with that of Europe shortly before 1900.

CURRENTLY MORE DEVELOPED AND LESS DEVELOPED REGIONS: ESTIMATES FOR 1800-2000

Although much doubt must be expressed concerning estimates of urban population and urbanization level in periods prior to the nineteenth century, decidedly safer ground exists for dates from 1800 onwards. In addition, the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat has carried out projections of urban and rural population up to 2000.¹⁸ Because divergent developments have differentiated certain regions of the world in the past two centuries, and large differences in living conditions are certain to persist for some time to come, it is of particular interest to distinguish the currently more devel-

oped regions from the currently less developed regions. Among the more developed regions are counted Europe (excluding Turkey), the Soviet Union, Japan, the United States of America, Canada, Argentina, Chile, Uruguay, Australia and New Zealand. The remainder of the world is considered to constitute the less developed regions.

An effort has been made to utilize Durand's estimates of total population; estimates of urban population by Hoyt, by Davis and Hertz, and, for more recent dates, by the United Nations; and separate estimates of urban population in the more developed and less developed regions derived from the city data of Chandler and Fox. The tentative estimates for Asia and Europe, discussed above, have also been taken into consideration. No precise rule has been followed. Several further methods of applying the rank-size rule were tried, such as on the basis of cities in the 100,000-199,999 group, and on the basis of cities shown, from the smallest given by Chandler and Fox up to cities twice that size. In each instance, somewhat different results were obtained. These results were then tested for consistency and adjusted in such ways to round figures so that a combined picture for the world and its two sets of regions could be obtained which is plausible, at least in so far as concerns both consistency with all the available data and consistency among the resulting figures themselves. From all that has been said before, apparent consistency should not mislead the user of these figures into thinking that they can be very accurate. They are, perhaps, as accurate as currently available knowledge permits.

The results of these estimating procedures are shown in the following tables. Table 9 shows, by 25-year intervals, the total urban and rural population of the world from 1800 to 2000 (as projected), percentage urbanization levels, average annual growth rates; and the world-wide "force of urbanization", defined as the absolute difference between the rate of urban population

¹⁸ The most recent projections appear in "Trends and prospects in urban and rural population, 1950-2000, as assessed in 1973-1974" (ESA/P/WP.54).

TABLE 9. ESTIMATES OF TOTAL, URBAN AND RURAL POPULATIONS OF THE WORLD; PERCENTAGE URBAN; AND AVERAGE ANNUAL GROWTH RATES IN TOTAL, URBAN AND RURAL POPULATION IN 25-YEAR PERIODS, 1800-2000

Year	Population (millions)			Percentage urban	Annual growth rates (percentage)			Force of urbanization ^a
	Total	Urban	Rural		Total	Urban	Rural	
1800.....	978	50	928	5.1	...	...	...	...
1825.....	1,110	60	1,050	5.4	0.5	0.7	0.5	0.2
1850.....	1,262	80	1,182	6.3	0.5	1.2	0.5	0.7
1875.....	1,420	125	1,295	8.8	0.5	1.8	0.4	1.4
1900.....	1,650	220	1,430	13.3	0.6	2.3	0.4	1.9
1925.....	1,950	400	1,550	20.5	0.7	2.4	0.3	2.1
1950.....	2,501	717	1,784	28.7	1.0	2.3	0.6	1.7
1975.....	3,968	1,556	2,412	39.2	1.8	3.1	1.2	1.9
2000.....	6,254	2,997	3,257	47.9	1.8	2.6	1.2	1.4

^a Urban growth rate minus rural growth rate.

TABLE 10. CURRENTLY MORE DEVELOPED AND LESS DEVELOPED REGIONS OF THE WORLD: ESTIMATES OF TOTAL, URBAN AND RURAL POPULATIONS; PERCENTAGE URBAN AND AVERAGE ANNUAL PERCENTAGE GROWTH RATE, 1800-2000

Year	Population (millions)			Percentage urban	Annual growth rates (percentage)			Force of urbanization ^a
	Total	Urban	Rural		Total	Urban	Rural	
<i>Currently more developed regions</i>								
1800.....	273	20	253	7.3	...	...	...	...
1825.....	305	25	280	8.2	0.4	0.9	0.4	0.5
1850.....	352	40	312	11.4	0.6	1.9	0.4	1.5
1875.....	435	75	360	17.2	0.8	2.5	0.6	1.9
1900.....	575	150	425	26.1	1.1	2.8	0.6	2.2
1925.....	715	285	430	39.9	0.9	2.6	0.0	2.6
1950.....	857	459	398	53.6	0.7	1.9	-0.3	2.2
1975.....	1,132	784	348	69.3	1.1	2.1	-0.5	2.6
2000.....	1,360	1,090	270	80.1	0.7	1.3	-1.0	2.3
<i>Currently less developed regions</i>								
1800.....	705	30	675	4.3	...	...	...	...
1825.....	805	35	770	4.3	0.5	0.6	0.5	0.1
1850.....	910	40	870	4.4	0.5	0.5	0.5	0.0
1875.....	985	50	935	5.0	0.3	0.9	0.3	0.6
1900.....	1,075	70	1,005	6.5	0.3	1.3	0.3	1.0
1925.....	1,235	115	1,120	9.3	0.6	1.7	0.4	1.3
1950.....	1,644	258	1,386	15.7	1.1	3.2	0.8	2.4
1975.....	2,836	772	2,064	27.2	2.2	4.4	1.6	2.8
2000.....	4,984	1,906	3,078	39.0	2.2	3.6	1.6	2.0

^a Urban growth rate minus rural growth rate.

TABLE 11. ESTIMATED PERCENTAGE OF TOTAL, URBAN AND RURAL POPULATIONS OF THE WORLD IN CURRENTLY MORE DEVELOPED AND LESS DEVELOPED REGIONS, 1800-2000

Year	Percentage share of world population in currently:					
	More developed regions			Less developed regions		
	Total	Urban	Rural	Total	Urban	Rural
1800.....	27.9	40.0	27.3	72.1	60.0	72.7
1825.....	27.5	41.7	26.7	72.5	58.3	73.3
1850.....	27.9	50.0	26.4	72.1	50.0	73.6
1875.....	30.6	60.0	27.8	69.4	40.0	72.2
1900.....	34.8	68.9	29.5	65.2	31.1	70.5
1925.....	36.7	71.2	27.7	63.3	28.8	72.3
1950.....	34.3	64.1	22.3	65.7	35.9	77.7
1975.....	28.5	50.4	14.4	71.5	49.6	85.6
2000.....	21.7	36.4	8.3	78.3	63.6	91.7