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Source: *Population (English Edition, 2002-)*, Vol. 57, No. 1 (Jan. - Feb., 2002), pp. 83-108
Published by: Institut National d'Études Démographiques
Stable URL: http://www.jstor.org/stable/3246628
Accessed: 29/01/2009 05:21

Law or Speculation?

A Debate on the Method of Forecasting Population Size in the 1920s

Henk A. DE GANS*

Some of the population forecasts made in the past have proved so wrong that critics might describe projections as demography's Achilles' heel. Yet in what other discipline does one dare to forecast the situation in 20, 30 or 50 years time, with a relatively narrow range of variation and with increasing accuracy? The pioneers of such a perilous exercise based their forecasts on universal "laws" of population growth, such as the logistic law, whereby the future was closely defined by the past. Another approach consists in predicting future trends in fertility and mortality schedules, in which case future population size is the result of variations in the age-sex-specific rates. This is the cohort-component projection method (CCPM) that is widely used at present, but was initially strongly contested. Henk de GANS *analyses here the origins and the background of the acrimonious debates over forecasting that lasted throughout the 1920s, and the factors that eventually led to the adoption of the CCPM approach.*

A dangerous fascination?

A forecast that is not dependent on personal judgement must be the ultimate dream of the forecaster. For a short while during the 1920s, the dream seemed to come true. A curve had been found, the so-called *logistic* curve, based on a mathematical equation, that seemed to fit observed past population growth almost perfectly. Future growth seemed to be determined only by its past course:

> "The contour of the extended or predicted portion of the resulting curve is fully determined by the past population figures, rather than by the judgement of the estimator. This very greatly reduces the play of personal

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An earlier version of this paper was presented at the European Social Science History Conference (ESSHC 2000), Session E-2: Population Science in Europe ca. 1900-1950, sub-session 1: Demography between science and policy.

> judgement in making predictions. The result has a dangerous fascination because the prediction seems to be growing out of the past and to be an inevitable statement of what the past implies for the future. Actually, however, the personal element is by no means absent, for in the preliminary work of fitting the equation to the observed data judgement and opinion play a considerable part." (Adams *et al.*, 1929, p. 110)

Adams, the author of this citation, was a regional planner made famous in the world of urban planners by his plan of New York and environs in 1928. This was the first regional plan made along the lines of the "survey before plan" concept which originated with the Scottish biologist Patrick Geddes (1854-1932). Geddes laid down the principle that no regional or city plan was to be made without thorough "preliminary planning research", that is without a socioeconomic and demographic survey. Adams's plan of New York became exemplary. It greatly influenced the authors of the well known General Extension Plan of Amsterdam of 1935 and of the innovative population forecast that underlay it. Positivist advocates of the "survey before plan" approach were convinced that, if applied well, it would result in a good urban or regional plan. The core of most surveys consisted of an investigation of past population trends and of a prediction of future population size, composition, and the resulting housing demand (de Gans, 1999a).

Adams spoke of a "dangerous fascination" with the logistic approach. The passage quoted above gives an excellent idea of the impression made at the time by the logistic growth approach. It helps to understand why the demographic approach to the calculation of the future size of population seemed to have difficulty competing with the logistic one. This is the subject of the following sections.

I. The re-invention of the law of logistic population growth

Adams had asked different teams of experts to forecast the population of New York and its region. One of these teams was that of Raymond Pearl and Lowell J. Reed, two professors at Johns Hopkins University in Baltimore, who in 1920 had introduced a new approach to the calculation of the future size of the population, the so called *logistic growth* approach. The calculations of Pearl and Reed made in 1923 for Adams's survey of New York rested on a mathematical theory based on a biological argument. The theory stated that

> "[...] there is a limit of population prescribed by economic forces such as food supply [...]; second, that when the rate of growth begins to retard, it will show a smooth curve similar but opposite to the curve for the earlier observed years; and third, that the growth of the city is dependent on a large number of interplaying forces, the future effect of which may be de-

termined from the results of their action in the past." (Adams *et al.*, 1929, p. 110)

Raymond Pearl, the man behind the new approach, was an American geneticist who was attempting to bring the science of population into the domain of biology. From the point of view of Pearl's theory of population growth, the influence of social and economic factors was always of a second-order kind. These factors could affect population growth only by operating through fertility, mortality and migration, which Pearl considered to be the three first-order variables, or primary biological forces(1). He was unwilling to see population growth as the product of a unique historical context. Of course, he knew that there were various environmental factors at work, such as the food supply, the economic situation in general, and social forces of various sorts in particular; but it should always be kept in mind "that these are all secondary factors from the biological point of view" (Pearl, 1927, p. 22). These factors set a limit on the ultimate population size, but their action could not be assumed to be constant in the future. According to Adams (1929, p. 110), Pearl and Reed did not presume to make predictions that would hold if radically different conditions affecting population growth arose, or if social and economic forces resulted in a new alignment. In making a forecast for an urban population, they simply postulated that it would also tend to develop along the lines of the logistic function.

Pearl gave a new impulse to the waning nineteenth-century Malthusian belief that the size of population is governed by a natural law. Malthus had posited that at a constant growth rate the population would increase exponentially. Demographers have criticized Malthus for the abstract universalism of his laws (Schofield and Coleman, 1988, p. 8). Malthus himself had been content to build conceptual models. Aware of their limitations, he did not expect them to prove universally applicable (Wrigley, 1988, p. 48). He did not consider whether populations actually grow at uniform rates over an indefinite period of time, nor whether the rate of increase is itself subject to change. Nor was he primarily interested in a law of growth. In his view, population tended to increase faster than subsistence, and thereby produce unsustainable results, whatever the rate, and regardless of whether the rate was constant or variable (Wolfe, 1928, pp. 677-678; also Ries, 1921). If the passion between the sexes was taken as a constant, it was safe to assume a tendency of populations to grow exponentially (Wrigley, 1988, p. 53).

Economists of the nineteenth century were not inclined to inquire whether the growth rate of the population was constant or not. They were mostly interested in the effects of population increase rather than in its modalities (Wolfe, 1928). The assumption of a constant geometrical growth provided them with an instrument to calculate the doubling time of

(1) Pearl does not consistently call migration a "biological" force. Elsewhere, he merely considers it a primary variable affecting the growth of human populations.

a population[2]. In the course of the nineteenth century Malthus's theory had gradually been accepted as a true law of population growth, though not always in a very rigid way. If population growth was determined by a natural law, then one could be confident of its future course. As long as this could be believed, official statisticians had no objection to accepting that the computation of the future size of population belonged to the domain of statistics. Such calculations would not undermine public trust in the reliability of the statistics produced by their statistical offices, which were their main concern.

