

## WORLD POPULATION

SAMUEL PRESTON

The question of optimum population size is probably a major concern in fisheries resources, just as it is in demography. The principal difference, I suspect, is that many of you are concerned with ways to *increase* species population sizes, and can often do something about it, while demographers often seem to be plugging for a *decrease* in the human population, and are virtually powerless.

Little disagreement remains about the undesirability of the current rate of world human population growth. From almost any standpoint it is unsustainable for a very long period of time. From an academic viewpoint, one of the major bones of contention that remains is how one should go about *arguing* that the present rate of growth is too high. Should we point to limitations of the world's food supply, to the increasing air and water pollution and aggravations of urban living, or to the burden that rapid population growth places on struggling economies? I should say at the outset that my preference is for the latter approach. And I do want to stress that this debate over what does constitute the problem of population growth is not merely academic. The trouble with advocating the right thing for the wrong reason is that conditions may change in such a way as to permit opposite conclusions from two chains of reasoning that were convergent a moment before. If the population problem is not one of starvation, then we would obviously be wrong in concluding, after a revolutionary breakthrough in food production, that we can henceforth ignore population growth.

The clearest case against the current rate of growth, I think, is the economic burden it often entails. Pollution is really more a product of technological change than of population change, and crowding often seems to occur, at least in developed countries, because people prefer to live in crowded conditions, given the choice of a better job in an urban area or a poorer job in the country. And the problem of increasing world food production is difficult to consider apart from the problem of developing more efficient economies. Enthusiasm about even the most spectacular developments in aquaculture would have to be tempered by the difficulties involved in getting the food to the people in need of it and, sooner or later, developing a means for them to purchase it. Most of the potential for increasing world food production lies in land which is currently being farmed with backward techniques. This is not to say that the future role of the ocean in food production is negligible; but it is to suggest that the popular notion that the food salvation lies in the sea may be misleading, at least under present conditions.

### A SKETCH OF WORLD POPULATION GROWTH

The subject of world population growth conveniently divides into three parts: what is known, what is expected, and what is hoped. We shall first consider what is known, or at least can be estimated. It is thought that at the time of Christ the world was inhabited by about a quarter of a billion people. Sixteen hundred and fifty years were required before the number of inhabitants doubled. In other words, during this long period of history the world's birth rate and death rate were closely balanced, with rates on the order of perhaps 45 annual births and 44.6 annual deaths per thousand people. Without any deaths the population would have doubled in about 15 years; this great multiplication was prevented by a continual series of famines, plagues, and epidemics. By 1750 the population had risen to about three-quarters of a billion. Only 150 years were required before this number doubled once again, so that by 1900 the world was inhabited by about one and one-half billion persons. The reason for the much more rapid rate of growth during this period is not very mysterious. In small part it was the opening up of new lands to European settlement, but the primary reason was a rising standard of living that permitted great improvements in sanitation and nutrition. Many of these improvements resulted from a revolution in methods of food production and distribution. Life expectancy at birth rose from perhaps 35 years in 1750 to 55 years in 1900 in the western countries. What had been a close balance between births and deaths was disrupted by man's increasing ability to alter his surroundings for his own advantage.

This imbalance has become even more marked since 1900. The population has doubled once again, from 1.6 to 3.3 billion. Moreover, at the present rate of growth it will double again by the year 2000; the amount of time required for a population doubling is getting smaller and smaller. This is what is meant by the words "population explosion," although the term is not especially apt. In an explosion the severest impact is felt at the moment of detonation, while the effects of world population growth are just beginning to be felt. Perhaps one of you could suggest a term which is equally dramatic but more suitable.

It has been asserted that man has upset the ecological balance of the universe. His natural enemy, the bacteria, has become less and less able to cope with man. This mortality improvement in western countries was spread over a relatively long period of time. Moreover, the economic changes which affected mortality also brought with them a fertility reduction.

A large decline in the birth rate has occurred in all western countries since the middle of the 19th Century. In the United States, for instance, a woman who survived to age 45 during the colonial period had eight children, on average; today she has less than three. Part of the reason for the drop in fertility is the mortality decline itself—fewer births are now necessary to insure a couple the same number of survivors, since many more births survive. A larger part of the reason is that married couples now desire fewer surviving children. The move from the farm to the city together with child labor laws have minimized the economic contributions of children, and women have found substitutes for childbearing to be increasingly attractive. So in western countries some of the population pressure that would have resulted from the mortality decline has been alleviated by a fertility reduction. This movement from a high mortality-high fertility population to a low mortality-low fertility population has been termed the "Demographic Transition," by demographers, of course.

