No one will deny that the Earth’s population, which was estimated in 1970 to be 3,600 million, is growing at 1.9 per cent a year. This rate of increase will, if it continues, result in a world population of double the present number in forty years or so. If population continues to double at this rate, in less than 750 years there will be one person on every square metre of land surface. This, of course, is a reductio ad absurdum argument and that stage will never be reached.

The question is what will prevent the population reaching the stage of saturation. Dr Loraine has said in his very readable book, The Death of Tomorrow, that ‘the solution will be apocalyptic rather than rational’, while Paul Ehrlich in his much read, much quoted and sometimes abused book, The Population Bomb (1968), said that the battle to feed all humanity is over. ‘In the 1970s’, wrote Ehrlich, ‘the world will undergo famines, hundreds of millions of people are going to starve to death in spite of any crash programme embarked on now.’ In the light of four years’ experience, Ehrlich’s views have been shown for what they are worth—sensationalist statements, a syndrome of the doomsday movement.

I will endeavour to show that there is no reason for believing that the solution to the expanding population—and a solution there must be—will be anything but rational. In analysing the situation it is clear that the future is not so bleak as Dr Loraine and others have made it out to be. One of the characteristics of the population growth since the end of the Second World War is that the developing countries have been growing at a much faster rate than the developed countries. The developed countries are much nearer population stability than the underdeveloped countries although they have not, as yet, reached that stage.

According to United Nations statistics, 31 per cent of the present world population is in developed countries and the remainder, 69 per cent, is in the developing world. In Europe as a whole, the average increase in population during the past decade was 0.8 per cent a year, while in south-east Asia, for example, during the latter half of the 1960s the population was increasing at 2.8 per cent a year. In short, the developing countries have borne the brunt of the population increase in the past three decades, and the chances are that they will continue to do so in the years immediately ahead.

In essence, the reasons for this are simple in that a rapid decrease in mortality
in the developing countries has not been matched, at least as yet, by a corresponding decrease in natality. The problem is to know what the total population is going to be in the years ahead, and to know whether the total population will grow to such a stage that it will create intolerable strains within the rapidly growing countries.

It is self-evident that such an increase cannot continue indefinitely, and the practical question is whether stability can be achieved before some cataclysmic event overtakes the world. The signs are that we can achieve stability by rational means without there being any event or series of events that will greatly alter life on our planet.

Let us first look at the difficulty of predicting population. It is well known that the incompleteness and inaccuracy of population statistics is a great impediment to population forecasting. The United Nations, for example, reckons that its estimate of the world population of 3,632 million made in 1969 may be up to 3 per cent in error, or well over a 100 million. Several countries do not carry out censuses (unfortunately these are the developing countries whose statistics are badly needed for predictions) and others may do so but the world never finds out about them.

But the simple fact is that merely a head count is not enough to enable one to predict future population. In India the potential for population growth is much higher than it is in Britain because a greater percentage of the female population are of childbearing age. But, of course, errors in determining age spreads are much greater than in determining total population, so any attempts to predict future world populations are more likely to be wrong than right in spite of all the goodwill of the people who try.

But even though in Britain the age structure of the population, its composition by sex, the current death rate and the current birth rate are known, predictions still have to be based on some assumption of what these values are going to be in the future. In Britain during the 1960s the fertility of women between the ages of 20 and 30—that is the number of children they produce during their reproductive lives—changed by as much as 25 per cent, for no simple or obvious reason. So predictions depend on knowing the initial conditions, which are not easy to determine in the developing countries, and assumptions must be made as to how the fertility and death rates and age of marriage, and so on, change in the future.

But in spite of my scepticism about the validity of population predictions, the trends for the future are hopeful.