The concern had its roots in the old adage of the Statistical Society of London, formulated in 1834, that the Society had been established for the single purpose of "procuring, arranging and publishing statistical facts"[3]. The adage became a guiding principle for many statisticians and statistical offices in Europe until well into the twentieth century. In the Netherlands, for instance, both the Amsterdam Bureau of Statistics (founded in 1894) and the Central Bureau of Statistics (founded in 1899) refrained from the business of population projections until the 1950s (de Gans, 1999b). The same guiding principle led J.H. van Zanten, the director of the Amsterdam Bureau of Statistics, to intervene in the discussion of the consequences of the continuing decrease of the birth rate of the main European countries at the 1930 Session of the International Statistical Institute in Tokyo. By demanding an official statement from the Board of ISI against population forecasting by statisticians and statistical offices, van Zanten succeeded in diverting the attention of his fellow statisticians from the issue at stake in favor of that of the responsibilities of the statistical community (de Gans, 1999a, pp. 108-111).

The "Malthusian law of population" permeated some influential German textbooks on city planning and architecture of the late nineteenth century (Baumeister, 1876; Stübben, 1890), and through these textbooks it influenced the practice of town planning in the Netherlands (de Gans, 1999a). Baumeister, for instance, was convinced that the growth of the population of big cities was governed by a geometrical law. He knew also that the law was not applicable in a general sense. From his empirical study of the growth of population of the most important cities of Germany in the period 1843-1871 he had learned that in some cities population growth had been slower than in others, and that sometimes it had even been interrupted. Forecasting the future development of population was, therefore, a problematic affair. Because the purpose of city expansion plans is to provide for the future, Baumeister advised to develop an approximate law of population growth from an analysis of statistical data

(2) The concept of the doubling time of population continues to influence demographic thinking to this day, as demonstrated by the title of an article by Lutz, Sanderson and Scherbov (1997) in *Nature:* "Doubling of the world population unlikely".

(3) "The Statistical Society of London has been established for the purposes of procuring, arranging, and publishing all facts calculated to illustrate the Condition and Prospect of Society" (Prospectus of the Statistical Society of London, as quoted in De Mast, 1998, p. 35.)

from the past. If necessary, the approximation could be modified, for it could not be taken for granted that the growth rate would remain constant. Once the growth rate was determined, however, the doubling time of the population, which was to serve as the time horizon of the municipal extension plan, could be calculated. Stübben held similar views on urban population growth. Population increase being the main reason for the extension of existing cities and the building of new ones, he advocated a prudent use of the law of geometrical growth and of the calculation of the doubling time of city populations in particular.

Adolphe Quételet was not at all convinced that the growth rate of populations was necessarily constant. He asked his compatriot, the Belgian mathematician P.F. Verhulst, to take up the question of the mode of population increase. In 1838, nine decades before Pearl and Reed, Verhulst "discovered" the mathematical formula of logistic growth (Verhulst, 1838; Wolfe, 1928; Dupâquier and Dupâquier, 1985). Half a century later, Price Williams questioned the practicalities of Malthus's law in a study of the increase of the population of England and Wales by stating that is was not necessary to refer to the checks on the increase of population resulting from the limited area for food production in the country. Things had changed since Malthus's time, through the large improvement of transportation resulting from steam navigation. He saw practically no limit to the area from which the food supplies of the United Kingdom could be obtained, so long as cheap and rapid communication with the great producer countries of the world was assured (Price Williams, 1880, p. 471). In France Leroy-Beaulieu held similar views at the time (Tapinos, 1999).

In the latter part of the nineteenth century it became gradually clear that Western population growth rates did not follow the Malthusian geometrical/exponential curve. Fertility started to decline almost uninterruptedly in most Western countries from about 1870, although absolute population growth continued to be high for a while. The decline of fertility in general, and its differential decline along social class lines in particular, fuelled social Darwinist thinking and resulted both in the eugenics movement and the development of mathematical statistics by the fathers of the movement, Galton, Pearson, Fisher and others.

1. Social Darwinism and the Eugenics Movement

The influence of Malthus has long been recognized not only in demography and economics, but also in the biological sciences through its contribution to the development of evolutionary theory by, among others, Darwin; its mathematical formulation by R.A. Fisher in 1930; and in the context of the regulation of animal populations, the work of Lack in 1954 (Schofield and Coleman, 1988, p. 8). In the emerging discipline of demography, Malthus's influence began to wane in the last decades of the nineteenth century, for it appeared that the forerunners in reducing the number of their offspring were the upper classes of society, and not the lower classes in which Malthus had placed his hopes (Soloway, 1990; Noordman, 1991/1992). The fertility reduction in the upper classes resulted in two related, though not identical, fears expressed by a heterogeneous group of writers, scientists and politicians. *Within* nations, an imminent eclipse of the elite was feared because the lower classes appeared to be the most prolific while the upper classes reduced their families; *between* nations, there was a fear of miscegenation and "pollution" of the sub-fertile indigenous populations by immigrants from more prolific nations.

The observed differential decrease of fertility affected the belief in Darwin's theory of evolution. At the end of the nineteenth century, the societal impact of Darwin's theory had gone much farther than its theoretical foundations could account for, presumably because of its prestige as a fruit of natural science. The theory turned into a metaphor of societal evolution, known as social Darwinism. Social Darwinism was founded on the belief that social development, the progress of society, was also determined by natural selection through the struggle for life (Noordman, 1991/1992).

Some social Darwinians, including Francis Galton, the father of the eugenics movement, became convinced that nature could no longer be trusted to take care of the improvement of the human race according to the principle of "the survival of the fittest," and that this had become a task for mankind itself. Although they did not question the validity of Darwin's theory of evolution, the course of demographic change led them to doubt the success of its operation and resulted in a pessimistic vision of society. The improvement of the probabilities of survival of people in poor health brought Galton to the conclusion that, as fitness was no longer a condition for survival, mankind was degenerating. He was concerned that high fertility was no longer a characteristic of the leading classes, which were thought to be the "fittest" in society. He was convinced that intelligence and other mental qualities were determined by heredity and that nature was superior to nurture. Progress required scientific control over human reproduction. The "fittest" members of society could be encouraged to marry and reproduce if given the right incentives (Kingsland, 1988, pp. 184-185).

Galton saw that eugenics needed a solid scientific basis if its programme of social engineering was to be accepted (Kingsland, 1988, p. 187). In the wake of Galton, Karl Pearson, his protégé and successor as the leading British authority on mathematical biology and eugenics, believed that if human evolution was to be controlled scientifically, the central concepts of natural selection and heredity had to be defined objectively, that is quantitatively. He considered his research into human variation and heredity to be thoroughly objective because its method was mathematical, even though the results of the research clearly supported the eugenics agenda. A similar link between scientific theory and eugenics can be seen in the research of Pearson's successor, Ronald A. Fisher, whose work was important in effecting a synthesis between Darwinian theory and Mendelian genetics in the 1920s (Kingsland, 1988, p. 188).