Why, then, the sudden increase in rates of growth? The reason is that mortality improvements have recently been extended to "third-world" countries, primarily through effective public health measures rather than because of the lengthy process of economic change that occurred in the West. The speed of fall in death rates in many cases has been unprecedented in human history. A malaria eradication campaign in Ceylon succeeded in increasing the life expectancy from 43 to 52 years between 1946 and 1947, an improvement that typically required the better part of a century in the West. The death rate in Moslem Algeria fell from 42 per 1000 in 1946 to 13 per 1000 in 1952. The end result is not only an unprecedented population size in third-world countries but also unprecedented rates of growth, with birth rates remaining at the high level once necessary to insure population replacement, and death rates approaching the

low levels realized in the West. In other words, these countries have undergone only the first half of the demographic transition. The world population is currently growing about 2.1 percent a year, and somewhat faster in the third-world countries. The figure in Table 1 should provide an idea of the size and rates of growth of the world's continents.

## TOWARD THE YEAR 2000

This leads to the second consideration: What trends in population size are expected in the near future? Simply assuming that the present rate of growth will continue provides an estimate of world population in the year 2000 which is double the current level. In actuality more sophisticated techniques of population projection are employed to make estimates, but in this case the assumptions about the most likely future course of mortality and fertility yield approximately the same estimate. Eighty-five percent of the increase anticipated in United Nations projections will occur in the continents of Latin America, Africa, and Asia. Between 1960 and 2000 the proportion of the world population living in these continents will increase from two-thirds to four-fifths. The population of Asia and Africa is expected to double, and of Latin America to triple. The population of Europe and North America is expected to increase "only" 35 percent. It should be noted that there is a large element of uncertainty about the present population of Mainland China, although it is probably not as uncertain as estimates of some of your fish populations, where about 20 percent of the world's population resides, so that any projections of her current population compound this uncertainty.

One consideration about future population growth is not generally recognized. Even if fertility rates show a dramatic and unexpected decline, the growth will still be enormous. The reason is that the average age of third-world populations is currently very low, as a result of their high fertility. In Costa Rica, 44 percent of the population is under 15 years of age, as opposed to 24 percent in Sweden. These large cohorts of young persons will shortly be entering their childbearing years, so that even with fewer children born per woman, the population birth rate is going to remain quite high. Even when the United Nations adopted what is considered to be a "low" fertility estimate, the world population was projected to increase to 5.4 billion by the year 2000. This is still an increase of 70 percent under very optimistic assumptions. On the other hand, if current mortality and fertility rates continue (that is, age-specific probabilities of dying or giving birth) then the population will increase to 6.8 billion by the year 2000. Just the *additional* inhabitants by that time would outnumber the current inhabitants.

What will be the effect of this tremendous expansion on human well-being? It is obvious that the relative rates of growth of developed and underdeveloped areas imply that the imbalance between the world's people on the one hand and resources and capital on the other will continue to increase. Per

TABLE 1  
Population and Growth Rates by Continent, 1965

	Estimated Population, 1965 (billions)	Estimated rate of natural increase, 1960-70 (annual percent increase) (assumption of "continued trends")
East Asia.....	.87	1.9
South Asia.....	.96	2.17
Africa.....	.31	2.7
Latin America.....	.25	3.4
Subtotal, "Third World Countries".....	2.39	2.5*
Europe.....	.44	0.8
North America.....	.22	1.6
Oceania.....	.02	1.7
USSR.....	.23	1.8
Subtotal, Developed Regions.....	.91	1.3*
Total, World.....	3.30	2.1

\* Weighted average.

Source: United Nations, Department of Economic and Social Affairs, *Provisional Report on World Population Prospects, as Assessed in 1963*. New York, 1964. ST/SOA/Ser. R/7.

capita incomes in developed countries are currently growing faster than those in underdeveloped lands, tending to widen the relative discrepancy between the two blocs, to say nothing of the absolute discrepancy. The higher population growth rates of developing countries contribute in many ways to this increasing discrepancy.

First, the high fertility in underdeveloped lands produces a population with a high "burden of dependency"; that is, a population with almost as many members outside of labor-force age as inside. This results from the preponderance of the very young which we have noted earlier. Thus even if productivity per worker were as high in underdeveloped as developed countries, per capita incomes would be lower since each worker supports a larger family.