The current population of Britain is 55.7 million, composed of 13.5 million children under the age of 15, 33.3 million adults of working age and 8.9
million people of retirement age. The Government Actuary, in November 1972, predicted the population of Britain up to the end of the century. First, it is no surprise to anyone that this differs markedly from predictions made a year ago, and bears little resemblance to ones made in 1955, 1960 and 1965. The reasons for these differences from the 1970 figures is that the 1971 census revealed that the British population is some 400,000 less than that estimated from the accumulation of birth and death certificates in the past decade, which reflects the fact that emigration has been seriously underestimated. If Britain cannot correctly estimate its population, there is little hope that countries in the developing world can get their statistics right.

The predictions made in November give a population of 63.1 million for Britain by the year 2001, whereas a population of 65 million at the end of the century was projected in 1970, and in 1965 the figure was projected to be nearer 73 million. Be that as it may, let us look nearer the present time and see what the projections for 1980 look like—we should have more faith in results projected over a shorter time. A 3.6 per cent increase in the British population is predicted in the next eight years, based on the current birth rate of 16.2/1,000 and death rate of 11.7/1,000, but what is significant is that in 1980 the number of children under 15 is predicted to be similar to that now—13.6 million. The number of adult people between the ages of 15 and 65 will increase from 33.3 million to 34.6 million, but by far the greatest proportionate increase will be in the retired group, which will increase from 8.9 to 9.7 million. So we are turning ourselves into an older society, but each generation is now almost reproducing itself. The dramatic approach to this happy stage can be seen from the census where the Government Actuary has made a cautious revision of average family size based on knowledge of the recent censuses, and he now assumes that each woman married or marrying after 1967 will have 2.33 children, not 2.40 as assumed in 1970 and before. The ideal rate, if that is the word, for one generation to reproduce itself is not 2.0 but 2.1 or slightly greater, which allows for some female children being infertile and also for death before and during childbearing years. Before we leave the discussion of the British situation, it is only fair to point out that a problem is likely to crop up and that is, that a baby boom is expected in the mid-1980s when the postwar babies become grandparents! So, unless the fertility of British girls changes in the next fifteen years or so—that is unless the average number of children decreases even lower than 2.33—this boom will occur. But who can tell what will happen to the fertility rate in the next fifteen years? There is, however, a case for concentrating attention on those people who are now, or soon will be, starting school and if the expected problems can be pointed out to these people—there is time to do it—then the predictions of
63 million people in Britain by the year 2000 could well be on the high side. But there is, of course, one other aspect of the population problem in Britain that has not been seriously considered, and that is the effect that the Common Market is going to have on the population. Will the continental Europeans find it better to live here than in their homelands, or will the British find greener pastures abroad? We can only wait and see.

Many people would say, quite properly, that the real population problem lies not in the developed countries but in the developing world. It is important to compare the developed and underdeveloped countries. In early underdeveloped societies the death rate was often as much as 40 per thousand per year, but these societies, in fact, achieved stability of population because they had a correspondingly high birth rate. With the onset of the industrial revolution conditions grew better, and with better care, the death rate gradually began to decrease. In these now developed countries, the birth rate began to decrease also but in a generation or two after the death rate decreased, without any help from contraceptives, abortion or other forms of birth control. This development is known as the demographic transition. But why did the birth rate decrease once the death rate decreased? Even 150 years ago, before the now developed countries entered the throes of their own demographic transitions, people did not produce as many children as they could. Eight

![Graph showing demographic transition in Sweden](image)

The demographic transition in Sweden. ● = birth rate; x = death rate.
children or more are possible in principle in a reproductive lifetime, but why did some women produce many less than this? Late marriages, particularly in Ireland, make the number smaller, and it has been argued for the United States that men had to spend a great deal of time away from their homes with consequently fewer children being born. Even in Catholic France and Italy, reproduction was less than it could have been. In France, total fertility has declined from about five children a lifetime in the late eighteenth century to 3.5 in 1880 and about 2.0 at present.

But perhaps the argument that carries most weight is that before the death rate began to decrease, parents had to have four or five children to ensure that two grew up through childhood—one child for adulthood had to be matched by one child for the grave. When people realised that this was no longer necessary the birth rate began to decrease also, but this occurred a few generations after the decrease in the death rate.