2. *The logistic curve and its attraction*

Interest in eugenics had stimulated the biological analysis of population growth. The question of whether populations actually behaved according to the law of geometrical growth was highly relevant to the debates taking place during the 1920s concerning the eugenic implications of differential growth rates. Pearl was not a fervent advocate of eugenics. He had come to the conclusion that the growth rates of Western populations were not following the Malthusian exponential curve, but were levelling off and tended to follow an S-shaped curve, which he called the *"logistic curve"*. He suggested that the logistic curve, which had proved to be a perfect fit of observed past population growth in several countries(4), was actually a law of growth, comparable to the laws of Kepler and Boyle. In his own words:

> "The net result of the first, or mathematical attack, upon the problem of population growth is to show that, with simple postulates as to the relations between the two first-order variables, birth rates and death rates, and the second-order variable, density of population, and without consideration of any other variables whatever, we are led rigorously to the conclusion that under these postulates the growth of population must necessarily follow that type of curve (the logistic) which is empirically found to describe the growth of actual populations of widely diverse organisms."(Pearl, 1927, p. 29).

In Pearl's view the logistic law was universally valid and depended upon an underlying biological mechanism, namely the inhibition of fertility by increased population density (Kingsland, 1988, p. 189; Soloway, 1990, p. 254). Biological populations, including human populations, had a self-regulating (homeostatic) propensity. From this point of view he saw the decline of population as a natural and beneficial result of urban overcrowding(5).

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(4) Pearl (1927, p. 26) refers to Sweden, the United States of America, France, Austria, Belgium, Denmark, England and Wales, Hungary, Italy, Norway, Scotland, Serbia, Japan, Java, the Philippine Islands, Baltimore City, New York City and the world as a whole.

(5) In this, Pearl followed Galton, Pearson and Fisher. Driven by an interest in eugenics and, consequently, genetics, these men had developed "biometry", a branch of mathematical biology, which was seen (by Galton) as "the application to biology of modern methods of statistics" or (by Fischer) as "the active pursuit of biological knowledge by quantitative methods" (Edwards, 1998, p.157). It was the beginning of mathematical statistics as well. Pearl's ambition was to develop a separate branch of mathematical biology, the "biology of groups". This was based on the conviction that populations obey a biologically grounded law of growth (Kingsland, 1988, p. 189).

Not for decades had a contribution to the theory of population commanded the attention that Pearl's logistic formula received. Adams's fascination is only one out of many examples of the impact of the logistic curve[6]. A contemporary, A.B. Wolfe, gave three explanations for its popularity: Pearl's prominence as a biometrician whose logistic formula was in line with statistical fashions; the extraordinary development of mathematical statistics, statistics being applied to all sorts of problems; and the new interest of biologists in human populations. The logistic "law" of population growth seemed to free twentieth-century society from the Malthusian fear of overpopulation. Wolfe blamed contemporary mathematical statisticians, whether in the natural or the social sciences, for reasoning too readily from a frame of mind in which empirical formulae were tacitly regarded as the laws that govern social phenomena. In doing so, they had brought a kind of "mystical virtue" to the logistic equation and its constants (Wolfe, 1928, pp. 679-680).

Neo-Malthusians were not over-enthusiastic about Pearl's law of logistic population growth, because of its underlying homeostatic implications. It suggested that a decrease of the growth rate was an automatic biological response to increasing population density. In consequence, birth control had no effect on population decline. The "contraceptive hypothesis" was therefore advanced as an alternative to Pearl's logistic hypothesis (Kingsland, 1988, p. 190). Some eugenicists were not enthusiastic either, for adherence to Pearl's theory implied a degree of complacency toward population growth. Although Pearl was convinced that heredity rather than environment played the main role in producing intellectual superiority, he suggested that the lower classes were able to produce superior individuals, who, given an opportunity for social mobility, would become valuable members of society. In his view there was no need to fear the high reproduction rate of the lower classes (Pearl, 1927).

3. Contemporary criticisms

Adverse criticisms of the Pearl-Reed formula came from three different directions[7]: from mathematicians and statisticians who saw defects in Pearl's mathematics of curve fitting; from economists who objected to the attempt to reduce a phenomenon so deeply influenced by human motivation and changing social environment to a mathematical formula; and from those who believed that general theory should rest on cultural premises. For the latter group, it had to be ruled out that a single factor could cause

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(6) In the Netherlands, for instance, 't Hooft (1929, p. 54); Lewandowski and van Dranen (1933).

(7) For overviews of adverse criticisms, see Wolfe (1928); Hiller (1930). See also the successive discussions on the merits of the logistic approach at the Annual Meeting of the Royal Statistical Society in 1924 (Discussion, 1925, pp. 76-90) and at the World Population Conference of Geneva in 1927 (Sanger, 1927, pp. 39-59).

varying rates of growth; any valid theory would have to involve distinctive types of causal factors for different social groups, and assume that varied combinations of material and nonmaterial cultural elements might account for observed trends in statistical data, which measured but did not explain the processes involved.

II. A competing approach: The emergence and diffusion of demographic forecasting methodology

Adverse criticism came also from the advocates of a competing approach to the calculation of the future size of population, that was later called the Cohort-Component Projection Model (CCPM). The foundations of the demographic method[8] were laid by the English economist Edwin Cannan in 1895, although the greater part of the underlying analytical-demographic apparatus had been developed long before. His rudimentary CCPM approach was the beginning of demographic forecasting. A century after its first appearance, the method is still widely used at the beginning of the 21st century, although it has now lost its predominant position as the standard projection model[9].

Like the logistic curve, the demographic approach was re-invented in the 1920s. The focus was first on understanding the mechanism of population dynamics: How do the separate components of population growth contribute to total population growth? What is the part played by the interaction of population composition (age-sex structure) and the various growth components (mortality, fertility, migration)? The next task was to understand the interaction between socioeconomic and demographic processes and, in the case of long-term projections, form a view (theory, expectation, belief) of where future population development is headed. In its simplest form, demographic forecasting consists of the calculation of the future size of population on the basis of extrapolations of the time series of the crude birth and death rates *(component projections)*; in a more elaborate form it consists of calculations based on an initial population by age and sex, and on the extrapolation of observed time series of age-specific rates (occurrence-exposure rates) of the components of population growth:

(8) Dutch interwar population forecasters distinguished between a "demographic" and an "economic" method. The latter was directed at the estimation of future migration at the urban and regional levels in particular. Urban and regional population forecasters preferred the application of the economic method but practicalities of time and money, as well as the complexity of its application, imposed the continued use of the demographic method (de Gans, 1999a, ch. 7).

(9) An interesting overview of the strengths and weaknesses of the cohort-component projection model (CCPM) and an explanation of why demographers hold on to the use of CCPM is given by Burch (1999).

mortality rates, fertility rates and eventually — particularly at the urban and regional levels — migration rates.

