

Statistical and Social Inquiry Society of Ireland

The Growth and Aging of Population

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GROWTH IN POPULATION

The United Nations Population Branch has recently issued a treatise on "The future growth of World Population". In a foreword to the publication, it is stated—

"While it took 200,000 years for the world's human population to reach 2,500 million, it will now take a mere 30 years to add another 2,000 million. With the present rate of increase, it can be calculated that in 600 years the number of human beings on earth will be such that there will be only one square metre for each to live on. It goes without saying that this can never take place, something will happen to prevent it.

"The growth of world population during the next thirty years has an importance which transcends economic and social considerations. It is at the very heart of the problem of our existence.

"Never in the history of mankind have numbers of the human species multiplied as rapidly as in the present century nor can it be easily conceived that the peopling of the earth will continue at a similar pace in the century which follows."

The population of the world was estimated at 1,094 million in 1850 and at 1,550 million in 1900 which represents an increase of 42 per cent. in that half-century. The population rose to 2,500 million in 1950, an increase of over 60 per cent. in the first half of this century. For the remainder of the century expectations differ according to specific assumptions. Three assumptions have been made. On the improbable low assumption, the world population would reach 4,880 million by the year 2000; on the medium assumption, 6,270 and on the high assumption, 6,900.

After studying the matter in all its aspects, the Population Branch of the United Nations has come to the conclusion that, barring either a catastrophe, or a deterioration of social conditions for progress in health of global proportions, a world population of between 6,000 and 7,000 million by the end of the century should now be expected almost as a matter of practical certainty.

I do not propose to include in this paper a detailed account of the methods adopted by the United Nations in arriving at these figures. Suffice to say that the assumptions have not been based on crude birth and death rates only. The figures have been calculated age group by age group, with the methods which are appropriate to detailed population projections, by sex and age.

The following table shows for continents and the world the estimated population and population projected by the medium assumption.

Year	World	Africa	Northern America	Latin America	Asia	Europe and U.S.S.R.	Oceania
Millions							
1900 ..	1,550	120	81	63	857	423	6
1925 ..	1,907	147	126	99	1,020	505	10
1950 ..	2,497	199	168	163	1,380	574	13
1975 ..	3,828	303	240	303	2,210	751	21
2000 ..	6,267	517	312	592	3,870	947	29

As the table shows, the population of most continents and of the world as a whole is likely to be quadrupled in the course of this century; the exceptions are Europe (including the Soviet Union) whose population nevertheless doubles and Latin America whose population is likely to increase ten-fold.

Anticipated changes in the distribution of the world population among continents are shown in the following table which gives percentage of population in each continent according to estimated and projected populations.

Year	World	Africa	Northern America	Latin America	Asia	Europe and U.S.S.R.	Oceania
	%	%	%	%	%	%	%
1900 ..	100.0	7.7	5.2	4.1	55.3	27.3	0.4
1925 ..	100.0	7.7	6.6	5.2	53.5	26.5	0.5
1950 ..	100.0	8.0	6.7	6.5	55.2	23.0	0.5
1975 ..	100.0	7.9	6.3	7.9	57.7	19.6	0.5
2000 ..	100.0	8.2	5.0	9.4	61.8	15.1	0.5

High rates of growth in the Americas and Oceania during the 1900-1925 period are associated with relatively large-scale immigration: it is unlikely that immigration will be of similar impact in the future as the indigenous population themselves have become large. Because of fertility decline, rates of increase in Northern America, Europe and Oceania diminished considerably in the 1925-1950 period. In the first half century population growth in Europe (including the Soviet Union) was also affected by heavy losses due to two world wars.

Because of declining mortality, population increase will probably be accelerated throughout the century in Africa, Latin America and Asia, even if it is admitted that, after 1975, fertility may decline. Low mortality and moderate or low fertility determine the rates of increase estimated for Europe, North America and Oceania.

Latin America's share in the world population will increase throughout the century, outstripping the populations of both North America and Africa. Early in the century there was one European for every two Asians; by the end of the century, this ratio may have become one to four. It is of interest to note that the largest single factor which has determined upward revisions of both

current and future world population estimates is the result of the 1953 population census on the Chinese mainland. Previously the latest available official estimate of the population of China had been 463 million in 1948. In 1953, 583 million inhabitants were on the mainland. It has now been established that population in China is growing at a substantial rate and the expectation is that future growth will also be rapid, contributing greatly to the increase in the population of the world.

The division of the world into regions where intensive use is made of technological methods and others where this is not done to any comparable extent is now widely recognised. Low mortality and low or moderate fertility prevail in the developed areas but are rare elsewhere.

It is estimated that the technologically advanced areas contain slightly more than one-third of the world population. This share may drop to less than one-quarter by the end of the century. The relative changes in continental and regional population will have major repercussions on the terms of trade for raw materials and finished products. Because of a rapid increase in the number of local consumers, raw material exported from certain countries may become scarce. Markets for finished goods produced elsewhere may widen; but a scarcity of materials may render their production costly. Changes in technology, economic organisation and structure may or may not offset some of these effects of differing rates of population growth.

Consideration of such numbers as 6,000-7,000 million people raises the question of determining at what point the earth would reach its maximum carrying capacity. In view of current scientific progress, conditional estimates may have to be revised upward. Recently attention has been drawn to vast unused resources of vegetable substances in the sea, the possible uses of solar energy, and the likelihood that atomic energy will become widely available as a source of power.

More disturbing than the projected figure of a population amounting to 6,000-7,000 million is the fact that it will probably be attained so soon. The year 2000 is no further in the future than the year 1914 is in the past. Not only technical achievement but progress in international co-operation and organisation will have to be more effective than during the first fifty years if the expected numbers of mankind are to be accommodated to the minimum conditions required for human dignity.