Secondly, of course, productivity per worker is *not* so high in underdeveloped areas. A worker typically has less land, capital, and education to work with. Land availability is not always a constraint, however; parts of Latin America, Africa, and Eastern Asia still have arable but uncultivated land. Some areas of the world like the northeast corridor of the United States and the colony of Hong Kong should convince us in any case that extremely high population densities—high ratios of people to land—are not inconsistent with high per capita incomes. In fact, per capita income in the northeast corridor is about \$1,000 higher than in the rest of the United States. The biggest difficulty is not land but rather capital scarcity. What is needed most in developing countries is investment of capital in factories, roads, agricultural extension programs, irrigation, fertilizer plants, and education.

Whatever the historical reason for the current low ratio of capital to labor in developing countries, we can be fairly certain that rapid population growth is preventing any rapid improvements. For one thing, in a population with a high burden of dependency there is a tendency for a larger proportion of current output to be immediately consumed, thereby *reducing* the amount of investible resources. Second, an economy where the population is growing more rapidly must run faster merely to stay in the same place. If the labor force is growing three percent a year, the capital stock must grow three percent a year simply to keep productivity constant. Since the value of the capital stock is typically about three times the value of annual output, this means that nine percent of the annual output must be invested before any improvements in per capita income can be achieved. An investment proportion of nine percent is often the most a country can manage, particularly if it is laboring under a high burden of dependency. Thus high rates of population growth make high levels of investment imperative, while at the same time tending to reduce the supply of investible resources actually available.

Where does food fit into this picture? Quite obviously, if population is going to continue to grow at three percent per year in many countries, the food supply must grow that fast to prevent famines or at least increasing malnutrition. I do not want to seem to minimize these problems. A study by the Food and

Agriculture Organization of the United Nations in 1967 found that 20 percent of the population in underdeveloped countries was undernourished—too few calories—and 60 percent was malnourished—too little protein. Malnutrition is known to cause a number of physical and mental disorders and contributes at least partially to the low productivity in many areas. To this extent a cheap, palatable, high-protein food supplement derived from fish might indeed help break one of the vicious circles of underdevelopment. But a moment's thought should convince us that the governments of developed countries are in no hurry to provide the resources necessary for such an extensive adventure. Foreign aid disbursements of the United States have been declining in recent years, not rising, and if you are really concerned with starvation, *per se*, you would probably not want to be put in a position of paying farmers to keep their land idle or opposing the expansion of funds for research in fisheries, which apparently has not kept pace with the expansion of interest in fish food.

Fortunately, there is also a vast potential for increasing food production in the underdeveloped countries themselves. The FAO, in an earlier estimate, predicted that world food production could be raised 50 percent simply by better use of fertilizer. Of course, fertilizer requires fertilizer plants, which require capital, whose availability is severely curtailed by population growth. Because of these interrelations, it is difficult to remove a discussion of food production from the context of overall economic development. That we may presently be nowhere near the upper limit of the earth's carrying capacity is indicated by Harrison Brown, who estimates that the earth might be able to feed fifty billion people. (We should note, however, that this apparently astronomical figure would be achieved in less than 200 years at the current rate of growth). I want to stress once again, however, that the undesirability of the current growth rate can be demonstrated without invoking limitations of food availability. Even though we might find a sudden solution to the world's food problem, it would not eliminate the world's population problem. Indeed, it might conceivably become more severe.

## FERTILITY

This brings me finally to what is hoped, what course of events in the near future would be most desirable. It is probably evident by now that a fertility reduction ranks highest on the list. It is inconceivable and certainly undesirable that a government would adopt a policy of higher mortality, or even fail to invoke available public health measures that would continue to reduce mortality. The desire to avoid unnecessary death and misery is precisely what has directed attention to the population problem. The problem is obviously not solved by *generating* excessive death and misery. So of the two variables affecting a population's size, only one, the fertility level, is operational. In some cases even fertility is removed from this category for ideological reasons.

It is worthwhile first to examine whether fertility rates can be expected to fall in the natural course of events. We have already indicated that birth rates fell in western countries as incomes rose. But it is obvious that they did not fall into line with death rates; the difference between the two rates is still large enough to produce a rate of growth over 1 percent per year in most developed countries. Moreover, the level of per capita income at which fertility rates did begin to show significant declines is still well out of the reach of most developing countries. Consequently we cannot expect, in the absence of some unfamiliar influences, that fertility rates in developing countries will fall sufficiently to provide a tolerable rate of growth. Of course, a new element is present, namely the availability of cheap and efficient contraceptive devices. These provide a method of preventing birth which is much more satisfactory than the method of withdrawal upon which the western fertility reduction was based. Probably the most promising of the birth control devices are the intra-uterine device (the IUD) and the birth control pill. The IUD is advantageous because it does not require constant maintenance. It can be inserted once and left in place if the woman's body can tolerate it. A major problem with the birth control pill is its price, but technological advances have been able to reduce the price down to about 15 cents per month when they are distributed on a mass basis. So the technological advances in death control have been more than matched by advances in birth control. The crucial difference is that public health measures can be adopted on a community basis and are universally welcomed, while contraceptive measures must be implemented by the much more numerous family units and are often resisted.

