



BOB WOODS

Robert Ivor Woods

1949–2011

Personal and professional career

IT WAS WITH MUCH SADNESS that colleagues at the University of Liverpool and friends in the population geography community in Britain learnt of Robert (Bob) Woods's premature death on 20 February 2011. The portrait captures Bob's personality well. He was a lovable, humorous and thoughtful professor with a network of research collaborators, the foremost being his Ph.D. students. He gave them great encouragement long after they had 'left the nest'. A few personal memories are appropriate here. Bob and I collaborated in the mid-1980s on an edited book on *Population Models and Structures*.¹ His gentle encouragement to get the job done was much appreciated. Looking back, Bob's contribution to the book represented his goodbye to spatial demography; thereafter he and his students immersed themselves in historical demography. People live on in the memory of those who have lived and worked with them. Bob touched many lives in his time. A small touching moment occurred during a Ph.D. examination I conducted in August 2011 at Liverpool. During the examination conversation the candidate and I were talking about her influences while at the Liverpool department. There was a small tear in her eyes as she mentioned that Bob had found time to talk encouragingly about her research, even though he was not her supervisor.

Born on 17 September 1949 in Birmingham, he was aged 61 when he died in Chester of pancreatic cancer. He is survived and sadly missed by

¹R. I. Woods and P. H. Rees (eds.), *Population Structures and Models* (London, 1986).

his wife, Alison, who provided a bedrock of support throughout his career, by his daughter Rachel, whose artistic and teaching career he nurtured, and by his son, Gavin, to whom Bob gave paternal support in his rugby and teaching pursuits. He was also survived by his mother Rhoda, who brought him up after she was divorced from her husband Ivor Woods. Ivor maintained contact with his son and so he had joint parental support in his schooling years. Bob attended direct grant Handsworth Grammar School in the 1960s and received an excellent education which prepared him for a successful application to the University of Cambridge.

He joined Fitzwilliam College, Cambridge in 1968 and graduated with a BA in Geography in summer 1971. His Director of Studies was Brian Robson (now a professor at the University of Manchester) who recalls that Bob

was a very rewarding, larger-than-life undergraduate, full of fun and with a mischievous sense of humour that, I suspect, partly tried to hide his dedication to things academic and his real enthusiasm for his subject and a fascination with the detail of the intellectual puzzles that he set himself. He was very self-deprecating, but above all a very kind and generous man [with] boundless cheerfulness.

Brian Robson published his classic text on urban social geography in 1969,² and this probably influenced Bob to apply for a Ph.D. opportunity in the subfield that became available. Although Tony Wrigley was researching and lecturing in Historical Demography at Cambridge while Bob was an undergraduate, it was only later that he engaged with Tony's work in the field.

Bob began his postgraduate studies in 1971 at St Antony's College, Oxford, working on his doctorate for three years with supervisor Ceri Peach (now Emeritus Professor of Social Geography) at the Oxford School of Geography. He submitted his dissertation on *Dynamic Urban Social Structure* (over 800 pages, completed in less than four years) and passed his D.Phil. examination in 1975. The University of Cambridge recognised his achievements with the subsequent award of a D.Litt. degree. Bob added to the spatial perspective of the ethnic segregation work of his supervisor a dynamic temporal perspective: his immigrant groups in Birmingham moved around, left old neighbourhoods, occupied new territory and so transformed socio-geographic space. The importance of analysing population processes simultaneously in space and time continued to be a methodological focus throughout his career.

²B. T. Robson *Urban Analysis: a Study of City Structure with Special Reference to Sunderland* (Cambridge, 1969).

At the University of Oxford, Bob was fortunate to be part of an influential group of research postgraduates who went on to greater things. The group that worked in the 'lower room for postgraduates' included Paul White (a colleague at the University of Sheffield, Professor of Geography and Pro-Vice-Chancellor), Philip Ogden (Professor at Queen Mary London and Pro-Vice-Chancellor), the late Dennis Cosgrove (Alexander von Humboldt Professor at the University of California, Los Angeles), Morag Bell (Professor of Geography, Loughborough University) and Eric Pawson (Professor of Geography, University of Canterbury), while in the 'upper room' was Tony Champion (Emeritus Professor of Population Geography, Newcastle University). It would have been fascinating to have eavesdropped on their discussions and debates.