The cohort-component projection methodology was developed because of a dissatisfaction with the standard geometrical law approach. New insights were derived from the increasing number of available time series of population statistics that undermined the belief in a constant growth rate and, consequently, in the law of geometrical growth. In its stead came the disquieting conviction that the future of population was open to speculation. G.B. Longstaff (1891) pointed out that keeping the rate of increase of the previous decade equal to that of the next decade, as England's Registrar-General was doing, implied that a number of contributing causes, each one of which was known to vary, would combine to produce a constant result. Cannan (1895, p. 508) showed that the continued use of the geometrical method would lead to bizarre situations. The geometrical method of estimating future population was also under discussion elsewhere than in England. C.L. Wilbur, the Head of the Division of Vital Statistics of the Department of the State of Michigan (USA) wrote to Cannan in 1898 that he thought it mathematically absurd to employ the geometrical system, with its fundamental postulate of increasing numbers, when successive censuses demonstrated clearly that the decennial rate of increase was decreasing. "The result is a series of 'faults' at the close of the successive decades that in no wise exist in the statistics themselves" (Wilbur, as quoted in de Gans, 1994, p. 346 fn. 28.)

1. Emergence and diffusion of demographic forecasting in the 1920s

Cannan's new approach rested on the principle that the direction of future population change can be reliably predicted from the interaction of population structure, as recorded by ten-year age groups in a census, and cohort survival ratios computed from the comparison of age groups in successive censuses of England and Wales (Cannan, 1895; for a discussion: de Gans, 1994). The success of such an approach was demonstrated by another pioneer of the first generation of modern population forecasters, Harald Westergaard (1908). The formal foundations of population dynamics were laid at about the same time by Alfred Lotka (1907) as he began to develop stable population theory (Dupâquier and Dupâquier, 1985).

The new approach enabled Cannan in 1895 to demonstrate that an imminent non-catastrophic end to further growth of the population of England and Wales was likely, and helped Westergaard to present to an audience of statisticians at the 1907 Session of the International Statistical Institute in Copenhagen an impressive prediction of what was later to be called the demographic transition, as well as a discussion of the consequences of regional differences in the pace of that transition in Europe in terms of the aging of the labour force and the composition of the migration flow from Europe to the United States of America (Westergaard,1908)(10). Using a component approach based on sound demographic analysis, Fahlbeck (1905) forecasted a continued decline of fertility, and showed that this could ultimately result in a negative growth rate at the end of the twentieth century.

Demographic forecasting took off in earnest during the 1920s through the activities of a new generation of methodological innovators. The literature on the history of modern population projections often considers that the English statistician A.L. Bowley was at the origin of the (re)emergence of cohort-component projections after World War I (de Gans, 1999a). Bowley was a former student of Cannan at the London School of Economics and Political Science and he had been impressed by the diagram that underlies Cannan's forecast of the population of England and Wales. With his 1924 projection Bowley wanted to work out the future age distribution and size of the population under the clearly defined hypotheses of a constant number of births and of unchanged death rates. Nowhere did he imply that such constancy was anticipated; he merely said that it was interesting to inquire what birth rate was necessary to prevent a decrease of population, and what the ultimate age distribution would be in a population in which the number of births was constant and the death rates stationary (Discussion, 1925, pp. 80-81). Bowley wanted to contribute to the public discussion on the consequences of the observed decrease of fertility in Great Britain by applying stable population theory. As would become customary in European projections during the interwar period, international migration was not taken into account, and the actual future population size would always be less than the calculated one because emigration was left out of the computations. (An immigration surplus was unthinkable then.) Bowley concluded that with the level of the birth rate of the years 1921-1923, the population would ultimately decrease, unless the death rate fell further (Bowley, 1924).

Because Bowley's projection was featured prominently in the discussions on the best and most reliable methods to calculate future population size that took place at the 1924 Annual Meeting of the Royal Statistical Society and at the 1927 World Population Conference, it is understandable that his contribution is given an eminent position in the history of projections. It is less known that better and more sophisticated forecasts were made independently in other countries, particularly the Netherlands, at about the same time or even earlier(11). From the point of view of the intellectual history of CCPM forecasting, Dutch national population forecasters such as Oly in 1924, Wiebols in 1925 and 't Hooft in 1926 occupied

(10) Even the process of sub-urbanization and its consequences were addressed.

(11) Strumilin (Soviet Union) may have made a CCPM-like projection as early as 1922. Early projections were made in Sweden by Cramér in 1925 and Wicksell in 1926; in the United States by Lotka in 1925 and Whelpton in 1928; in Italy by Gini in 1926, followed by Felici Vinci in 1927; in Germany by the Statistisches Amt in 1926; and in France by Alfred Sauvy in 1928 and 1929 (de Gans, 1999a, pp. 96-97).

the vanguard of the innovation movement together with Bowley (de Gans, 1999a). As was the case with Bowley, population forecasting in the Netherlands focused on the future size of the national population. The motivation of the Dutch forecasters came from the need to give a sound objective, empirical, and non emotional foundation to the national debate on the population problem(12). The debate originated in the fear of overpopulation among leading Dutch economists, in the face of the persistence of a high growth rate of the Dutch population in the years after the First World War and a bleak economic outlook in the early 1920s (van Praag, 1977).

The 1924 forecasts of Bowley and Oly are strikingly similar. In terms of modelling there are hardly any differences. Both started from stable population theory. In both forecasts life table probabilities of survival were used, which was an innovation in comparison to Cannan who had used "survival-in-England-and-Wales" ratios (de Gans, 1994). The differentiation between the male and female parts of the population too was a novelty. With respect to fertility both started from the assumption of a constant future number of births. Oly was also interested in getting an idea of the range of future population sizes by calculating a lower variant as well, assuming a decrease of the birth rate from 26 to 18 per thousand in the next 40 years. In doing so he was the first to calculate alternative futures of the Dutch population (de Gans, 1999a, pp. 94-95).

Wiebols went a few steps further in the development of CCPM methodology. Starting from the age/sex structure of the most recent population census he assumed dynamic survival rates and general fertility rates. He would have preferred to use age-specific fertility rates but was not able to do so because the required data were not available in the Netherlands. Wiebols even developed the theoretical structure of an urban population forecasting model where marital status and in- and out-migration were accounted for (de Gans, 1999a, p. 27). Further methodological innovations were initiated by city planners during the 1930s, as part of their search for a better socioeconomic foundation for city expansion plans. This resulted in the impressive forecasts of van Lohuizen and Delfgaauw for Amsterdam (Grondslagen, 1932) and Angenot for Rotterdam (1934). They demonstrated that hypotheses on migration could easily be incorporated into the CCPM approach. Angenot was the first forecaster in the Netherlands, and perhaps in the world, to introduce a matrix notation and matrix mathematics into population projections, in the presentation of results for the male and female immigration surplus population (Angenot, 1934). In principle, his simplified matrix approach lent itself to further specification for urban, regional and national populations, but it lacked the clarity and transparency of Leslie's model (de Gans, 1999a, p. 209). In terms of formal modelling the CCPM approach would reach its apex in 1945, when P. H. Leslie

(12) Basically, the debate in the Netherlands on the population problem focused less on the issue at stake, namely the considerable population growth, than on the moral and ethical implications of neo-Malthusianism with respect to the limitation of family size.

noted that the cohort-component forecasting model could be written as a system of simultaneous linear equations, presented compactly as a matrix multiplication (Willekens, 1990, p.19).