There is considerable controversy regarding the effectiveness of current world-wide efforts to reduce fertility. The intent of these efforts is, for the most part, to establish programs of "family planning." The central idea of family planning programs is to allow a woman to achieve her desired family size. In most cases this involves giving a woman the means to avoid unwanted pregnancies. Obviously this is best achieved by distributing contraceptives at a minimal cost. Family planning as an ideal is very hard to fault, on other than religious grounds. More than half of the people in the world live under governments that have adopted family planning, at least in principle. These include India, Pakistan, Malaysia, Indonesia, Singapore, Taiwan, South Korea, Iran, Kenya, and Communist China. The inclusion of Communist China in this list illustrates an earlier point. It is commonly assumed that one of the principal policy goals of Communist China is to maximize her military and industrial strength. Why, then, should it want to discourage population growth? The answer is that there is no scarcity of people but rather one of capital, and greater capitalization can be achieved by slowing down the rate of population growth.

Two countries that have adopted and implemented family planning programs—South Korea and Taiwan

—have succeeded in reducing their birth rates noticeably, although their growth rates are still high. Another piece of evidence that suggests the potential usefulness of family planning is that sample surveys taken in 20 countries show, without exception, that substantial majorities of married couples want to restrict their childbearing. So it is quite evident that family planning has some potential usefulness in reducing birth rates. But the extent of this potential may be limited. Family planning is sufficient in the long run only if women desire the number of children necessary to replace themselves, and no more. Here sample surveys are much less encouraging. Women questioned in virtually every locality indicate that they desire, on the average, more than a replacement number of children. Even in Taiwan, where family planning has scored one of its successes, the growth rate is quite high, and the reason is not hard to uncover. The average Taiwanese woman desires about 4.5 children, enough to double the size of the population every generation. Likewise, in South Korea indications are that family planning, that is, contraceptives, have appealed for the most part to women 30–39 who already have four children, including two sons. In Tunisia the average number of children considered ideal is 4.3; in the Punjab over half of the visitors to family planning clinics had six or more children.

Nor do we have to leave the country to observe excessive childbearing desires. A Gallup Poll just published this past month showed that 45 percent of American women feel that the ideal family size is at least four children. By the way, the husbands were much more moderate. Only 35 percent of the husbands thought this was a good number. Five percent wanted zero. One could infer from all of these figures that permitting a woman to have the number of children she considers "ideal" is, in and of itself, seldom going to reduce the rate of population growth close to zero, a rate which is essential in the long run. Thus family planning, while it may represent an effective first step in the effort to reduce birth rates, can at the moment only be viewed as such. Kingsley Davis summarizes the difficulties very succinctly:

"The term 'family planning' suggests that reproduction is being regulated according to some rational plan. And so it is, but only from the standpoint of the individual couple, not from that of the community. What is rational in the light of a couple's situation may be totally irrational from the standpoint of society's welfare."<sup>1</sup>

Alternative suggestions for reducing the birth rate usually entail a large amount of governmental interference in the decision-making process of couples. Several very imaginative solutions have been proposed, usually half in jest. One is to put a contraceptive into the water supply and sell the antidote at what would certainly be an extremely high price. Another suggestion is to allow each married couple two chits good for two children, which they could

<sup>1</sup> "Population Policy: Will Current Programs Succeed?" *Science*, 158(3802): 737, 1967.

use themselves or sell in a gigantic stock market—the government itself would sell enough additional chits through the market to insure exact population replacement. In both of these cases I think the price of the antidote in the water supply or the chit on the stock market would be very high, I would estimate probably somewhere between five and ten thousand dollars. If a couple desired six children it could still have them but only at a high price. Both of these schemes would generate a redistribution of childbearing from poorer to richer families, which many consider desirable.