Bob took up his first academic job at the Social Statistics Unit, University of Kent, in 1974, where he started his demographic teaching. Being asked to teach a course in demography in his first postdoctoral job was to influence his subsequent career. He employed the demographic knowledge and skills acquired at Kent in his subsequent research and forged a strong bond between demography and population studies in his subsequent publications.

In 1975, he moved to a lecturer post at the Department of Geography, University of Sheffield. His appointment panel included Ron Johnston, later Professor and Head of Department (now Professor at the University of Bristol), who supported Bob Woods in his developing career, teaching some joint courses and helping in his promotion to Senior Lecturer. It was at the University of Sheffield that Bob met his wife Alison (née Cook), a graduate from the University of Aberdeen who joined the department in 1976 as a lecturer in aerial photography interpretation and analysis. Bob and Alison married in 1977. Their daughter, Rachel, was born in 1979 and their son Gavin in 1982. Alison took up the role of home maker, later taking a Postgraduate Certificate of Education and becoming a secondary school teacher of geography. Key collaborators during Bob's fourteen-year spell at the University of Sheffield were Paul White, with whom he edited a collection on the impacts of migration,³ and John Woodward, a medical historian who invited Bob to participate in the seminar series of the Department of Social and Economic History there. This awakened Bob's interest in historical demography. John Woodward and Bob Woods collaborated on a successful ESRC grant to pursue research in the area and together they edited an important book on morbidity and mortality

³P. E. White and R. I. Woods (eds.), *The Geographical Impact of Migration* (London, 1980).

in nineteenth-century England.⁴ At the University of Sheffield Bob also began his career as a supervisor of doctoral students, in which he was to excel.

In 1989 Bob Woods moved to take up a Chair in Historical Geography at the University of Liverpool and in 1996 was appointed John Rankin Professor of Geography. At Liverpool, he established the MA in Population Studies. He served as Head of Department between 1993 and 1996, Faculty Director of Postgraduate Research and Associate Dean for Postgraduate Studies between 1998 and 2002. Later he led the People, Space and Place Research Cluster.

Throughout his time at Sheffield and Liverpool, Bob was a very active supervisor of doctoral students, shepherding twenty-five to a doctorate and engaging actively with many of them in joint publications. Several of his students have progressed to take up posts in Historical Demography and allied fields in British and overseas institutions: Andy Hinde is a Senior Lecturer and Head of Division of Social Statistics and Demography at the University of Southampton; Eilidh Garrett is a Senior Research Associate at the Cambridge Group for the History of Population and Social Structure, University of Cambridge; Chris Galley is a Lecturer and researcher at Barnsley College; Graham Mooney is Professor in the Institute of the History of Medicine at Johns Hopkins University, Baltimore; Catriona Ni Laoire is a Research Officer and part-time Lecturer at University College, Cork; Nicola Shelton is Head of the Health and Social Surveys research group at the University College London Research Department of Epidemiology and Public Health; Chris Smith works in population research at the Office for National Statistics; Mark Brown is a Senior Lecturer in the School of Social Sciences at the University of Manchester; Violetta Hionidou is Senior Lecturer in the School of History, Classics and Archaeology, Newcastle University; and Clare Holdsworth is Professor of Social Geography in the Department of Geography, Geology and the Environment, Keele University. Bob's students were very appreciative of his wise and skilled supervision. Chris Smith wrote his appreciation:⁵ 'As a supervisor Bob Woods was simply superb. He was always available, approachable and down-to-earth, calm, and directed me in a very subtle way to focus on particular issues ... He was in every sense

⁴R. I. Woods and J. H. Woodward (eds.) *Urban Disease and Mortality in Nineteenth-Century England* (London, 1984).