So clearly, when the death rate began to decrease it took several years before there was a general realisation that fewer children were dying. And, eventually, it became clear that there was no need to have so many children. Thus, the demographic transition which has been completed in most of the developed countries has resulted in an almost stable population.

But what of the less developed countries? What are the signs? In fact they are all good. The death rates have fallen in the years since the war and there is now indisputable evidence that the birth rates are beginning to follow suit in several countries (see Table 1). So how far will this develop? And indeed, how

| Country     | 1950-54 | 1955-59 | 1960-64 | 1965-69 | 1970 |
|-------------|---------|---------|---------|---------|------|
| Ceylon      | 39      | 37      | 36      | 32      | 29   |
| El Salvador | 49      | 50      | 49      | 45      | 40   |
| Hong Kong   | 35      | 37      | 35      | 25      | 19   |
| Jamaica     | 35      | 39      | 40      | 37      | 34   |
| Mauritius   | 45      | 41      | 39      | 32      | 27   |
| Puerto Rico | 37      | 34      | 32      | 27      | 26   |
| Singapore   | 46      | 43      | 36      | 27      | 23   |
| Taiwan      | 46      | 43      | 38      | 31      | 28   |

fast is the demographic transition taking place? Dudley Kirk, Professor of Demography at Stanford, is of the opinion that the transition is indeed well under way in several developing countries. But, most importantly, he considers the rate of progress of the transition to be much faster than that achieved
by the developed countries between 1875 and 1940. The progress of the demographic transition can probably be helped along by education, advice on birth control and, if the country concerned has no moral objections, easier abortions. But the important point to realise is that the rapid decrease in birth rate that is already occurring in the developing world is happening without assistance from any artificial means.

There are, however, countries where the transition is not evident. Brazil is a case in point, and although there is a lack of information on India, it does not yet seem to be following the route set by the other developing nations. If, indeed, India and Brazil follow the example set by Ceylon, Hong Kong, and so on, then the world population will turn out to be near the lower end of the UN’s prediction of a world population of between 5·9 thousand million and 7·1 thousand million by the end of the century. And what predictions, precisely, does the UN make for the future?

The UN considers the developed nations as a whole. Their population in 1968 was 1,038 million. The assumptions made are that the fertility in these countries will now only decrease slowly, from 18·6 births per thousand to 17·5 per thousand in A.D. 2000. This means that the annual rate of growth of population of these countries, which is now about 1 per cent a year, will decrease to 0·9 per cent in 1980 and 0·8 per cent in the 1990s. And in the year 2000 the population of the developed nations will be 1,545 million. It is interesting to note that of the increase, 226 million will be over 25, most of whom are already born. Thus, the larger numbers arise mostly from increased longevity. The Gross Reproduction Rate, that is the number of girl babies produced per woman of childbearing age, will decrease from 1·3 at present to 1·2 in the year 2000.

These assumptions are conservative, for no account is taken of the possibility of a general reduction in fertility, such as recently happened in the United States. So who is to say that Zero Population Growth in the developed countries will not be with us early in the 21st century?

The developing world, of course, presents more of a problem as there is no yardstick on which to base the rate of reduction of fertility. The UN prediction, based on no decrease in fertility in the developing nations, gives a population of 6,370 million in the year 2000 for these nations. But fertility is already falling, and this is undoubtedly an upper estimate.