One national newspaper commenting on the gloom of the United Nations Report and particularly on the remarks relating to the intensity of pressure on world resources through the quadrupling of the population within a century, closed its article with a quotation from St. Matthew's Gospel—

“Wherefore, if God so clothe the grass of the field, which to-day is and tomorrow is cast into the oven, shall He not much more clothe you. O ye of little faith”

The population in 1901 of the area which now constitutes the United Kingdom was about 38,200,000, and the Government Actuary in London has estimated that by the year 1996 the population will have reached 55,600,000, an increase of 46 per cent. during

the century, as compared with over 300 per cent. for the world as a whole and 124 for Europe including the U.S.S.R. According to the projection of population of the United Kingdom for the second half of the century, there will be a considerable slowing down in the rate of increase as compared with the first half. During the period 1900-1950, the percentage increase was 32, but it is anticipated that for the period 1950-1996 the increase will only amount to 10 per cent.

It has been estimated that the population of Northern Ireland will reach a figure of 1,594,000 by the year 1996 as compared with 1,237,000 in 1901, an increase of less than 30 per cent. The percentage increase during the first half of the century was 11 and according to the projection will be 16 in the second half.

AGING OF POPULATIONS

Turning to the question of the aging of the population, one fact which has emerged from a recent study undertaken by the United Nations Organisation is that in the greater part of the world the age structure of populations has undergone little change covering the periods for which records are available. This is particularly true of the economically under-developed countries or, rather, of all countries with a high fertility. Only in the economically advanced countries has the age structure been changed over the years. A phenomenon whose appearance more or less coincided with the decline of fertility observed in those countries. The coincidence of declining fertility and aging and the stability of age structure in countries with high fertility suggest that fertility movements have played a fundamental part in the development of aging. Where age composition has been modified in the past, the change has approximately coincided with a decline in fertility.

In Appendix A the world population is given by regions together with birth and death rates and population growth relating to the period 1951-55. It will be observed that the birth rates are high for Africa, Middle and South America and a part of Asia and particularly low in comparison for the whole of Europe. Forty-five births for 1,000 of the population for the whole of Africa, Middle America and South East Asia and between 35 and 42 for South America and the remainder of Asia (excluding the U.S.S.R.) compared with 18 to 21 for Europe and 25 and 26 for Northern America and the U.S.S.R.

The death rates are also relatively high for regions other than Northern America, Europe, Oceania and U.S.S.R.

The birth and death rates were determined by the United Nations through a study of the range of these statistics in the countries of each region in which statistics are believed to be complete or for which there are objective estimates of birth and death rates. The age distribution was also analysed in relation to the assumed birth and death rates. I mention this aspect because of the figures in Appendix B in which crude birth and death rates are given for individual countries, some of which appear to be at variance with those in Appendix A. One of the explanations is that the rates in Appendix B are incomplete in some instances. For example, in Cuba and Equador the data exclude births and deaths of infants

dying within 24 hours of birth. In Algeria infants who die before their births are registered are excluded, and the rates for Colombia are based on baptisms recorded in Church registers and burial permits. Again, in India and Burma only parts of these countries are covered by the registration system.

In the case of some countries the crude death rate has fallen sharply in the past few years. For instance, the rate for Chile was 17.3 in 1949 as compared with 12.8 in 1955: India 15.8 as compared with 13.1: Japan 11.6 as compared with 7.8 and Egypt 20.6 as compared with 18.4.

Appendix B also shows the percentage distribution of the population by three broad age groups 0-14; 15-64 and 65 and over. It will be seen that the percentage of old people varies widely from one population to another. The range extends from a minimum of 2.4 per cent. in Brazil to nearly 12 per cent. in France.

If populations were to be arbitrarily defined as "young" if they have less than, say, 4 per cent. of persons above the age of 64; as "mature" when the percentage is between 4 and 7; and as "aged" when it exceeds 7 per cent., it would appear that an overwhelming proportion of world populations may be regarded as "young" or "mature" and only a very small proportion as "aged". The "aged" countries would comprise a small proportion of the world population and would cover a small part of the surface of the globe. The most "aged" populations are those of Western Europe, the United States, Canada and Oceania.

The data for 1950 show that in France there was one person in eight; in Great Britain one in nine; in Northern Ireland and in Sweden one in ten and in the United States one in twelve over the age of 64, whereas in Japan the rate was one in twenty and in Colombia one in thirty-four.

The age structure of a population changes in accordance with movements in births and deaths and the tendency of the country to attract immigrants or encourage emigrants. With advances in medical science and economic and social development, underdeveloped countries are experiencing a reduction of mortality without any decline in fertility. It is reasonable to suppose, however, that mortality will not continue to decline indefinitely without leading to a decline in fertility. If mortality declines substantially, the increase in the family dependency burden will ultimately lead to a decline in fertility. The reproductive behaviour of couples seems to be determined by the number of children who survive, not by the number born. For example in Egypt the infant mortality rate for 1953 was 148 per 1,000 live births as compared with 38 for Northern Ireland, the respective birth rates being 40 and 21 per 1,000 of the population. If the increase in the family dependency burden is very great only a decline in fertility can make the burden tolerable by reducing it. The association of high mortality with low fertility or of high fertility with low mortality for an extensive period is improbable, though the combination of a birth rate near 45 per 1,000 with a death rate near 10 per 1,000 has in recent years been reliably recorded in several countries e.g., Venezuela and Malaya, the corresponding rate of natural increase being about $3\frac{1}{2}$ per cent. per annum. At that rate, a population

doubles in 20 years and increases tenfold in 67 years, a rate of growth whose continuation over a very long time span is difficult to imagine.

Future Trends

In the case of countries where mortality has been low for some years, the decline in mortality was not spread uniformly through all ages but affected the younger age-group much more than others. The situation is different with respect to other age-groups, where there is still room for much improvement. A good example of this disparity is found in Northern Ireland where a broad indication of the trend of death rates is provided by the following table which shows deaths per 1,000 of the population in four age-groups during the three year periods adjacent to each census date.