⁵Published as part of the programme of the Bob Woods Memorial Symposium held at the University of Liverpool, 9–10 March 2012, p. 20. <http://www.liv.ac.uk/environmental-sciences/bob_woods_memorial_symposium/index.html> (accessed 12 June 2012).

exceptional.’ Chris Galley observed in his *Lancet* obituary that ‘I cannot recall anyone who worked closely with Woods having a bad word to say about him. When I worked with him I was always keen to please: but you didn’t do this by agreeing with him, you did it by telling him something interesting that he didn’t already know.’⁶ Nicola Shelton testified that ‘[Bob Woods] was the best boss I ever had; he was always interested in my work and a fantastic mentor.’⁷

Bob Woods gave generously of his time to learned society activities. He served on the committee of the Royal Geographical Society, with the Institute of British Geographers’ Population Geography Research Group (POPGRG) in various capacities which has, in his honour, established the ‘Bob Woods Prize’ for Best Postgraduate Dissertation in Population Studies at a UK university, with a first call for nominations in 2012. I am sure Bob would have been very pleased with this initiative. On behalf of the POPGRG, he was founding co-editor with Huw Jones of the *International Journal of Population Geography* from 1997 to 2002. The journal continues to go from strength to strength as *Population, Space and Place*. In 2003 he became one of the co-editors of the journal *Population Studies*, until illness intervened. He was an active member of the British Society for Population Studies, serving as its President in 1991.

His contributions to knowledge were recognised by election to a Fellowship of the British Academy in 2003 (section S4, Sociology, Demography and Social Statistics with cross-membership in section S3, Anthropology and Geography). He was later elected to the Academy of Learned Societies for the Social Sciences. He received the Royal Scottish Geographical Society’s Newbiggin Award in 2005, was awarded Research Fellowships by the Nuffield Foundation in 1984–5 and the Wellcome Trust in 2005–7, and took up a Visiting Fellowship at All Soul’s College, Oxford in 2005.

Themes of his four decades of scholarship

Bob’s career was a journey across a landscape of subdisciplines within geography. As a research postgraduate he was a social geographer who used spatial demographic methods to understand the dynamics of rapidly

⁶Chris Galley, ‘Robert Ivor Woods’, *The Lancet*, 377(9774): 1312, 16 April 2011, doi:10.1016/S0140-6736(11)60529-1.

⁷Quoted in Chris Galley’s *Lancet* obituary.

growing immigrant subpopulations in a major metropolis. Then as a teacher he had to prepare a lecture course in formal demography and embraced these techniques in his subsequent research, following the precept that if you want to learn a subject thoroughly, then teach a course on it. He developed an abiding interest in population theory, which requires viewing population change and its drivers across decades and centuries. At first his empirical explorations in the 1970s and early 1980s were into contemporary population developments. Then, inspired by the reading of Tony Wrigley's important book on historical demography,⁸ and the publication of Wrigley and Schofield's seminal work on the history of the population of England in 1981, he applied his intellectual curiosity and formidable theoretical and empirical analysis skills to the field of historical demography. Spending time reading and interpreting the historical records of the population in the archives, in his study at home or in cafés on field trips suited his personality. Understanding the patterns, transitions and causes of mortality of nineteenth-century England was the main focus of his work from the early 1980s to the 2000s. In the last decade he added to his meticulous quantitative analysis an interest in the contributions of individuals to the reduction of mortality and in the emotional impact of mortality on Victorian society at a time when death rates were, from a contemporary viewpoint, truly horrendous. His book *Children Remembered* is a unique combination of demographic and literary analysis, replete with poetry and painting, which demonstrated that parents, even in an age of large families, were still deeply moved by the death of their children.⁹ His colleague Paul Williamson has reviewed Bob's career in scholarship in a piece in *Progress in Human Geography*, which includes a listing of his publications.¹⁰

Bob Woods authored many books: an influential textbook which provides an excellent introduction to population analysis methods, including standard, abridged and model life tables and the Coale fertility indexes;¹¹ a textbook on population theory which places the techniques of the first book into a wider explanatory framework;¹² and a set of research mono-

⁸R. I. Woods, 'Textbooks that moved generations—E. A. Wrigley, *Population and History* (1969)', *Progress in Human Geography*, 30 (2006), 405–8.