A long time would be required before the American Congress, or any other, would even consider such visionary schemes. Nonetheless, it is not impossible to imagine journalists sometime in the 21st Century solemnly proclaiming this to be an idea whose time has come. In the meantime, there are several less radical proposals worth considering. One is the elimination of all present encouragements to fertility, such as income tax allowances, or dependency allowances in graduate fellowships. Another is the imposition of a marriage or birth tax. Abortions could be legalized, a step completely in line with the ideal of family planning. This is a very promising possibility; Japan's rapid fertility reduction was achieved largely through subsidized abortions, and abortion is a very common method of birth prevention in Latin America, despite its illegality. In at least two countries, Japan and Hungary, abortions outnumber live births. Of course, abortion raises moral questions that are somewhat more troublesome than contraceptives. The Catholic Church decided in 1869 that abortion would be equivalent to murder and has since successfully blocked numerous attempts to liberalize the abortion law despite the fact that in a recent Gallup poll, 83 percent of the American population favored some liberalization. The position of the Catholic Church receives little or no support from scientists. Dr. Robert Hall, Associate Editor of "Obstetrics and Gynecology," states that "scientifically the fetus is not a human being for the simple reason that it cannot survive even with outside help. An infant can survive with the help of an adult; an adult can survive on its own, but the fetus is dependent on its mother's womb." Perhaps the government could reimburse people for a sterilization operation, a method pursued in India. Or we could encourage women to work, a step which in eastern Europe has inadvertently reduced birth rates to the lowest levels anywhere in the world. This step would also help facilitate what many feel to be a necessary transition in values, from a society in which the family is one's primary source of satisfaction to one where a person's work, work associates, and neighbors begin to play a larger role.

## SUMMARY

The recent reductions in mortality have introduced an enormous amount of excess capacity into the reproductive mechanisms of the human race. The result has been what by any standards must be termed an overproduction of human beings. Indications are that

current efforts to reduce the birth rate will have to be supplemented by governmental measures that either directly regulate a couple's childbearing or provide strong incentives to infertility. Only if an unexpected change in attitudes toward family size occurs on a world-wide scale can family planning programs hope to reduce growth rates close to zero. Certainly the most troublesome piece of evidence in this regard is the fact that no nation on earth has been able to attain a zero growth rate for a period of any length without death rates which, by modern standards, are intolerable.

A Great Depression was necessary before the limitations of laissez faire capitalism were realized. Let us hope that a similar catastrophe is not necessary before laissez faire fertility is abandoned. To allow the situation to deteriorate until the earth can simply no longer support any more people would be an irresponsible gamble, that would in any case tend to depress the level of human well-being. Although the problem is currently most acute in developing countries, developed countries are in an ideal position to act as moral leaders by demonstrating that a nation *can* adjust to the new realities by reducing its annual stream of births.

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## DISCUSSION: Dr. Samuel Preston—WORLD POPULATION

Discussant: Dr. Warren S. Wooster

*Wooster:* Since I am not an expert on the subject of world population, there is a question I have, that might initiate some discussion. I hope there are other questions.

You make the point as an economist that the ultimate limitation on accommodation of people on the earth is capital rather than food. This implies that you could have the food if you could pay for it or provide the machinery to produce it. Is there enough surplus capital? As you say, our foreign aid is going down and, at the same time, I guess our investments abroad are going up. I don't know these rates, but suppose the existing capital were more equitably distributed, what would the situation be on bringing the development of the countries to a point where they could handle their own problems?

*Preston:* This is difficult to say for several reasons, one of which is that there are so-called increasing returns to capital. In a country which has a large

amount of capital per worker, such as the United States, additions to the capital structure might provide for a larger increase in per capita income than would the same capital structure in an underdeveloped country. So perhaps the additions could be made in the United States and the benefits redistributed to the people outside the United States. This might be an ideal solution. Certainly there is an inequity—not really an inequity since it resulted from historical forces over which very few people alive had any control—but a redistribution of capital to the underdeveloped countries would double their incomes from what would raise ours only by 5–10 percent. So it is partly a distribution problem. The reasoning is that eventually these countries are going to have to generate enough annual investment to sustain themselves. However, we might help them get to that point now.

*Wooster:* We were discussing at breakfast the problem of the rates of all these things. The rate at which the developing countries could reduce fertility—and, as you say, you are not allowed to tinker with the mortality rate—versus the rate at which everything goes critical because there are just too many people for the food available. There is a recent statement saying the whole thing goes critical in 1975. Would you have any views on this, given that you seem so pessimistic about having the problem solved rapidly enough to do any good? When does the situation go critical?