Census Year	0-14	15-44	45-64	65 and over	All Ages
1901 ..	17.3	9.0	24	100	19.6
1911 ..	14.6	7.3	22	72	17.4
1926 ..	11.0	5.3	18	76	15.1
1937 ..	8.8	4.2	17	76	14.4
1951 ..	3.9	2.0	12	75	11.7

The overall decline in mortality between 1901 and 1951 has been considerable. It will be observed that in the two younger age groups the rates have declined by more than three-quarters and that the rate for the 45-64 group is only one-half of the 1901 figure. While mortality in the highest group fell considerably between 1901 and 1911 there was no indication of a declining trend between 1911 and 1951.

There are grounds for optimism with regard to future mortality trends among older persons. Some progress has recently been made in the diagnosis of degenerative diseases mainly affecting the old, and it must be remembered that the old people of to-morrow will belong to generations that will have lived in better economic and sanitary conditions, and that they will, on the whole, probably be healthier. But what is perhaps of greater importance is that the aging of populations has in itself stimulated interest in the social and medical care of the aged and society's increasing concern with the wellbeing of the aged may contribute to the lengthening of many lives. As the decline in mortality may in future be more marked for the old than for the young, its effect will be to increase the expectation of life at higher ages and that will automatically increase the aging of populations at the apex of the pyramid. Interesting data on the problems resulting from age structure have been provided by the United Nations in the following tables showing the estimated numbers of persons under 15, 15-59 and 60 and over and the number of persons aged under 15 and 60 and over per 100 persons aged 15-59.

POPULATION (MILLIONS) AT VARIOUS AGES

Continent	1950			1975		
	under 15	15-59	60 and over	under 15	15-59	60 and over
World	910	1,400	160	1,400	2,100	300
A {						
Africa	81	110	8.7	130	160	14
Latin America	65	88	9.4	130	160	20
Asia	550	760	62	910	1,200	110
B {						
Northern America	46	100	21	66	140	38
Europe	100	240	47	120	280	81
Oceania	4	7.7	1.4	6.5	12	2.9
U.S.S.R.	60	110	14	82	160	31

In 1950, the four regions in the second group had a combined child population of 210 million compared with 700 million in the regions in the first group. On the other hand, the number of persons of 60 and upwards in the second group exceeded 83 million which was more than half the total in the world. By 1975, the contrast is likely to be more striking. Group B is expected to have about 275 million children and more than 150 million aged 60 and over, while in Group A the number of children will probably exceed 1,100 million and the number aged 60 and over 144 million.

The second table shows the estimated numbers of persons aged under 15 and 60 and over per 100 persons aged 15-59.

Continent	1950			1975		
	under 15	60 and over	sum of both	under 15	60 and over	sum of both
World	64	12	76	69	14	83
Africa	75	8	83	77	8	85
Latin America	74	11	85	80	12	92
Asia	73	8	81	77	10	87
Northern America	45	21	66	49	28	77
Europe	42	19	61	41	29	70
Oceania	51	19	70	56	25	81
U.S.S.R.	56	13	69	51	19	70

Dependency burdens are likely to increase in most areas of the world. In parts of Africa, Latin America and Asia the decline in mortality, particularly in early childhood and at advanced ages leads to a proportionately greater number of survivors in childhood and old age relatively to persons of middle age. In Northern America, Europe and Oceania because of fertility declines in the more distant past, the number of old persons continues to rise relatively to other sections of the population.

Comparative figures for England and Wales, Scotland and Northern Ireland to those quoted for continents are as follows :—

POPULATION (THOUSANDS) AT VARIOUS AGES

	1951			1976		
	under 15	15-59	60 and over	under 15	15-59	60 and over
England and Wales	9,692	27,097	6,969	9,926	27,653	9,844
Scotland	1,255	3,109	732	1,279	3,124	984
Northern Ireland ..	378.7	802.6	189.4	401	860	239

The larger number of children in Northern Ireland in proportion to the number in Great Britain emphasises the fact that we have a higher birth rate. The crude birth rates in 1956 were—England and Wales 15.7; Scotland 18.5; Northern Ireland 21.1. Between 1951 and 1976 the number of children in England and Wales is expected to increase by 2.4 per cent.; by 1.9 in Scotland and by 5.9 in Northern Ireland. The percentage increases for adults 15-59 are—England and Wales 2.1; Scotland 0.5; Northern Ireland 7.1 and for the sixties and over England and Wales 41; Scotland 34 and Northern Ireland 26.

PERSONS OF GIVEN AGES PER 100 INDIVIDUALS AGED 15-59 YEARS

	1951			1976		
	under 15	60 and over	sum of both	under 15	60 and over	sum of both
England and Wales ..	36	26	62	36	36	72
Scotland	40	24	64	41	32	73
Northern Ireland ..	47	24	71	47	28	75

It will be noted that compared with Europe as a whole, England and Wales, because of a low birth rate, is expected to have a lower dependency burden in regard to children in 1976—36 per 100 of the population aged 15-59 against a figure for the whole continent of 41, but that the figure for older people will be relatively high, 36 per hundred as compared with an average of 29. In Northern Ireland, because of the high birth rate, the dependency burden in regard to children will be substantially higher than the average rate but the rate for older people will be one below the average. The rate for Scotland is expected to be the same as that for the whole of Europe in the case of children, but the rate for older people is 32 as compared with 29.

The Secretary of State for Scotland said last month—

“ It always seems to me to be nonsense to suggest that the community cannot afford to have more old people. A far bigger proportion of the population was now of so-called working age than at the beginning of the century. If our grandfathers could contrive to increase the nation's wealth so much we ought surely

to be able to do the same with a higher population of working age. It may be that the smaller proportion of children is going to create economic problems around A.D. 2,000. I propose to leave these to nuclear power and to our successors."