2. *The fear of speculation*

The shift to demographic forecasting, whether mere component or CCPM-like forecasting, at the turn of the nineteenth century implied a loss of confidence in the apparent certainty provided by the geometric law of population growth. There are several indications of an unwillingness to renounce the belief in the law of exponential population growth and to accept an approach based on the knowledge of population dynamics, i.e. the interaction of population composition (age-sex structure) and the age-sex specific components of population change. The indications date as far back as the time of the first emergence of demographic forecasting and can be found among economists, statisticians and actuaries. The Registrar General's Office of England, for instance, stubbornly persisted in using geometrical growth methodology, ignoring a growing number of signs that the hypothesis of a constant rate of population growth did not conform to reality (Cannan, 1898). Both Cannan (1895) and Westergaard (1908, p.104) referred to the difficulty the statistical and actuarial establishment had to accept the fact that there was no such thing as a law of population. C. A. Verrijn Stuart, the leading statistician of the Netherlands, thought it necessary to state explicitly that there was no fixed, unchanging law of mortality (Verrijn Stuart, 1910, pp. 268-287; 1928, p. 364). In France the distrust in the existence of a Malthusian law of population growth had important consequences. The lengthening time series of vital statistics demonstrated that the growth rate was not constant, and it was no longer possible to make accurate calculations of the doubling time of population. For that reason Jacques Bertillon, the leading French statistician and demographer of his time, concluded that it was better not to try at all to predict the future. Population forecasting was completely abandoned until the late 1920s (Lachiver, 1987, p. 39). Because of this negative attitude France played no part in the methodological innovation in forecasting until the late 1920s.

The ambivalence with respect to demographic predictions is reflected in the reception by fellow statisticians of Westergaard's predictive scenario of the demographic transition in Europe. Verrijn Stuart, for instance, was impressed by the imaginative qualities of Westergaard's contribution but he dismissed it because of its speculative character (Verrijn Stuart, 1910, pp. 286-287). Only much later, when longer time series of birth and death rates were available and demographic forecasting had become common practice among statisticians and even in statistical offices, did Verrijn Stuart start to mitigate his harsh opinion of 1910 by speaking of the "somewhat speculative nature" of Westergaard's paper (Verrijn Stuart, 1928, p. 344). The ambivalence is also reflected in the views of the pioneers themselves, who were firmly convinced of the contribution of their analytic approach to future population development, but at the same time were overzealous in emphasizing the speculative quality of their efforts. Cannan made it quite clear that he had no desire to put his reputation at stake by prophesying that the growth of population would follow exactly the line resulting from his calculations. He merely intended, so he professed, to show the direction of the development of future population, though his confidence rested on the conviction that his line was more probable than the one laid down by the "official" method of the Registrar General's Office. Fahlbeck considered his graph of the observed and extrapolated birth and death rates a mere conjecture, "a prognostic". Westergaard's use of the term "horoscope" speaks for itself. Many years later Kuczynski concluded that at its best the result of a projection could be seen as "a reasoned guess" (Kuczynski, in Honey, 1937, supplement: "Abstract of the discussion"). In fact, accentuating the speculative character of demographic projections was a common element in all the innovative forecasting efforts of the first decades of the twentieth century.

III. Logistic law versus demographic speculation

It is not unrealistic to characterize the process of emergence, international diffusion and acceptance of cohort-component population projection methodology and its application in planning as a success story. This is completely at odds with the impression one might get from the mere study of the discussions on the future size of population at the influential Annual Meeting of the Royal Statistical Institute in London (1924) and at the World Population Conference in Geneva (1927). On these occasions there was a direct clash of opinions between adherents of the logistic and the demographic approaches.

The confrontation took place against the backcloth of a temporary rise of fertility in the years following the war, and of the gloomy economic conditions in Europe resulting from the devastations of war and the long term effects of the Treaty of Versailles which had formally ended World War I (Skidelski, 1992). For a while the fear of overpopulation was looming. When at the end of the 1920s the resumption of the drop in the birth rate had become manifest, the opposite fear emerged, that of population decrease and even race suicide. The fear acquired momentum after the publication of Kuczynski's work on *The balance of births and deaths* (1928), which caused great shock in Western societies. By applying the concept of Net Reproduction, Kuczynski demonstrated that the major nations of Europe, France, Germany and England, were no longer reproducing themselves, and that population decline was at hand, leading to the prospect of extinction. Nearly all of the literature of demographic future studies in the 1930s, whether scholarly or popular, was based in one way or the other upon Kuczynski's Net Reproduction Rate (Soloway, 1990, p. 234). The seed of the ensuing race suicide panic in England had already been planted by Bowley's cautious projection of 1924, from which he concluded that a decline of the population was imminent (Bowley, 1924)(13).

Pearl's logistic "law" found many advocates in the 1920s; among them were eminent mathematicians, statisticians and biologists. This is not surprising in itself, because the logistic equation had been shown to fit past population growth quite well for several countries. It was also a convincing model of what is happening to biological populations in general and human populations living under specific economic conditions in particular. The logistic law seemed much more realistic than the law of geometrical growth. Moreover, to those living under conditions of high population growth the homeostatic character of the logistic model opened the possibility of a brighter future than the bleak vision of traditional Malthusianism, at least for those who were open to optimism. Experts from the biological sciences demonstrated that the Malthusian demons of overpopulation (war, pestilence and starvation) were not necessarily lurking at the end of the demographic road. Populations could take care of themselves by keeping their growth in balance with the means of existence in a different way. This state of mind is convincingly demonstrated by a question that was raised by one of the participants in the discussion that followed Pearl's presentation at the World Population Conference of 1927, namely whether Professor Pearl considered that his theory, and the data available to him, gave him reason to suppose that the population of a given area may come to decline

> "in a relatively orderly manner without catastrophes such as famine or war, because if, I say deliberately if, any regions of the world are overpopulated, we must undoubtedly hope that their population will decline in that manner rather than catastrophically." (J. B. S. Haldane, in: Sanger (ed.), 1927, p. 39).

Pearl answered that the clearest possible evidence existed that at various times and places in the past history of the world there had been gradual and non-catastrophic declines in the numbers of certain populations, but it was a mistake to suppose that catastrophes fell outside the scope of the logistic theory of population (Pearl, in Sanger (ed.), 1927, p. 55).