*Preston:* That estimate I think is made by Paul Erlich based upon limitations of the world food supply, a position which I was implicitly arguing against. Perhaps the next speaker who is talking about world food production would have more informed views on the matter, but I think it is the consensus, at least among the people who know a little about it, the demographers, that food production certainly has the potential to increase and this shows every time someone like Malthus tries to limit the growth rate of the human population by invoking the limitations of food supply; his predictions were proven wrong and there is no reason to expect that these predictions won't continue to fall short. I don't think that I could specify any one time at which the problem is going to become more severe. The question really is, is the situation in which six billion people live at a subsistence, near starvation, level worse than a situation where three billion people live at subsistence, near starvation, level? I would say that probably the situation where six billion people were at this level would be more severe because the additional capital and investments that would be necessary to get them out of this situation would be twice as hard to generate in that situation as it is currently.

*Wooster:* I have a feeling that, given the bad distribution, the mortality rate will begin to operate. We are getting richer and the developing countries are getting poorer per man. At some point this discrepancy is going to be intolerable and they are going to come and take it away from us. In the process, of course, the mortality rate is going to be high.

*Isaacs:* Of course, you mean *our* mortality rate.

*Wooster:* Whose ever.

*McGowan:* I can think of at least one limit on food production, namely the number of available carbon atoms in the world. Even if technological developments were such that we understood completely the mechanism of photosynthesis so that we could duplicate it and perhaps increase its efficiency, there is still just so much carbon available, and that's it!

*Schmitt:* What is the level?

*Preston:* Is it 50 billion, as Harrison indicated?

*McGowan:* I don't know, but I suppose that it could be estimated. You were saying that all these estimates have been wrong because food production has more than kept pace with population growth. Do you think that there is a limit?

*Preston:* Yes, I am sure there must be an upper limit but we are probably nowhere near it.

*McGowan:* There must be upper limits and that could be one of them. Another point is, how is it that the Japanese were able to introduce birth control so successfully? What is it about their society? Why did they accept it so readily?

*Preston:* That is a very important question, and for this reason Japan is a model not only of demographic transition, but of economic development.

*McGowan:* Yes, but how did they do it? It seems to me that their society is worth intensive study.

*Preston:* Well, it's a question to which there is almost no answer. I once had a professor of Economic Development, Sir Arthur Lewis, who is one of the world's authorities on ways to develop economies, and he attributed it to the "national energy" of the Japanese.

*Whittington:* One of the reasons Japan has been able to achieve the reduction in birth rate is the fact that less than one percent of the population is hampered by any moral theology as we are—about one percent are considered Christian in a population of nearly 100 million people. Birth control doesn't have any political opposition at all. Incidentally, Japan last year became the third industrial nation in the world.

*Preston:* We know that in Japan the process of demographic transition began with an agricultural revolution generating surplus off the land. We also know that there was some manpower available in Japan that is often not available in underdeveloped countries as a result of their landlord system. It was really the landlords of the rural countryside that led the agricultural revolution and provided the leadership for it. The surplus allowed people to live in cities and carry out manufacturing activities. It is also true that the lack of any religious constraints to fertility control is very much in evidence. As I say, the State almost provides a free abortion to any woman who wants it, and there are apparently more abortions

than live births in Japan. They have about the lowest birth rate in the world, and obviously their low birth rate is certainly not going to constrain their economic growth.

*Schmitt*: Isn't it possible that Japan has reacted to its war defeat when it tried to gain lebensraum in the way Germany tried to expand into Russia? An underpopulated Australia was just too irresistible a target. I think the dashing of these attempts was probably the prime motivation. Japan is the country with the fewest tillable acres per person and despite its high rate of industrialization has a very low living standard. It is, I think, reacting to a crisis condition.

*Preston*: This is quite possible. The decline in birth rate accelerated dramatically after World War II, but it had been declining since about 1920 in Japan, so there was some reason already there in terms of the position in economic development, or whatever, that influenced the fertility rate. That may be the reason that the State provided the free abortions after World War II—meeting a great public demand—but it was after World War II that the great decrease began.

*Alvaríño*: I think that education has a strong impact on birth control. People realize that to have children is a responsibility, not a privilege. The educated people in the Catholic countries of both Europe and Hispano-America do not follow the religious precepts on this particular matter. They do limit the number of their children to usually less than four. Apparently their intellectual, moral, and social values have some bearing on family size.

*Preston*: That is a good point. The earliest fertility reduction in the world occurred in France, which is essentially a Catholic country. Even in Latin America, as I indicated, abortion is the leading method of preventing births, and Latin America is essentially Catholic as well. So it is not necessarily true that one's national religion means that you can't pursue programs of fertility reduction. It does mean in many cases that you can't pursue them on a governmental level. Latin American governments have been slower than all other governments in the world to adopt programs of family planning, or whatever, and a large reason is that every time they try to do something, the Catholic Church puts up an intense amount of pressure and prevents it.