⁹R. I. Woods, *Children Remembered: Responses to Untimely Death in the Past* (Liverpool and Chicago, IL, 2006).

¹⁰P. Williamson, 'Robert I. Woods (1949–2011)', *Progress in Human Geography*, 2012, doi: 10.1177/0309132511408274.

¹¹R. I. Woods, *Population Analysis in Geography* (London, 1979).

¹²R. I. Woods, *Theoretical Population Geography* (London, 1982).

graphs in the field of historical demography, covering population history, mortality, and infant and fetal health and mortality.¹³ Bob's books set a new course for population geography in adopting more rigorous methods of analysing population change. Description of static population geographies would no longer be enough in future. Bob was comfortable with the mathematics of demographic analysis and felt that population geographers should understand the basics. In this we shared a common belief, though today only a minority of population geographers are comfortable navigating the algebra and graphics of formal demography.

Bob wrote fifty-four articles in peer-reviewed journals, starting in 1976 with a paper on the effect of spatial scale on the computation of segregation indexes¹⁴ and ending in 2009 with a paper on disease environments in Victorian England and Wales.¹⁵ He also wrote up his research output in book chapters in edited collections, of which he produced five with colleagues.¹⁶ Some of these chapters are context setting pieces;¹⁷ others are important syntheses of knowledge and insights into the demographic transition in the West.¹⁸ Edited books are important means of research dissemination because they bind together outputs by leading researchers on a particular theme and together have more impact than if published individually in journals. His publications start with his 1975 D.Phil. thesis (874 pages!),¹⁹ from which some of his early publications were derived,

¹³R. I. Woods, *The Population History of Britain in the Nineteenth Century* (London, 1992; republished Cambridge, 1995); R. I. Woods and N. Shelton, *An Atlas of Victorian Mortality* (Liverpool, 1997); R. I. Woods, *The Demography of Victorian England and Wales* (Cambridge, 2000); Woods, *Children Remembered*; and R. I. Woods, *Death before Birth: Fetal Health and Mortality in Historical Perspective* (Oxford, 2009).

¹⁴R. I. Woods, 'Aspects of the scale problem in calculation of segregation indexes: London and Birmingham, 1961 and 1971', *Tijdschrift voor Economische en Sociale Geografie*, 67 (1976), 169–74.

¹⁵R. I. Woods and N. Shelton, 'Disease environments in Victorian England and Wales', *Historical Methods: a Journal of Quantitative and Interdisciplinary History*, 33 (2009), 73–82.

¹⁶White and Woods, *The Geographical Impact of Migration*; Woods and Woodward, *Urban Disease and Mortality in Nineteenth-Century England*; Woods and Rees, *Population Structures and Models*; D. Noin and R. I. Woods (eds.), *The Changing Population of Europe* (Oxford, 1993); and E. Garrett, C. Galley, N. Shelton and R. I. Woods (eds.), *Infant Mortality: a Continuing Social Problem* (Aldershot, 2006).

¹⁷R. I. Woods and P. H. Rees, 'Spatial demography: themes, issues and progress', in R. I. Woods and P. H. Rees (eds.), *Population Structures and Models* (London, 1986), pp. 1–3.

¹⁸R. I. Woods, 'The spatial dynamics of the demographic transition in the West', *ibid.*, pp. 21–44.

¹⁹R. I. Woods, 'Dynamic Urban Social Structure: a Study of Intra-Urban Migration and the Development of Social Stress Areas in Birmingham', D.Phil. thesis, University of Oxford, 1975.

and one 1975 departmental paper,²⁰ a medium he subsequently avoided, believing that the rigour of peer review was essential before publication, a process which he oversaw as editor or co-editor of journals.