The UN Population Division has also published three alternative estimates of the future population of the developing world on the basis of different assumptions about the future decline of fertility. Each country of more than 250,000 inhabitants has been dealt with separately. The most common assumption appears to have been that in the first five years after the onset of
fertility reduction, the Gross Reproduction Rate would decline by 5 per cent, that it would decline by 10 per cent in each of the two succeeding intervals of five years, and by 15 per cent in each of the three succeeding intervals of five years. This corresponds to a reduction of 50 per cent in the Gross Reproduction Rate in the first thirty years after the onset of fertility decline, beginning at a point determined separately for each developing country but assumed to be somewhere in the next fifteen years. The prediction of this model, the medium variant as the United Nations calls it, is that the developing world will have grown to 5,040 million by the end of the century, giving a population for the world of 6,494 million. At that point, according to this prediction, the population of the world will be growing at 1.7 per cent a year (compared to 1.9 per cent at present). The developing countries will still be characterised by the high birth rates and low death rates—the assumptions imply that the birth rate in the developing countries will, by the end of the century, amount to an average of 27.4 per 1,000 per year and that the Gross Reproduction Rate will be 1.7. The two other models, the high and the low variants, advance and retard the onset of fertility decline by five years.

What are the economic and other consequences of decreasing the rate of population growth? Professor Dudley Kirk has found that the GNP—that concept so hated by environmentalists—is inversely related to the birth rate, although which comes first, the decrease in birth rate or the increase in GNP, is like the chicken and egg question. Another correlation revealed by Kirk in his analysis of demographic transitions is that the higher the birth rate the lower the life expectancy of baby girls. It is also well known that total fertility in women is smaller among social groups where infant mortality is low.

But the question is: are we to be satisfied with the prognosis? The signs are that fertility in several underdeveloped countries is decreasing. The Net Reproduction Rate is slowing down, and if we take statistics to their illogical extremes, the UN predictions that the Gross Reproduction Rate (the number of girls born per couple) falls by 0.1 every decade suggests that stability should be reached by the 2070s. This, of course, is the inverse of the exponential increase in population argument and admits of the same amount of credence. But if some people insist on believing in the relentless progress of exponential growth, then there is no reason why others should not similarly believe that the rate of growth will decrease as fertility decreases.

So, for all practical purposes the growth of the population of the developed countries has reached stability in that each generation is now reproducing itself. Absolute stability, or ZPG, seems not to be so far ahead if one believes the UN statistics. Some developing countries are showing healthy signs that a demographic transition is in progress in very many of them, although there
J. Roy. Coll. Phycns Lond.

are exceptions. There is good reason to think that the transition will be com-
pleted much faster in these countries than it was in Europe, and they could
probably be helped along directly by increasing advice on contraception
and abortion, and indirectly by aid, which will help them develop.

This article is based on a paper read at the General Meeting of Members held in the
Royal College of Physicians in November 1972.

References
Ehrlich, P. R. (1968) The Population Bomb. New York: Ballantine Books Inc.
Loraine, J. A. (1972) The Death of Tomorrow. London: Heinemann.

Book Review

The Medical Society of London 1773-1973. Edited by Thomas Hunt. Heinemann
Medical Books. Price £2.50, 160 pages.

Pascal, apologising for a long letter to a friend, stated that he had had no
leisure to make it shorter. No such excuse is needed for this book which con-
tains a wealth of historical and biographical information in the relatively
short space of 160 pages. Obviously, this has only been achieved by the ex-
penditure of much time and care by the editor and contributors.

The story of the library is of particular interest. From the start, Lettsom’s
plans for the Society included the formation of a library, towards which he
made many generous gifts of books. Successive librarians have had to face the
problem of cataloguing and of preserving the older books which are always
tender and easily damaged when moved or when stored in cellars during
wartime and exposed to the ravages of damp and dust.

There is little doubt that the library has helped the Society to maintain its
independence and has come to its rescue in times of financial trouble. Most
libraries become dealers in books, and in 1928 the 16 volumes of the famous
Ward diaries, acquired from Dr James Sims, were sold for £10,000 clear of
expenses, which was enough to pave the way for the acquisition of the Society’s
present home. Cataloguing sometimes disclosed duplicates and books of little
interest to the Fellows, the sale of which has contributed to the Society’s
finances. Many of the rarer books and the Greek manuscripts are now housed
in the Wellcome Historical Library, under the care of Dr Poynter, where they
are accessible to Fellows of the Society.

This book of moderate cost can be recommended to all those interested in
medical history and biography.

D.E.B.