*Chapman*: I will make a point connected with distribution. It is often lost sight of that a very large part of the world population which suffers from protein malnutrition is that which is outside the money economy and we don't have any good mechanism for getting food from the money economy into the subsistence economy. I think this is something that activity must be directed toward. Presently the abundance of staple foods, cereals, sugars, carbohydrates of all sorts, and also of protein in the international market, is so great that the world market prices are depressed—but you can't get the stuff out of those channels into the subsistence economy where it is needed.

A second point, quite different, I have become sensitive to, in the last few months since I have been in contact with representatives of Qatar, Dubai, and Kuwait. They suddenly have a great deal of capital and Kuwait has been in this situation for some years. Capital is no problem; getting it used is really a social problem and it doesn't work out very well. Kuwait has found this out, Qatar is in the process of finding this out. It just doesn't work out well to take a bucket full of money around and leave it on the doorstep from time to time—there has to be some means provided for citizens to earn it or you have all kinds of social problems. This is another thing to be thought about in this connection.

*Preston*: Those points are both well taken. Both of the problems that are present could be solved, I guess, by a sufficient level of economic development to get everyone into the monetized economy. That is, to have them producing something that is of value to someone else so that they could sell it and receive the money for it and then use the money to buy the necessary protein on the world market if they can't get it domestically.

Similarly in Kuwait, giving them money is no help because the country isn't producing anything else except oil, so that if the people wanted to buy anything, all they can buy is oil or else imports at fantastic prices. So that what they have to do is start some domestic based industries for production and in that case a redistribution from the big oil companies to the little man would succeed in raising the standard of living.

*Evans*: Is it not true that waste disposal and pollution may be as likely a population limit as is food?

*Preston*: I think it is and I mentioned that but I probably dismissed it too easily. While pollution is more a product of technological change than of population change, certainly if you have the same technology and you double the population then you are going to double the air pollution. I think air pollution is mostly a product of manufacturing activities which could be attributed to a change of technology, but water pollution is probably more closely related to the size of the population than to the level of technology.

*Isaacs*: You mentioned the possibility of establishing other sorts of rewards for the family group, or additional rewards other than having children. I've often wondered if, in this sort of symptomatic approach to the world population problem, there are not hidden implications that we overlook. The whole matter of the human being is a very complex one in psychology, motivation, etc. All of a sudden in a few generations we are going to try to change child bearing from something profoundly fundamental that for millennia was basically good and applauded by society to something that smacks of sin. I wonder if such a change can be made without grave psychological damage—not only to the parents but to the children. Perhaps the unrest of students is not unrelated to this increasing opinion that having children is bad.

Perhaps the whole problem will be dictated by some side effect. The bomb may be an unexpected one in an unexpected direction, rather than a population explosion in any simple ordinary sense.

*Preston:* Yes, I think tinkering with any set of social values has never been successful, except perhaps within institutions like the Church, but I think there has been no group of sociologists who sat down and decided to change the attitude of the world and went ahead and did so successfully. Personally I share the same fear of what would replace the family, and that is why I think that a better solution to these immediate problems of birth control would be a series of economic sanctions. Couples could still feel that child bearing is a worthwhile activity but expensive. This would be done by providing incentives to sterilization, dis-incentives to fertility, eliminating tax allowance, etc. Something is going to have to be done.

*Isaacs:* As an example of possible unexpected directions that tinkering may lead to, I have often wondered about the profound metamorphosis demanded of maturing children and its variation with family size. After all, the family is certainly a communal group by any definition—including, "to each according to his need—from each according to his ability." In our democracy we have insisted that each of the maturing members of the family group evolve or metamorphose to what we consider a higher level of independent democratic existence within the broader social group. This metamorphosis seems to me to be stimulated in large families and perhaps to be repressed in small ones. Hence as the family size continues to decrease and as there is a greatly lessened compulsion for this assertion of independence, it becomes easier for the young adult to hold onto the family type of relationship with society rather than to establish one of his independent contributions. The diminished family may thus lead to a sort of path of least-resistance socialism or communism. Indeed, this already may be taking place.

*Powell:* How do you work in the fact of the emotional makeup of a woman who often gets married to have a baby and hold a baby in her arms? This is not just to reproduce herself. These aren't just cold, scientific facts. A woman wants children. This is part of her nature—nothing she has been taught. It is something instinctive. How do you work in this factor?

*Preston:* Well there is something physiological, but I also think that child bearing, the level of child bearing, is partly decided, too, by the ideal of the society at a given moment, otherwise why have American women reduced their child bearing from 8 to less than three children? It is not a predetermined level which they have to seek out because of something physiological, it is also subject to some alteration by social values. But I would hesitate to fiddle around with the values because, as I said, I think other methods are available that could achieve the same goal.

