experiment stations and private-sector industrial research. The new knowledge produced by research is embodied in biological, chemical, and mechanical inputs produced by the industrial sector and by specialized agricultural enterprises (as in seed multiplication). Agricultural development is thus an integral part of the total process of development. Progress in agriculture is intimately linked to progress in the rest of the economy through product, input, and labor-market linkages.

The agricultural revolution that is currently under way in grain production is firmly based on this model. This technical revolution, which Brown dramatically catalogs, is a necessary but not a sufficient condition for economic development. Will the potential commodity surpluses resulting from this new biological and chemical technology be used to generate viable economic growth in the total economy or will they be absorbed by even faster population growth? The choice that faces most developing economies is between the historical examples provided by Java and Japan—between involution and development. The indications of a rise in the rate of population growth in the Indian Punjab, where the new wheat varieties and the new irrigation technology have combined to produce a dramatic increase in output, are a disturbing reminder that the Malthusian link between food production and population growth has not yet been ruptured in most areas of the world.

If the Malthusian link is to be broken, the breaking will depend on the implementation of policies that are drawn on a more general model of the relation between population growth and economic development than is implied by Dumont and Rosier. Clearly the technical and economic capacity exists, or can be created by investment in agricultural experiment-station capacity and in the industrial capacity to produce the essential chemical and mechanical inputs, to meet world food requirements for the foreseeable future. The significant question raised by continued escalation of population growth rates during the rest of this century is not whether it will be possible to meet food requirements. Food requirements will be met. The significance of rapid population growth lies in the competition between (i) the use of resources to meet food and other subsistence requirements and (ii) the use of resources to improve the quality of human life, to permit the great bulk of families in this world to achieve progressive increases in the level of consumption both of commodities and of social services and amenities.

There are points on which each book can be faulted. Dumont and Rosier are entirely too pessimistic regarding the potential for increased food production in the developing countries. They completely ignore the fact that the most rapid growth in agricultural output since World War II has occurred in less-developed countries, such as Mexico and Taiwan. In spite of Dumont's training in the agricultural sciences and his experience in the less-developed world, they underestimate both the potential for productivity growth in the densely populated areas of the tropics and the responsiveness of peasant producers to economic incentives. The most significant economic incentive that can be made available to peasant producers is advances in technology which sharply reduce the costs of production per unit of product.

Brown's enthusiasm regarding the contribution of the multinational corporation to the economic development of the poor countries is not yet fully matched by performance. Clearly, much of the new crop-production technology must be made available to the agricultural producers of the poor countries embodied in the form of biological, chemical, and mechanical inputs produced by the industrial sector or by specialized agricultural firms. It is not correct to credit Esso with great success in its Philippine fertilizer operations. The Esso fertilizer investment in the Philippines embodied a technology that was obsolete before the plant was constructed. The much-publicized BIMAS program in Indonesia, under the management of multinational corporations such as CIBA (Swiss), Hoechst (Germany), and COOPA (Lichtenstein), has been something close to a disaster both for the Indonesian government and for many of the farmers who have been forced into participation in the program. One does not have to enumerate the more spectacular failures, such as the Calabrian venture in grain marketing in Thailand and the Lytton venture in Greece and Crete, to demonstrate that the limitations inherent in the current state of cooperation between the multinational corporation and the developing economies have not yet been fully overcome. Both the multinational corporation and the bureaucracies of the developing countries clearly have much to learn in working out a viable, nonexploitative partnership that is productive in terms of economic development for the host countries and a profitable return on investment for the multinational corporation.

The faults of the Cochrane book are less spectacular. The main limitations are described by its subtitle, "A Guardedly Optimistic View." It is a solid but unexciting book, typical of the texts used in most undergraduate classes—admirably designed to "turn off" any but the most diligent reader.

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The Case for Population Growth

General Theory of Population. ALFRED SAUVY. Translated from the French edition (Paris, 1966) by Christophe Campos. Basic Books, New York, 1969. xii + 556 pp., illus. $12.50.

In a period when associations are formed in the United States for the purpose of promoting a zero population growth and idealistic young women pledge to have no children, the translation of Sauvy's magnum opus (first published in French in 1952 but extensively rewritten in 1966) is timely. Sauvy has expressed more cogently than anybody else the case for a positive, albeit moderate, rate of growth. However, if I interpret correctly the foreword by E. A. Wrigley, the British historical demographer, the translation was prompted less by a concern for timeliness than by the interest of historians and other social scientists in the influence of population on the functioning of societies of the past, on which the book's theoretical models throw a great deal of light. This is but one indication of the scope of this major work, full of wisdom and wit, by one of the elder statesmen of demography. It exceeds the reach of most texts on population, touching not only on such classical

subjects as optimum theory, the social factors of fertility and mortality, migration, and geographical distribution, but also on more specialized topics such as the relation of population to social classes and productivity, the value of man, and social security.