In 1901 the population of the United Kingdom aged 15 to 64 numbered 24 million (63 per cent. of the total population), by 1956 this figure had risen to 33,800,000 (66 per cent.), and the figure is estimated at 35,700,000 (64 per cent.) for 1996. In Northern Ireland, the figures are 782,000 (63 per cent.) in 1901, 861,000 (62 per cent.) in 1956, and 1,003,000 (63 per cent.) in 1996.

Male Activity

In addition to the size and age structure of the populations, a variety of economic and social factors determine the labour supply in each country. The extent of participation in economic activities varies considerably among males at different ages within each country, as well as from country to country. The following table shows the average per cent. active among males in each age group in three groups of countries at different levels of economic development.

Countries	Age groups in years							65 and over
	10-14	15-19	20-24	25-34	35-44	45-54	55-64	
Under-developed	% 31	% 32	% 93	% 96	% 97	% 96	% 91	% 78
Semi-developed ..	9	71	92	96	97	96	90	62
Developed ..	5	69	91	96	97	95	83	41

Between twenty and fifty-four years, activity rates are very high and almost identical in the three groups of countries. Under twenty and over fifty-four the differences increase as the countries' level of economic development rises. In other words, as one moves away from the middle age groups, the higher the level of living the lower the activity rate. The rates quoted are averages, but, as an example, activity rates in older age groups in Egypt were 94 for men aged 55 to 64 and 84 for men aged 65 and over as compared with 78 and 25 in Belgium in the same age groups.

The behaviour of populations with reference to the entry into and the withdrawal from the labour force corresponds to the different broad stages of economic development, but the behaviour of men between twenty and fifty-five remains more or less unchanged. Social advancement tends to postpone entry into the labour force and to advance the age of retirement, but in recent years the countries of Western Europe and North America have been increasingly concerned about the need to promote the greater employment of older men and women, in consequence of the growing proportion of older people in the population. At the World Population Conference held in Rome in 1954 papers were

read on this subject by representatives from eight countries which gives some indication of the importance of this problem. The countries comprised most of those in Western Europe, the United States and Canada.

The paper submitted on behalf of Great Britain mentioned that the Minister of Labour and National Service had appointed a National Advisory Committee to advise and assist him in promoting the employment of older men and women. In its first report the Committee stated that the principal barrier to the extended employment of older persons lies in the traditional attitudes of mind and only a better understanding of the issues is likely to change them. It was pointed out that the country could not afford to dispense with the services of fit and willing people, and attention was drawn to the need for further study into the effects of aging on capacity for work both by academic research and practical experiment in industry. Among the questions on which information is required are fitness and capacity for work at the later ages, absenteeism, timekeeping and accident rates of older workers.

The paper by the Norwegian representative at the Conference in Rome stated that Norway is confronted with a grave problem of covering the economic and social needs of an increasing number of elderly persons by a proportionally dwindling group of younger people. The ratio of the number of persons aged 65 and over to the number of persons 15-64 is often used as a crude measure of the load of dependent aged in the population upon the economical active sector. This measure shows a steadily rising burden. For every person 65 years old and more there were 8 persons 15-64 in 1920: 7 in 1950 and in 1970 it is expected that there will be 5.

The expectation of life for a man in Norway aged 65 is now 15 years and for a man aged 70, 11 years and for a woman 16 and 12 respectively. If the active ages are reckoned from 16-65, the present average life expectancy at the age of 65 represents a period nearly one-third of the entire average working life expectancy of the Norwegian to-day.

The present age of retirement in Norway is relatively high compared with that in many other countries. The great majority of men are gainfully occupied till the age of 70. Under the National Old Age Pension Scheme which came into operation in 1936 pensions are subject to a means test and are not payable until the age of 70.

Figures are furnished below for several countries showing the percentage economically active among males in the age group 65 and over at recent censuses of population.

Spain†	...	...	...	85
Egypt*	...	...	...	84
Turkey*	...	...	...	79
Chile†	...	...	...	76
Brazil*	...	...	...	66
Irish Republic†	...	...	...	63

Japan†	...	...	...	55
Switzerland	...	...	...	55
France	...	...	...	54
Norway†	...	...	...	48
United States	...	...	...	42
Canada	...	...	...	39
Northern Ireland	...	...	...	39
Australia	...	...	...	34
Great Britain	...	...	...	32
New Zealand	...	...	...	31

The countries marked * have been classified by the United Nations as under-developed because 60 per cent. or more of total economically active males are employed in agriculture. In those marked †, the classification is semi-developed countries as the percentage of males employed in agriculture was 35 to 59. The remainder are regarded as industrialised countries.

The 1951 Census returns showed that of the 61,000 men aged 65 and over enumerated in Northern Ireland, 24,000 were engaged in active employment. The number in employment at the 1901 census was 31,100 out of a total of 36,000 and in 1926, 31,000 out of a total which had risen to 45,700. The percentage of men in the age group who were actively employed were—86 in 1901; 68 in 1926 and 39 in 1951. These decreases are partly due to the introduction of contributory pension schemes and partly because there were more survivors at the higher ages in 1951. For instance, in 1901 men aged 75 plus, when in most cases the working life is over, numbered 11,300; by 1951 this figure had jumped to 20,800, an increase of 84 per cent.