1. The concept of law: Two interpretations

It is easy to understand why the public impact of the belief in the new law of logistic population growth was so considerable. However, because the concept of "law" is not an unambiguous one, some explanation

(13) The anxiety with respect to the future of the population resembled the panic of two generations earlier at the time of Cannan's 1895 forecast of the population of England and Wales (Soloway, 1990, p. 232).

and elaboration are in order. We start from an interesting discussion of the concept given by a contemporary, the French sociologist Bouthoul (1935, pp. 222-223). In his view forecasting and scientific law are conflicting concepts. They stem from two different interpretations of the concept of law and lead therefore to two different views of forecasting and of the role of the forecaster.

In the first, rather naïve interpretation, the concept of scientific law describes a uniform development which takes place according to a pre-existing plan. This notion of a universal law of nature is associated with science at least since the seventeenth century and it is still taken for granted in much of twentieth-century philosophy of science. Giere (1999, p. 23) holds that the original view of science as discovering universal laws of nature had its basis in the actual practice of science, but was imported largely from theology. According to theology God had laid down the laws of nature and human conduct. The task of the natural philosophers was to discover these laws, which were of course universal. In spite of its theological origins, the idea of universal laws of nature provided a powerful resource for Enlightenment philosophers. If the laws of the universe could be discovered by human reason alone, what need was there for priests and ultimately for God? (Giere, 1999, p. 24).

In this view of science, the concept of law implies that the future is predetermined, and the task of science is merely to uncover what has already been set forth. Thus, in population forecasting, once the law that governs the course of total population is discovered and its mathematical expression known, its future course can be determined *with certainty* and almost without the intervention of the forecaster's judgement. It is this interpretation of the concept of law which underlies the classical approaches to forecasting (geometric/exponential as well as logistic), as exemplified by the attitude of Thomas Adams (see section 1)[(14)].

In the second interpretation given by Bouthoul, a scientific law is a *relational* concept. This view assumes the existence of a relationship between two different orders of facts, that is neither arbitrary nor accidental and has a more or less permanent character. The combination of two orders of facts brings about a specific reaction that can be known, specified and predicted. Applied to forecasting, the second concept of law means the recognition that order exists, but also that no unique, unavoidable direction follows from the course of the phenomena involved. A change of direction results from changes of the interplay of the main influencing elements, either by the occurrence of new elements, by the repression of existing elements, or by variations of their numbers, intensity, frequency,

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[(14)] Of course, the concept of law of nature itself is questioned in the current philosophy of science. In the view of *social constructivism,* for instance, the very idea of law of nature does not make sense; or the idea makes sense but there simply are no such things; or whether there are laws of nature or not makes no difference to an understanding of how science works (Giere, 1999, pp. 58-59).

and so forth. Consequently, to retain its scientific character, a forecast must involve reservations at the very moment it ventures into the domain of the future, even if all the relevant factors, facts and influences pertaining to a phenomenon in a specific field have been inventoried. Such a reservation is always of the "*ceteris paribus*" type.

In this interpretation the concept of "law" is part of what the logical positivist view of science sees as the logical structure of the scientific method (i.e. the sequence Observations/Facts→ Hypothesis→ Experiment→Law →Theory). A law shows a functional relationship between two or more kinds of events, but a theory is needed to tell why the relationship exists (Casti, 1989, p. 13). Applying this to the study of future populations, one cannot make long-term forecasts without a theory of where a population is headed in the long run. Examples of such theories are the demographic transition theory or the theory of demographic parallelism (de Gans, 1999a, pp. 55-59).

Currently the concept of theory itself is questioned in the philosophy of science. The model-based approach to science prefers not to make a sharp distinction between a model and a theory. Giere (1999, pp. 167-168) for one suggests that if one wants to stay close to actual scientific practice, it is better to understand the word "theory" as including both a cluster of models and a broad range of hypotheses utilizing these models. He prefers therefore to speak of a "constructive realistic approach" to science; "constructive" because it sees models as humanly constructed abstract entities and "realistic" because it understands hypotheses as asserting a genuine similarity of structure between models and real systems. For Giere, the primary representational device in science is not the law but the model, of which there are three types: physical models; visual models; and theoretical models (Burch, 2001). Starting from this point of view both Malthus's exponential growth formula and Pearl's logistic curve are models rather than laws or theories, that describe the trajectory of the growth of some populations during specific periods of time.

The distinction between the two interpretations of the concept of law is useful, though one should be cautious in attributing the first interpretation of the concept to the leading proponents of the logistic approach who were directly involved in the methodological discussion: G. Udny Yule, who elicited a reaction from Bowley in London in 1924, and Raymond Pearl who crossed swords with R.A. Fisher in Geneva in 1927(15). It is easier to attribute this interpretation to those adherents who were less well versed in the intricacies of science and mathematics(16).

(15) The main participants in the debate mentioned, Bowley excepted, stood in the tradition of the English biometrical school of mathematical statistics and genetics. Pearl and Fisher were geneticists. In his younger years Yule had found an inspiring teacher in the geneticist and mathematician Karl Pearson and had made fundamental contributions to the theory of statistics himself (Kendall, 1970).

(16) See, for instance, fn. 7.

2. *London, 1924*

At the Annual Meeting of the Royal Statistical Institute in January 1924, G. Udny Yule delivered the keynote lecture on the subject of the growth of population and the factors controlling it. In his lecture he demonstrated the goodness of fit of Pearl's logistic curve. Although Yule repeatedly stressed that he was not concerned with prediction (Yule, 1925, pp. 9, 11), he presented himself as a fervent advocate of the logistic law of population growth which he saw as superior to the demographic method advocated by Bowley.

> "But the illustrations I give are, I hope, sufficient to show that the law is quite capable of representing the growth of a population over what is humanly speaking a fairly long period of time." (Yule, 1925, p. 22)

In Yule's view one could safely assume that a population growing on a limited territory tended to follow the logistic law. Although he explicitly stated that he had no intention whatever of presenting the limiting population values of his logistic curve as prophecies and that he was not concerned here with prediction, he could not escape the temptation of comparing these values with the results of the endeavours of Cannan, whom he blamed for having been a false prophet, and of Bowley. The comparison brought him so far as to warn against the risks of prediction (Yule, 1925, pp. 8-11; Discussion, 1925, p. 80). He concluded that he had added little that was actually novel, given the work of Verhulst and, more recently, the contributions of Pearl, Reed and others. The outcome of all these contributions exhibited the growth of population "as a biologically self-regulating process; indeed, a process of which the regulation is extraordinarily sensitive" (Yule, 1925, p. 40)

At the December meeting, where the issue of "The laws governing population" was discussed again, Bowley deplored that so much prominence had been given to the logistic equation(17). He acknowledged that the logistic method had the merit, and exposed to the danger, of mathematical neatness and that it expressed what might be regarded as a fundamental law of population — that is, that population cannot increase indefinitely in a constant geometrical progression(18). Bowley was of the opinion, however, that there was no reason *a priori* to justify the use of the logistic function which was "purely empirical" (Discussion, 1925, p. 76). This meant, basically, that Bowley blamed the logistic approach for being "data driven" instead of "theory driven". In Bowley's view one was asked to accept the logistic approach because of one argument only, namely that it gave results which were in agreement with the records of certain populations.