The book represents a personal synthesis of the subjects to which Sauvy and his colleagues at the Institut National d'Etudes Démographiques (INED) have contributed. INED was founded in 1945, as the scientific brain of the French Ministry of Public Health and Population. Its creation at the time was seen as part of a needed task of reconstruction and regeneration. Sauvy was director from the start until 1962, and edited the journal *Population*. At the forefront of the institute's preoccupations (as stated in the first issue of the journal) was "the quantitative and qualitative weakening of the French population" as a result of "the chronic ill that has plagued France for half a century"—the low growth rate. Because of the importance of this problem to the national interest, INED was given generous public support, and under Sauvy's vigorous and imaginative leadership it assembled topflight scientists and evolved into what Wrigley calls in the foreword to this book "the world's leading centre for demographic research." There is probably no other scientific field where such a claim could be made legitimately by a French institution.

The sometimes narrowly French point of view may seem parochial to the reader of the English translation. Time and again, the book refers to members of INED as the acknowledged authorities on the subject at hand. Sauvy's access to English sources unfortunately seems very partial and in general dated. For instance, it may puzzle those familiar with the American fertility surveys to read that the high fertility of the mid-1950's in Western countries is attributed to painless childbirth, on the basis of a little-known study of a sample of American officers during the war (p. 370). Furthermore, much of the discussion where Sauvy blames many ills of French society, from rent legislation to the distillation of agricultural products, on Malthusianism is bound to be incomprehensible to foreign readers. To these objections, however, one must answer that the translation removes one excuse for American parochialism—no less faulty than the French variety—and constitutes a useful introduction to a vast, and insufficiently known, parallel body of literature. I must add at this point that Sauvy is not the clearest of writers even in French, because he is apt to resort to veiled cultural allusions, drawing upon Valéry or French political history. The translator performed creditably in the circumstances, although he often did a less adequate job on technical arguments. (There is an example on p. 8 where the French *production* and *progression* are translated as "productivity" and "progress" instead of as their English homographs, the meaning of the paragraph being thereby ruined.)

Since I am discussing subjects of mild irritation before turning to the main argument of the book, I shall make reference here to one liability of the "General Theory" type of approach. The title is justified, not in that the book succeeds in unifying the field of population into a single, coordinated body of knowledge, but in that it uses population as the central theme and the unifying concept in its general discussion of economy and society. The adoption of a viewpoint makes for stimulating new insights into old issues, but it cannot be pushed too far without running the risk of losing perspective. Sauvy tends to explain everything by population growth or its absence, from the great American depression of the 1930's (p. 280: "probably due to the sudden stop in the traditional current of migration") to the decay of French universities (p. 289: "less useful professors cannot be suppressed to make way for sociologists and statisticians. . . . A body can only improve through growth . . ."") and out-of-date architecture (p. 295: "the direct result of conservative Malthusianism"). This monistic view of history leads him to such statements as that "the uprisings of colonised peoples may have appeared to be due to political reasons but were in fact caused by mere pressure of numbers" (p. 109). He calls the adoption by the French of the *Code de la Famille* in 1939 "the most important turn in the history of their country" (p. 385).

Sauvy has divided his work into two parts. The first deals with economy and population, the second with sociological issues. Although the title of the first part reads The Economics of Growth, its unifying concept is population size; and society's need for moderate population growth is really the main argument of the second part, entitled The Life of Populations.

The subject of population size has traditionally been discussed in the theory of optimum population. This theory says no more than that, given stable technology and constant material resources, there is a number of people such that it would enjoy the highest level of living. If the population of England were reduced to 50 persons, or if it were suddenly inflated to 500 million, the standard of living would be unfavorably affected. Between these two situations, there must be one that is the most favorable of all. This economic optimum, however, is not well defined. There may be a vast zone of indifference to size; and density of population and technology are in fact related. The author is well aware of the criticisms made of the concept of optimum, but he uses it for its analytical value in models, together with its correlates, under- and overpopulation. The usual symptoms of overpopulation are undernourishment and underemployment. The cure, however, is not fewer people but more economic development and technical progress.

The concept of an economically optimum population is used as an ideal standard, not as a practical magnitude that can be manipulated or even computed. Sauvy examines how various types of societies would affect the optimum, how unequal distribution of goods and the existence of social classes would modify it. One of the most illuminating analyses of the book is his treatment of the relationship of technological progress and employment. (Sauvy stretches the meaning of optimum population to make it equal full employment.) Contrary to widespread fears, progress historically has been generally "processive," that is, it has increased the number of workers together with productivity, either directly or by causing shifts in types of activity and consumption patterns. In underdeveloped countries, however, where the labor market is overcrowded and privileged social classes appropriate the fruits of progress, new technology may increase unemployment and decrease the standard of living of the redundant population.