In 1951, 12,000 of the 24,000 were returned as engaged in agriculture, horticulture and forestry and of that 12,000, more than 7,000 were over 70 years of age which suggests that the bulk were farmers whose sons were doing the actual work. The occupations followed by the remainder were—

Commercial, Finance and Insurance Occupations, Directors, Managers, Clerks and Typists	...	3,222
Workers in Metal Manufacture and Engineering	...	1,188
Unskilled workers	...	1,142
Transport and Communications	...	828
Workers in Building and Contracting	...	814
Professional and Technical Occupations	...	786
Personal Service	...	753
Workers in wood	...	545
Textile workers	...	538

In 1901, out of a population of women aged 65 and up numbering 39,200, 11,600 were actively employed. By 1951, the figure had more than halved (5,550) though the population in the group had

increased to 74,200. The occupations followed in 1951 were stated to be—

Agricultural and Horticultural Occupations	...	1,754
Personal Service	... ..	1,294
Commercial, Finance and Insurance Occupations, Clerks and Typists	... ..	930
Makers of Textile Goods and Articles of Dress	...	547
Textile workers	... ..	440
Professional and Technical Occupations	... ..	283
Unskilled workers	... ..	98

Apropos activity figures, a paper which aroused much interest and discussion at the World Population Conference was entitled "Biological versus chronological age." The paper deplored the lack of flexibility in the definition of individual aging and stressed the importance of the difference between the "biological age" and the "chronological age" of the same person. The divergence between the two ages increases with age and at 70 (chronological age) might be as much as 20 years plus or minus. It was maintained that from the point of view of social organization generally and with particular reference to the consideration of the problems arising in connection with the retirement of older persons, comprehensive studies should be undertaken with a view to the definition and measurement of biological age. It was, however, pointed out that a prime difficulty would arise in organising a team of biometricians, capable of investigating all aspects of personality and of finding groups of persons of all ages, representative of the population as a whole, who would be willing to submit to examination.

Expectations of Life

The following which gives in summary form the Life Tables for Northern Ireland for the first half of this century illustrates the general improvement which has been made in expectation of life in all developed countries.

Age	Males			Females		
	1901	1926	1951	1901	1926	1951
0 ..	47.1	55.4	65.5	46.7	56.1	68.8
5 ..	52.6	58.7	64.0	51.0	58.0	66.8
15 ..	44.6	49.9	54.4	43.4	49.3	57.1
25 ..	37.3	41.5	45.0	36.4	41.3	47.6
35 ..	30.3	33.4	35.8	29.6	33.6	38.3
45 ..	23.0	25.3	26.9	22.7	25.8	29.3
55 ..	16.1	18.0	18.8	16.0	18.7	20.8
65 ..	10.5	11.9	12.1	10.4	12.7	13.5
75 ..	6.1	7.2	7.1	6.2	8.1	7.9
85 ..	2.4	4.0	3.9	2.1	4.7	4.3

The expectations for both sexes increased at all ages between 1901 and 1926, and further increases, except at the oldest ages, were recorded between 1926 and 1951.

At birth the expectation for boys was 47.1 years in 1901, which by 1951 had increased to 65.5, an increase of 18.4 years. Between

1901 and 1926 the increase was 8·3 and between 1926 and 1951, 10·1; an improvement of 1·8 years on the previous quarter-century. But there the rate of improvement between the two periods ended for males. A boy aged 5 had an expectation of life of 52·6 years in 1901, which had jumped to 58·7 by 1926, an increase of 6·1. The expectation had further increased to 64·0 by 1951, but the increase amounted to 5·3.

At each subsequent age point quoted, the rate of increase between 1926 and 1951 was smaller than for the preceding 25 years, and, when we reach the ages of 75 and 85, it is found that the increase recorded between 1901 and 1926 became a decrease of 0·1.

In 1901, girls had an expectation of life of 46·7 years at birth, actually 0·4 lower than boys. This has now jumped to 68·8, an increase of just over 22 years—3·3 years higher than the rate for boys. It is interesting to note that the rate of improvement established between 1901 and 1926 was increased in the case of females until the age of 55 during the 1926-1951 period.

It will be seen that at all ages the 1951 expectations are greater for women than for men, whereas in practically every case the 1901 expectations were lower for females than for males and the 1926 expectations differed little for the two sexes.

Women in Northern Ireland have a lower expectation of life than their sisters in England but higher than those in Scotland. On the other hand, men in Northern Ireland from age 35 onwards have a higher expectation than those in England and higher also than those in Scotland throughout life.

In connection with the Life Tables for Northern Ireland the following figures show that between 1926 and 1951 mortality rates for women declined to a greater extent than those for men, which has resulted in considerable changes in the ratio of male to female mortality.

MALE MORTALITY RATES AS PERCENTAGE
OF FEMALE RATES

Age	1926	1951
0	125	125
5	97	121
15	79	138
25	82	116
35	82	116
45	93	131
55	100	141
65	105	133
75	112	119
85	120	112

As in other parts of the United Kingdom, the ratio of male deaths is now heavier throughout life, whereas a quarter of a century earlier the female rates were heavier than the male over a considerable span of ages.

Further evidence that women are surviving longer than men is provided by the numbers in the higher age groups as recorded in

Northern Ireland at the 1901 and 1951 censuses. In 1951, there were 61,000 men aged 65 and over as compared with 36,100 in 1901—an increase of 68 per cent.—while the number of women increased by 89 per cent. from 39,200 to 74,200. For both sexes, the highest percentage increase took place in the 75-79 age group—122 per cent. for men (5,573 to 12,404) and 153 for women (5,854 to 14,830).

In the case of men, the lowest percentage increase (35) was in the 85 + group where the women had a gain of 78 per cent. The actual gain for men was a mere 600 as compared with 1,600 for women. The lowest percentage increase (61) for women was in the 80-84 group. The attached diagram sets out for both sexes the comparisons between 1901 and 1951.

The following table shows the expectations of life at birth and at age 65 for a number of countries. It will be noted that, with one exception, (Norway) the populations of Industrialized countries have prospects of a much longer life than those of what the United Nations call Semi- or Under-Developed Countries, particularly at birth. Generally speaking, this applies also to men aged 65, but in Brazil and Chile women of that age have prospects not far below the average for all the countries mentioned.