(17) From the Proceedings of the Discussion one gets the impression that Yule was not present at this meeting. If this is true, there was no direct confrontation between Yule and Bowley (See Discussion, 1925).

(18) Bowley's remark is another example of the impact Malthus's law of geometrical population growth must have had until after World War I.

3. *Geneva, 1927*

Raymond Pearl took a prominent part in the World Population Conference. He was one of the key scientists present and delivered the opening lecture on "The Biology of Population Growth" in which the curve-fitting merit of his logistic method was central (Pearl, 1927). The initiative for the organisation of the World Population Conference of 1927 was taken by a group of biologists headed by East, Little and Pearl, all well known in eugenics circles. But it was in large part to the credit of one person, Margaret Sanger, that the conference could be organised. Sanger was a politically astute advocate of birth control and of the right of women to determine whether they will bear children, and how many. She had been the driving force behind the National Birth Control Conference of New York in 1921 and the sixth International Birth Control and Neo-Malthusian Conference of New York in 1925. Her successful organization of conferences was due to the wealth of her husband, her easy access to funds because of her many social contacts and, last but not least, to great organising ability (de Gans, 1999a).

The aim of the Geneva conference was to launch an international discussion on the population problem and on population science in which biologists, physicians, sociologists, economists, statisticians and politicians would participate. The focus of the conference was the problem of the continuing increase of population which was sharply felt by various nations and seen as a menace to the future.

In the discussion following Pearl's lecture the approach of Bowley found an advocate in the person of R. A. Fisher (Fisher, in Sanger (ed.), 1927, pp. 43-46). Fisher began his intervention by stating that Yule's calculations of the population of England and Wales by fitting a number of logistic curves had shown the limitations of the logistic method. Fisher granted that the logistic equation provided an excellent curve for the interpolation of total population over short ranges, "provided we have not any other important relevant information" (Fisher, in: Sanger (ed.), 1927, p. 45). But, so continued Fisher, whilst Bowley's demographic method allowed for a future decrease of population after a period of increase, the logistic did not. Presumably referring to the efforts of Cannan and Bowley, Fisher pointed out that population censuses provide relevant information on the age structure, an information of greater significance than the population totals themselves. These census data allowed for much more accurate predictions than those that could be made from any curve (including the logistic one) of population totals only and it would be foolish to ignore the existence of such data. On the basis of these data one would arrive at very different conclusions from those indicated by the logistic curve (Fisher, in Sanger (ed.), 1927, p. 45).

In fact, Fisher suggested to concentrate on the study of population dynamics as the cause of changes in total population size. One recognises in Fisher's argument the dilemma between modelling for strictly scientific purposes, directed at the understanding of the processes of future population change, and applied forecasting where the main issue is to make extrapolations that fit observed trends as accurately as possible. Pearl defended himself by answering that Fisher had mainly addressed the use of the simple logistic curve for predicting the future growth of a given population, while he, Pearl, in his specific example of the population of England and Wales, had only claimed that these populations had closely followed the logistic curve so far as their accurately recorded history went. This was a simple statement of fact, which was very different from saying that these populations would in the indefinite future continue to follow the same particular logistic path. He denied having ever been guilty of so rash a prophecy. He had always felt compelled to take the position that, if and when there was clear evidence that the conditions which generated particular logistic curves changed, it would be necessary to examine all the data anew to see whether the whole recorded growth of the population could be described by a different logistic curve, or whether it would then be necessary to resort to some entirely different form of mathematical representation of the facts. Pearl granted that Fisher was right in his criticism that the simple logistic curve did not account for population growth followed by a decline (Pearl, in: Sanger (ed.), 1927, pp. 55-56).

Given our knowledge of the success of CCPM in becoming the new standard method of population projection, we would expect it to have found a number of advocates in the discussions of 1924 and 1927. This was only partially the case. In London, T.H.C. Stevenson of the Registrar General's Office, who opened the discussion at the December meeting of the Royal Statistical Society with an introduction on "The Laws Governing Population", regarded Bowley's article as an interesting statement of the direction in which present conditions were leading, rather than as a serious attempt to forecast the future (Stevenson, 1925, p. 63). Wholehearted support came from Greenwood, who thought that Bowley's method was right in principle, but that allowance ought to be made for the improvement of mortality rates, and further for a declining birth rate (Greenwood, in Discussion, 1925, p. 86)[(19)].

Perhaps the most striking feature of both discussions is that neither Yule, who definitely was familiar with Bowley's article, nor Pearl, who refers to Yule's article, appeared to be inclined or able to evaluate the merits of the CCPM approach. It is also possible that Pearl was on the defensive because of Fisher's critical interventions. However, it is very likely that Yule and Pearl were blind to the promises of Bowley's CCPM approach because they were convinced of the law-like fit of the logistic function to

[(19)] "...it was no doubt foolish to suppose that any statistical method would enable one to predict the population of a country at some remote epoch, but quite sensible to believe that an extrapolation, based on observation of the way death-rates and birth-rates were actually changing, would give an estimate of population ten or twenty years ahead not likely to be very remote from the truth." (Greenwood, in: Discussion, 1925, p. 86).

actual population trends and of what this implied for the prediction of the future[20].

4. Why demographic forecasting prevailed

The resistance to the new demographic methodology of population forecasting had little to do with a reluctance to accept the use of the mechanism of the relationship between the age-sex structure and the age-sex specific rates of fertility, mortality and migration, or with the remoteness of forecasting horizons. Population futures, whether one used the demographic method or applied a law of population growth, generally had remote horizons. It is clear from their reactions that the leading proponents of both the demographic approach (Cannan, Westergaard or Bowley) and the logistic law approach feared being blamed for predicting or prophesying. Apparently, this fear did not pertain to logistic futures of the population as long as it could be believed that they were based on a natural law. It was the speculative nature of demographic forecasting only that was seen as a major problem.

A few years after the World Population Conference, demographic forecasting seemed to emerge triumphant at the Tokyo conference of the International Statistical Institute (ISI) in 1930, where the consequences of the decrease of the birth rate were among the main items discussed. This is small wonder. In Geneva Raymond Pearl had been the key person. The Tokyo conference, however, had been organized by the Board of the Statistical Office of ISI. Here Bowley and the Dutch statistician Methorst, who was another advocate of the demographic method, played a major role (de Gans, 1999a). Neither the papers presented nor the resulting discussion paid much attention to the logistic law. Basically, the ISI conference demonstrated that CCPM had found general acceptance as the new standard method in population forecasting.