It is paradoxical that, although Sauvy believes that the normal cure for overpopulation resides in technical and economic development, he appears to believe that underpopulation should be remedied by a larger number of people.

> France, for example, has too small a population for the whole of its land to be occupied. The necessary expansion of towns causes excessive depopulation in certain districts and the population falls below the optimum level, . . . causing a general decay of transport and public services [p. 195].

This, of course, is one of the problems of the American countryside as well, that it has been constantly losing its people to the metropolitan areas, although one is reluctant in this instance to blame the exodus on too small a population.

Sauvy's main argument, however, when it comes to practical applications (and not to economic models, as in the first part of the book) is that population *growth* is necessary, irrespective of the advantages and disadvantages to be expected from population *size*. It may be useful to add at this point that the work antedates the current popularity of ecology and the population-bomb scare. The only ultimate limits on human growth it recognizes are space and the biomass. In this context, Sauvy advocates a moderate population growth. There is an area of optimum growth, "a reasonable area from which it would be dangerous to stray in one direction or the other" (p. 299). He recognizes that fast growth constitutes an intolerable burden in the Third World. Indeed, "a growth of 2.5 or 3 percent per year would be very difficult to bear even by a developed country" (p. 282). But the cost of growth tends to be exaggerated. History and experience show us, says Sauvy, that, in the absence of population growth, savings do not go into productive investment. France, with its very early fertility decline, and its essentially stationary numbers since the mid-19th century, should be the richest country in the world. However, because the French were not compelled by growth to invest in equipment, only one-eighth of the savings helped to develop the economy. The rest disappeared into government securities and gilt-edged foreign stocks such as the Russian railroads; and capital use at home was restricted by the shortage of manpower.

Beyond a vague belief in a theory of creative pressure ("sailing ships can use head winds but cannot move with no wind at all," p. 284), Sauvy uses two main arguments in favor of growth. First, there is no renewal without growth. "Expansion is the only way to adjust proportions" (p. 289). Obsolete industry tends to disappear painlessly in an expanding market, and risk investments are always vindicated by the expanding demand. The second argument is that demographic aging takes place with low fertility and brings in its wake various costs, such as the burden of pensions, decreased adaptability to the changing technology, and a conservative attitude.

The main lesson of the book is that there are costs to a zero growth rate: the costs of aging, and possibly of economic stagnation. Growth cannot go on forever. "Real progress may well consist one day in knowing how to live without growing" (p. 266). We must learn to cope with aging, learn to renew and improve without relying on growth to do it. This is what population policy should aim at.

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Systems Analysis for Social Policies

Urban Dynamics. JAY W. FORRESTER. M.I.T. Press, Cambridge, Mass., 1969. xiv + 290 pp., illus. $12.50.

This book is about a computer simulation model of how the central city first grows, then stagnates and decays. The primary authors of the clear text (and somewhat less lucid multidimensional graphs and equations) are Jay Forrester, a computer scientist turned industrial analyst, and an IBM 360/67 computer. The book clearly reinforces the case of those who cry for a more systematic approach to the urban crisis. It shows how urban problems such as housing shortages or unemployment are generated by internal forces and cannot be solved by attacking external symptoms. It is also, however, a demonstration of the hazards of oversimplifying the application of "systems analysis" to the evaluation of social policies.

Forrester's main endeavor is the development of a tool to be used by urban policy makers. A major problem in making policy decisions is the great degree of uncertainty about what in fact will happen if a particular policy is implemented. Will it have the direct consequences its sponsors claim for it? Even if it does, will it perturb a balance elsewhere and lead to entirely unexpected and unwanted secondary effects, like the metropolitan sprawl generated by our urban highway program? Forrester's basic thesis is that the forces that determine the answers to these questions can be isolated, understood one at a time, and synthesized into a model of reality, but that nobody is capable of anticipating the results of more than a few of these forces operating simultaneously. "Feedback," where a force causes a result which in turn modifies the original force, both within a given simple interaction and as a coupler between interactions, leads to a complexity that only a computer can follow.

Urban Dynamics represents just such a synthesis between a human's ability to simplify and model and the computer's capacity for dealing with complexity. Forrester has constructed a model containing what he believes are the major components of the city—three classes of population (the underemployed, labor, and management), three types of housing (one for each of the population classes), and three types of industry (new, mature, and declining). The changes over time of each of these basic components, or "level variables," are controlled by one or more of 22 "rate variables," which are functions of behavioral characteristics, exogenously set policies, and the level variables, that is, of the perceived state of the city. (The specific interactions are too numerous to review here, but are clearly described in the appendix of the book.) The specification of the level and rate variables and the functions determining the rate variables comprises a complete, self-contained model of the city, which is fed into the computer. By specifying the initial conditions in the city and the length of time its growth is to be observed, the analyst can have the computer simulate the behavior of the city through any stage of its development.