Country	Age 0		Age 65	
	Male	Female	Male	Female
Netherlands	70·6	72·9	14·1	14·7
Norway	69·2	72·6	14·7	15·5
New Zealand	68·3	72·4	12·9	14·8
United States	67·4	73·6	13·1	15·7
England and Wales	66·4	71·5	11·7	14·3
Canada	66·3	70·8	13·3	15·0
Australia	66·1	70·6	12·3	14·4
Northern Ireland	65·5	68·8	12·1	13·5
Irish Republic	64·5	67·1	12·1	13·3
Scotland	64·4	68·7	11·4	13·2
South Africa*	63·8	68·3	12·4	14·5
South Africa†	41·7	44·0	11·0	12·3
France	63·6	69·3	11·9	14·4
Ceylon	57·6	55·5	12·5	11·2
Japan	56·2	56·6	†	†
Brazil	49·8	56·0	10·4	13·5
Chile	49·8	53·9	11·4	13·4
Belgian Congo	37·6	40·0	8·5	10·1
India	32·4	31·7	8·2	9·3

* European.

† Coloured.

‡ Not available.

It will be noted that a female American infant has the greatest expectancy at 73·6 years and that for boys the male Dutch infant is in the most favourable position at 70·6. Of the countries listed, Northern Ireland is eighth on the male side and ninth on the female side beating the Irish Republic and Scotland by a short head in regard to both sexes.

Later figures showing improvements have been published for some countries, but it seemed advisable to quote figures around 1950 for all countries in order to provide a comparison. The later figures readily available are—England and Wales, for boys at birth rose from 66.4 to 67.5 in 1955 and for girls from 71.5 to 72.9. Similar figures for Scotland are 64.5 to 65.7 for boys and 68.3 to 70.6 for girls, for Northern Ireland 65.5 to 67.4 for boys and 68.8 to 71.0 for girls, and for Japan 56.2 to 63.9 for boys and 56.6 to 68.4 for girls. It will be noted that Japan has made rapid strides in recent years.

According to the Actuaries, further gains in life expectancy may be anticipated, but there is no immediate prospect that the expectation of life can rise very much above 75 years.

APPENDIX A

POPULATION, BIRTH AND DEATH RATES AND POPULATION GROWTH, BY REGIONS :
1951-55

(Population estimated as of mid-year 1955; rates are per 1,000 population and are estimated annual averages for 1951-55).

World and regions	Population Mid-year 1955 (millions)	Birth rates	Death rates	Population growth	
				Rates	Millions
World	2,691	34	18	16	42.6
AFRICA :					
Northern Africa	78	45	25	20	1.5
Tropical and Southern Africa	145	45	25	20	2.8
AMERICA :					
Northern America	183	25	9	17	3.0
Middle America	58	45	19	26	1.4
South America	125	40	17	25	3.0
ASIA :					
South West Asia	73	42	22	20	1.4
South Central Asia	499	41	28	13	6.3
South East Asia	185	45	28	17	3.0
East Asia	724	35	16	19	13.3
EUROPE :					
Northern and Western Europe	137	18	11	6	0.8
Central Europe	134	20	11	9	1.2
Southern Europe	138	21	10	10	1.4
OCEANIA	14.6	25	8	22	0.3
U.S.S.R.	197	26	9	17	3.2

From Demographic Year Book, United Nations, 1956.

APPENDIX B

PERCENTAGE DISTRIBUTIONS OF POPULATIONS BY THREE BROAD AGE-GROUPS
POPULATIONS : CRUDE BIRTH AND DEATH RATES

(From Demographic Year Book and U.N. Publication XIII, 1956)

Country	Age Groups Percentage of Populations			Pop. (Mns.)	Crude Birth Rate	Crude Death Rate
	0-14	15-64	65 and over			
	%	%	%			
AFRICA :						
Algeria	43.0	54.3	2.7	7.6	43.2	13.7
Egypt	38.1	58.8	3.1	19.0	40.0	18.4
South Africa (European)	30.5	63.3	6.2	2.6	25.5	8.5
„ „ (Others) ..	39.5	56.9	3.6	10.0	48.1	17.5
AMERICA, NORTH :					(1952)	(1952)
Cuba	36.4	60.3	3.3	5.8	25.1	6.5
Mexico	41.8	54.9	3.3	25.8	46.2	13.3
U.S.A.	27.1	64.7	8.2	150.7	24.6	9.3
Canada	30.3	61.9	7.8	16.1	28.4	8.2
AMERICA, SOUTH :						
Argentina	30.9	65.2	3.9	15.9	23.9	8.6
Brazil	41.9	55.7	2.4	52.0	Not A	valuable
Chile	37.1	59.4	3.5	5.9	35.0	12.8
Colombia	42.0	55.1	2.9	11.5	40.4	12.8
Ecuador	42.5	54.0	3.5	3.2	44.5	15.9
Peru	42.1	53.6	4.3	6.2	29.5	11.4
Venezuela	42.0	55.4	2.6	5.0	47.0	10.1
ASIA :						
Burma	37.4	59.8	2.8	2.9	36.4	20.7
Ceylon	37.1	59.4	3.5	8.1	37.9	11.0
India	37.4	59.0	3.6	356.9	25.8	13.1
Japan	35.4	59.7	4.9	89.3	19.4	7.8
Malaya	41.3	55.5	3.2	4.9	43.0	11.5
Philippines	44.2	52.7	3.1	19.2	34.2	9.9
Thailand	42.3	55.1	2.6	17.4	34.2	9.7
EUROPE :						
Austria	23.3	66.6	10.1	6.9	15.6	12.2
Belgium	20.9	68.0	11.1	8.5	16.8	12.2
Denmark	26.3	64.6	9.1	4.3	17.3	8.7
France	21.7	66.5	11.8	42.8	18.6	12.2
Germany West	23.5	67.2	9.3	47.7	15.7	10.8
Great Britain	22.5	66.7	10.8	48.8	15.3	11.7
Irish Republic	28.9	60.4	10.7	2.9	21.2	12.6
Italy	26.4	65.6	8.0	47.2	18.1	9.3
Netherlands	29.5	62.7	7.8	9.6	21.4	7.6
Northern Ireland	27.6	62.5	9.9	1.4	20.8	11.1
Norway	24.4	66.0	9.6	3.3	18.7	8.3
Portugal	29.5	63.5	7.0	8.4	23.9	11.3
Spain	26.2	66.6	7.2	28.0	20.6	9.4
Sweden	23.4	66.3	10.3	7.0	14.8	9.4
Switzerland	23.6	66.8	9.6	4.7	17.1	10.1
Yugoslavia	30.8	63.5	5.7	16.9	26.7	11.4
OCEANIA :						
Australia	27.1	64.9	8.0	9.0	22.6	8.9
New Zealand	28.4	62.0	9.6	2.2	24.9	9.0
„ „ (Maoris)	46.5	51.0	2.5		44.4	9.7