There are several reasons why CCPM, the demographic forecasting approach, got the upper hand in the end. At the time of the debates at the Royal Statistical Society in 1924 and the World Population Conference in 1927, many influential statisticians and statistical offices in various European countries were already involved in projections along the lines of the cohort-component approach. Moreover, between 1927 and 1930 Kuczynski's book on the balance of nations had been published. Kuczynski's use of the Net Reproduction Rate made it clear that a proper knowledge of the levels of age-specific rates of fertility and mortality was paramount for an insight into where populations were headed. Kuczynski's book made un overwhelming impression and convinced many students of population of

[20] An intervention at the World Population Conference of Geneva that could be interpreted as supporting the demographic approach came from the Dutch statistician H.W. Methorst, but the intervention took place in a different session from the one where Pearl and Fisher crossed swords (de Gans, 1999a, p. 103).

the predictive power of the NRR. The NRR might well have been instrumental in the propagation of the application of the CCPM approach in population forecasting, for CCPM started also from age-specific fertility and mortality rates. The fact is that the authors of almost all the Tokyo papers on the issue of the consequences of the continuing fall of the birth rate that gave the results of demographic projections for specific countries appear to have been familiar with either the concept of replacement or of its counterpart, the concept of intrinsic growth (de Gans, 2001). Last but not least, in 1931, only one year after the Tokyo Session of the ISI, on the occasion of the second general assembly of the International Union for the Scientific Investigation of Population Problems in London (the successor of the World Population Conference), Alfred Lotka demonstrated that it was possible to construct a unified formal model wherein the logistic and cohort-component characteristics were integrated, by dealing expressly with the characteristics of a population growing according to the logistic law (Lotka, 1932).

Another important factor was the relative simplicity of the mathematics of the demographic approach. The CCPM approach could be applied easily by forecasters lacking a sound mathematical training (Burch, 1999). Although the calculations were labour-intensive before the era of computers, the calculation schemes of the model are relatively simple. In the first part of the 1930s Dutch city planners found that migration could also be integrated in the computations and demonstrated that forecasts along the lines of CCPM could be used for the estimation of future housing demand by applying age-specific headship rates. This furthered the diffusion of the CCPM approach and its use as a planning and policy making instrument in urban and regional planning during the decades following the Second World War.

Conclusions

Should one consider only the discussions at scientific meetings on the future course of population and on the method to predict it, one would be tempted to conclude that the cohort-component method of projection did not easily find general acceptance. From its emergence in the mid-1920s the demographic approach had to compete with the revitalized belief that the course of population was governed by a natural law in the form of Pearl's law of logistic population growth.

The belief in a law of geometrical population growth which had been very much alive in the nineteenth century had weakened at the turn of the century. New insights into the dynamics of population due to the improvement of official statistics and the increasing length of time series had demonstrated that the growth rates of populations were not constant.

Because of its origin in the natural sciences and the status of its propagators in statistics and population science, and because of the public interest in the application of mathematical statistics to all kinds of problems, the logistic growth methodology made a deep impression. The logistic law had homeostatic properties, and it fit the time series of observed population growth in the past decades very well. It did not matter that, apart from providing a very general theory about the behaviour of populations in a fixed environment under fixed conditions, the logistic law lacked the ability to forecast a decline of population, and did not contribute to the understanding of the underlying dynamics of population change, at least until Lotka showed, in 1932, that it was possible to develop a unifying model.

Because of their inclination to stress the speculative nature of their calculations and to protect themselves against accusations of being false prophets, the early pioneers of the CCPM method of forecasting made themselves more vulnerable to such criticisms than was strictly necessary. The 1920s debate on the method of forecasting population was initially a debate between biology and demography. It is not far from the truth that the discussion between Pearl and Fisher at the World Population Conference took place on the sidelines of the field where the actual innovations of population forecasting methodology were occurring. A striking aspect of the discussions of 1924 and 1927 is that the leading proponents of the logistic law approach, Yule and Pearl, were unwilling or unable to see the merits of CCPM as a forecasting instrument or did not consider it appropriate to pay attention to its merits.

Some of the guardians of official statistics refused to get involved in this kind of forecasting. In the Netherlands, for instance, where forecasters were in the vanguard of the CCPM approach, the innovation was almost completely left to people outside the statistical establishment. In several countries, however, well-known statisticians and statistical offices were making CCPM-like forecasts. Those who were familiar with the field knew that demographic forecasting was gaining ground.

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DE GANS Henk A.– **Law or Speculation? A Debate on the Method of Forecasting Population Size in the 1920s**

The interwar period witnessed the emergence, diffusion and international adoption of population forecasting in the form of the cohort-component projection methodology. The interaction of population structure by age and sex and age-sex specific rates of the components of population change, mortality, fertility and migration, was used to indicate the most likely future course of national populations. However, right from the beginning the demographic approach was challenged by a revival of the belief that the future course of population is governed by a law. The belief was based on the (re)discovery of a homeostatic model, the so called law of logistic population growth. The logistic approach to population forecasting was advocated by the American geneticist Raymond Pearl, who introduced it in the 1920s. It replaced the 19th century Malthusian law of geometrical population growth. The decade of the 1920s witnessed the confrontation of the "logistic law" and "demographic" approaches. This article discusses the background and context of the confrontation of the two approaches, the issues at stake and the outcome of the contest. The debate on the method of forecasting population was initially a debate between biology and demography. The controversy was played out in conferences, articles and books, on the sidelines of the field where the technical innovations were made. The cohort-component method was easily applied in planning. It provided detailed insights into the factors accounting for the dynamics of population, and yielded details on the future population by age and sex.

DE GANS Henk A.– **¿Ley matemática o coyuntura especulativa? Un debate de los años veinte sobre la metodología de proyecciones demográficas**

El "método de componentes principales", utilizado para llevar a cabo proyecciones de población, apareció, se difundió y se adoptó universalmente en el periodo de entre-guerras. El método se basa en la interacción entre la estructura por edad y sexo de la población y las tasas por edad y sexo de los componentes de la dinámica demográfica (mortalidad, fecundidad y migración) para proyectar la evolución futura más verosímil de las poblaciones nacionales. Sin embargo, desde sus inicios, este método basado en el análisis demográfico compitió con una teoría según la cual los efectivos futuros de población están determinados por una ley. Esta teoría se basaba en el (re)descubrimiento de un modelo homeostático, la "ley logística" del crecimiento demográfico. La teoría logística de las proyecciones de población, desarrollada y preconizada por el genetista americano Raymond Pearl en los años veinte, reemplazó la ley maltusiana de crecimiento geométrico, dominante durante el siglo XIX. La década de los años veinte vivió el enfrentamiento entre la teoría "de la ley logística" y el método "del análisis demográfico". Este artículo presenta los antecedentes y el contexto del enfrentamiento entre estos dos métodos, las posturas respectivas y el inicio del debate. Para empezar, la discusión sobre los métodos de proyección demográfica enfrentó a la biología con la demografía. La controversia tomó forma a través de congresos, artículos y estudios, en los límites de la disciplina que había dado lugar a las innovaciones técnicas. El método de componentes principales dominó claramente las áreas de planificación, ya que permitía una comprensión precisa de los factores que explican la dinámica demográfica, y daba un perfil detallado de la estructura por sexo y edad de la población futura.

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