*Chapman:* I want to broaden that thought a little bit and return to John's introductory remarks. It

should really be considered without smirks that we are animals, that in the long hours of human evolution the thrust of environmental selection has been toward reproducing and existing as adults between the ages of 16 and 25. Now just in the latest seconds of human evolution, we want to change that whole emotional, physical, psychological basis and I don't think it is going to be easy. That is why we need a few humanists, a few sociologists, and other people working on these problems as well as economists. I am very glad to see economists get a better hold on this problem but I think we need these other disciplines.

*Wooster:* Actually, it is not that having children is going to be bad in this new world, but that it is a privilege rather than a right. It has been said that the trouble with family planning is that the planning is too small because it is purely on a family basis. But if the planning is to be done on some larger scale, this gets you into all sorts of difficult situations. There would be a master plan, saying how many babies each can have. Then there would be the question of who ought to have the babies. The high types ought to have lots of kids and the bad types ought not to have very many.

*Isaacs:* Which gets you into eugenics, and that is always unacceptable.

*Wooster:* One place where this operates to some extent is in Israel where they have a true socialistic system, in one sense. I visited one of the oldest kibbutzim in Israel some years ago where the children were all in dormitories, so to speak. They were sort of everybody's children and were segregated by ages the way they are in school. However, this was not working too well. They found that there was really a magic link between parents and their children and it wasn't the same for the children in the kibbutz where everybody were their parents. In fact, they are going back now and try to provide enough facilities for the individual families to have their children back in the family group on weekends. That is, of course, a very practical idea—to see your kids only from time to time.

*Isaacs:* This is a good example of the emotional factors that trouble the tinkers. Does anybody really understand anything about these curious emotions associated with relatives? We put up with some bore because he is a cousin or something, and yet we'd kick him out of the house if he weren't. I have never quite understood this, although it is clear when the relationship is close, as with children. I think the example you give is an excellent one, Warren. It is clear in this case that regardless of how intensely the training was carried out to supersede the family, these relationships remained strong.

*Johnson:* Speaking partly of this psychological effect (short term), has anyone made any study of what effect Teddy Roosevelt's large family had on immediate birth control? Many of you may not remember this, as most of you are a lot younger than I am, but Roosevelt and his family were very much admired. I think he had eight or nine children.



*Preston:* I don't recall specifically seeing a reference to an effect, and I can recall what the declining birth rate curve looks like, but I don't remember seeing any break at that point. During Kennedy's administration, while he didn't have a large family himself, he radiated the values of large family life, yet the birth rate declined during his administration. In fact, it started about 1960 and declined throughout the sixties.

*Wooster:* A correlation of this occurred to my mind—a small group of oceanographers, those who are on the international circuit and see their children seldom, seem to have a rather large number of children. I started a study some years ago about the sex ratio of the children of oceanographers. At that time I was associated with Towny Cromwell, Roger Revelle, Gordon Riley, and Ray Montgomery. There was a heavy preponderance of female offspring, and I thought this could be the subject of a small piece of demographic research, in a broader context, perhaps.

*Preston:* I think that that has been noted before for other professional groups. I don't know what the reason is.

*Isaacs:* Dr. Preston, I am impressed by a number of the points you have made. One in particular I think you made very well is that the world's human population ecology is, for the moment, a rate limited rather than a gross limited process. That seems to be

generally overlooked. We are always setting some sort of limitation on the total number of people in this world, and you point out very well and convincingly that the present and foreseeable problem is one of attaining feasible and compatible rates of all these things, per capita development, population growth rate, investment, and so on. It is not just the total gross food supplies, number of people, etc. This is an extremely important point, and I think you have made it very well.

The whole matter of the nature of the critical limits and critical processes is of vast importance. I know when I go through an atomic power plant, the most frightening dial of all of them, among all sorts that say "danger," "scram," and so on, the most frightening one is the dial in the middle that says "seconds to supercriticality." It sits there waving around about the 1,000 second mark, sometimes getting down to around five, and then no matter how rapidly one mentally calculates how many more neutrons are required for the thing to go supercritical, five seconds is frightening. We should have a big dial like this for the human population. We might find our moon technology of use in that. We could put the dial up there. Then every development, every crop, every birth could wiggle this huge hand a little bit one way or the other!

Well, we have had a very spirited discussion, and I want to thank the speaker for a fine presentation and a very interesting one. I thank the audience for their interesting comments and discussion.