DISCUSSION

Dr. M. D. McCarthy in proposing the vote of thanks paid a tribute to the Belfast branch of the Society for the standard of their meetings and to Mr. Mulligan for his paper. With vivid recollections of the population projection prepared in the pre-war years when fertility in many countries of Western Europe was low and when the projection of the then current trends led to forecasts of rapidly declining populations he did not believe that population projections should be presented as "what was likely to happen". The sophistication of the methods used has increased but he doubted whether the results would prove more accurate in actual practice. This was not to decry the value of such exercises. It is always extremely useful to project the long term consequences of current rates and trends to see where they will lead the economy over a period of years. But this is done not as a forecast but to quantify the ultimate results of the current patterns and to make it possible to judge if steps should be taken to try to adjust the trends if we do not like the consequences which will ensue as a result of their continued operation.

Long term population forecasts are particularly fallible and they depend to a great extent on the assumptions made. He would have liked if Mr. Mulligan had, without perhaps going into detail, given his views on the basis of the U.N. Population Division's calculations. The "high" and "low" estimates given for 1975 for the World population are fairly close together, at 3,590 million and 3,860 million, they differ by less than 10 per cent. What the publication in questions calls the medium forecast for 1975 is in fact its high forecast less a downward adjustment of 30 million got by varying the mortality trend in Africa only. However, the difference between the estimates for the year 2000 is very large, from 4,880 million to 6,900 million or over 2,000 million.

It is instructive to divide the world into two regions and to consider the variations on the different assumptions in the increases in the different regions. For this purpose one may take what one shall call, from the population point of view, the "non-explosive" region Northern America, Oceania, Europe and the U.S.S.R. together where the population was 755 millions in 1950. The "low" estimate for this area for 1975 is 977 million and the "high" estimate is 1,012 million, a difference of only 35 million, and these give percentage increases over the 25 years of between 29 and 34 per cent. At the end of the succeeding 25 years the forecast population of these regions will be 1,125, 1,288 or 1,343 million on the three assumptions the "low" assumption representing an increase of 15 per cent. and the "high" assumption one of 33 per cent. in the period. For the rest of the world, the population of which was 1,742 million in 1950, the estimated increases up to 1975 on the two bases are 875 and 1,102 million giving rises of 50 and 63 per cent. respectively. In the succeeding 25 years the three sets of assumptions used for what may be called the "explosive" regions in question give increases of 1,138 million, 2,163 million and 2,719 million representing percentage rises in the period of from 44 to 96 per cent. Thus the assumptions that really matter in the fore-

casts so far as the total population is concerned are those chosen for Africa, Latin America and Asia (excluding the U.S.S.R.). Of these the most important are those for Asia where the forecast increases over the half century range from 1,510 million to 2,870 million. In Africa the range of the increase is from 221 to 462 million and in Latin America from 282 to 650 million.

Now it is notorious that for these "explosive" regions that basic fertility and mortality figures are almost wholly lacking and those partial indications that are available are, to say the least, of dubious quality. Much of the basis is inferred from the information (such as it is) on the current age distribution of the populations, and therefore even the starting point of the forecasts is insecure. In the case of all these regions the mortality assumptions assume a steady improvement in the expectation of life of about $12\frac{1}{2}$ years in each 25 year period, the starting point varying with the best estimates of the present conditions in the region. The only exceptions to the assumed decline in mortality are the "medium" estimate for Middle Africa for the 1950-75 period and the "low" estimate for that area for the whole 50 years. He has not had sufficient experience of the regions in question to assess fully the validity of these mortality assumptions but it does seem that the assumption that the "life table" death rate in Asia generally will drop from about 33 per 1,000 in 1950 to $23\frac{1}{2}$ in 1975 and to 18 in 2000 may be optimistic. Spectacular gains in the health field can and have been achieved in relation to infective and parasitic diseases, but there are other elements of mortality which are closely linked to the level of living. When we remember that real per capita national income in say India, Pakistan, Burma, Kenya, Uganda and the Belgian Congo is only about one-seventh of what it is in the Twenty-six Counties or less than one tenth in the United Kingdom, it is clear that the application by W.H.O. and similar agencies of the methods of modern preventive medicine cannot have the full possible effect in reducing death rates unless accompanied by increases in national income at rates which are he thought unlikely to be achieved. In fact over the fifty years 1900-1950 the expectation of life at birth in India increased by only 9 years while in the next fifty years the forecast is that it will increase by 25 years.

Turning to the fertility assumptions for these areas we find that the "high" assumptions involve, despite the falls in mortality, that fertility remains at a level equivalent to a Gross Reproduction Rate of 3 right up to the year 2000 that is to say birth rates of 45 to 50 per 1,000. The "medium" assumption is that this rate will continue up to 1975 and then begin to fall. Now this may or may not be true and in fact as the U.N. Report says "The exact conditions which accompany reductions in fertility remain, so far, quite incalculable". However, he did feel that despite the fact that fertility rates, depending as they do on cultural attitudes surrounding the constitution of families, are often highly resistant to change, nevertheless in the regions in question the social and cultural environment is in such a state of flux that quite conceivably changes in these rates are possible in short periods. The birth rate in Japan fell from 34.3 in 1947 to 18.5 in 1956 and it is not impossible that

similar spectacular changes could occur in other countries. One might possibly detect a certain bias in the approach of the authors of the U.N. document when they say "The recent very sharp decline in the Japanese birth rate has been so extraordinary as to furnish no basis for reasonable prediction". In fact if one said that the social changes now occurring in many underdeveloped countries are so extraordinary that one just cannot forecast what is going to happen to fertility one might be nearer the mark. It is quite possible that either the results of medical research or changes in social attitudes will radically alter the fertility levels in these countries in the comparatively near future and one cannot accept the confident assertion of the U.N. Office that "barring either a catastrophe, or a deterioration of social conditions for progress in health, of global proportions a world population of between 6,000 and 7,000 million by the end of the century should now be expected as a matter of certainty". What has happened is that the rate of mortality has been and is being reduced so spectacularly that the complex of causes which link mortality and fertility in these communities has not yet been able to operate, and the explosive growths in reproduction are taking place. How quickly the inevitable adjustment of fertility and mortality will be made is the main question and the assumption is that the U.N. demographers may have overestimated the lag.

In Western Europe the demographic trends have meant that an explosive rise in numbers has not taken place so that with the relatively slow growth in the totals considerable aging of the populations has resulted. In the Twenty-six Counties for example there was 3.1 per cent. of the population aged 65 and over in 1841 and 10.7 per cent. in the same age groups in 1951. It is true that at the same time the numbers of children under 15 fell from 38.1 per cent. to 28.9 per cent. so that the total which one might call "dependent" group fell from 41.2 per cent. to 39.6 per cent. of the population. Nevertheless such a group in the Twenty-six counties constitutes a larger proportion of the population than in most other countries. It is only 33.1 per cent. in England and Wales, 34.6 per cent. in Scotland and 37.5 per cent. in the Six Counties, 35.3 per cent. in U.S.A. and 33.8 per cent. in France. Thus, being high in the list both for the proportion of aged and of children, means that the proportion of the economically active in the community is notably low and this poses many problems. Of course this situation has arisen as a result of various factors but that of emigration of the population in the active age groups is perhaps the one which distinguishes the Twenty-six county economy from all others. In fact the situation as regards this "burden" of the non-gainfully occupied is likely to deteriorate, though not perhaps as rapidly as in other countries where the aging process has not gone so far, that is unless the emigration of the active continues at a very high rate. It is this fact of a distorted age distribution, more even than that the Twenty-six county population is stable or falling that is the most serious consequence of emigration.

He would hesitate to follow Mr. Mulligan in his international comparisons of the percentage of economically active among those 65 years or more. The classifications depend very much on the

social structure of the country. A man aged 70 may be returned as a Farmer and so classed as "economically active" despite the fact that he may personally be contributing very little to national product. In fact the results of the classification may be more an indication of the way in which the community is providing for the support of the non-working population than anything else. When the aged are maintained within the family structure they tend to be returned as economically active at Censuses of Population. When they live increasingly on their own savings the active proportion falls and when they are supported by social security measures then the proportion returned as active will be low.

Dr. E. A. Cheeseman, in seconding the vote of thanks, preceded his comments on the paper by drawing attention to the contribution which Mr. Mulligan and his colleagues at the General Register Office made to medical research work and to Queen's by providing speedily on request information which, although available in their office, was not routinely published. Because Mr. Mulligan was always prepared to help in this way a valuable spirit of co-operation had grown up between the medical school and the Registrar General's Department and it was to be hoped that this would long continue.

Although the paper raised many interesting problems, the speaker proposed to confine his remarks to the validity of using the proportion of the population above 60 or 65 as an index of the "dependency burden" imposed by old people on the rest of the community. Many old people live full and active lives and impose no burden, and the degree of the burden imposed by others varies. Such variation appears to be related, in ways at present ill-defined, to a number of medical, economic, social and possibly genetical factors. In a random sample of persons aged 60 and over in Northern Ireland Dr. Adams¹ and his colleagues interviewed 101 men in Belfast and 203 in other areas. The proportion of these in full time occupation was 51 per cent. in Belfast and 39 per cent. elsewhere. (The percentages are probably comparable with Mr. Mulligan's activity rates, which required definition). When Dr. Adams' data were analysed by age, the percentages in full time occupation were:—

	60-64	65-69	70-74	75-79	80+
Belfast . .	76.7	61.1	31.1	9.1	—
Other areas	64.7	43.5	32.8	19.4	5.9

Thus if it is accepted that men in full time occupation did not represent a burden to the rest of the community, there is evidence in these figures that the "dependency burden" varies with age over the age of 60 and with urban versus rural residence. Undoubtedly in addition to these factors there are others, so that the proportion of a population over an arbitrary age is never likely

¹ Adams, G. F. and Cheeseman, E. A. (1951), *Old people in Northern Ireland*, Belfast: Northern Ireland Hospitals Authority.

to reflect the true burden imposed by persons over that age and comparisons of such proportions between countries, in which the concomitant factors are differently represented, are bound to be misleading.

It is clear that more research is required. The paper to which Mr. Mulligan referred on chronological versus biological age contained a plea for studies to define and measure biological age. In effect, what is required is more information about the variation among old people of given age groups in their fitness, ability and desire for work. Some work has already been done in this field, for example by Drs. Hobson & Pemberton² in Sheffield, but much more is required and it is not, as the paper suggests, a problem solely for biometricians—economists, sociologists and medical workers have an equal if not more important contribution to make. The problem for future research is not how to obtain representative samples, in Northern Ireland at least we know this can be done, the problem is what should be measured.

² Hobson, W. and Pemberton, J. (1955), *Health of the elderly at home*. London. Butterworth & Co.