What *themes* did Bob Woods cover and how did they change over time? A simple classification is suggested here, though a more detailed reading could lead to a more refined typology. Bob's work covered all the components that determine demographic change: fertility (eight publications), mortality (seventeen), migration (five) and international migration indirectly via studies of immigrants (ten), though most of this latter work concerned the population distribution and migration within the country of international immigrants. But this account underweights his interest in mortality, which should also include his publications on infant mortality (thirteen), fetal mortality (six) and the emotional aspects of child death.²¹ He also published more general works on aspects of population development.²² His early papers focused on the spatial distributions of immigrant populations²³ and how those changed over space and time.²⁴ 'Immigrant' has been a contested term for populations with origins outside this country as the available census data for monitoring the changing spatial locations of immigrants were based on country of birth in the 1961, 1971 and 1981 Censuses and therefore excluded the descendants of persons who had immigrated in the past. There is also confusion between 'immigration' used as a demographic accounting term, which includes returning UK citizens, residents or natives, and 'immigrants' used as a term to distinguish persons with a different race, ethnic origin or culture from the majority

²⁰R. I. Woods, *The Stochastic Analysis of Immigrant Distributions*, Research Paper 1, School of Geography, University of Oxford (1975).

²¹Woods, *Children Remembered*.

²²R. I. Woods, 'Urbanisation in Europe and China during the second millennium: a review of urbanism and demography', *International Journal of Population Geography*, 9 (2003), 215–27; D. Baines and R. I. Woods, 'Population and regional development', in R. Floud and P. Johnson (eds.), *The Cambridge Economic History of Modern Britain, Volume II: Economic Maturity, 1860–1939* (Cambridge, 2004), pp. 25–55.

²³C. Peach, S. Winchester and R. I. Woods, 'The distribution of coloured immigrants in Britain', in G. Gappert and H. M. Rose (eds.), *The Social Economy of Cities* (Beverly Hills, CA, 1975), pp. 395–426; Woods, 'Aspects of the scale problem': R. I. Woods, 'A note on the future demographic structure of the coloured population of Birmingham, England', *Journal of Biosocial Science*, 9 (1977), 239–50; R. I. Woods, 'Ethnic segregation in Birmingham in the 1960s and 1970s', *Ethnic and Racial Studies*, 2 (1979), 455–76.

²⁴R. I. Woods, 'Population turnover, tipping points and Markov chains', *Transactions of the Institute of British Geographers*, ns 2 (1977), 473–89; R. I. Woods, 'Migrations and social segregation in Birmingham and the West Midlands region', in White and Woods, *The Geographical Impact of Migration*, pp. 181–97; R. I. Woods, 'Spatiotemporal models of ethnic segregation and their implications for housing policy', *Environment and Planning A*, 13 (1981), 1415–33.

White British population. After much debate this led to the introduction of the broader concept of ethnicity. An ethnic identity question was proposed for the 1981 Census and implemented in the 1991, 2001 and 2011 Censuses. Bob Woods wrote on these issues in 1983.²⁵ Outside these core themes, Bob wrote about fertility (making intensive use of the Coale indexes as an aid to understanding the drivers of fertility change) and its links to class and geography,²⁶ morbidity in Victorian England,²⁷ and, with his Liverpool colleague Bill Gould, on the Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) on a world canvas,²⁸ as well as about medical history²⁹ and nuptiality.³⁰ He also published works on methods³¹ and extensively on population theory (fourteen publications). A later section of the memoir returns to some of these themes in discussing some of his important contributions through a review of selected publications.

What *time periods* were of interest to Bob Woods? Here we use a broad-brush temporal classification. He was interested in the long run of several centuries and, in the case of one paper, a millennium. He dipped his toe into the eighteenth century but his main focus was the nineteenth

²⁵P. E. White and R. I. Woods, 'Migration and the formation of ethnic minorities', *Journal of Biosocial Science*, Supplement 8 (1983), 7–24.

²⁶R. I. Woods, 'On the long term relationship between fertility and the standard of living', *Genus*, 39 (1983), 21–35; R. I. Woods and C. W. Smith, 'The decline of marital fertility in the late nineteenth century: the case of England and Wales', *Population Studies*, 37 (1983), 207–25; R. I. Woods, 'Social class variations in the decline of marital fertility in late nineteenth-century London', *Geografiska Annaler, Series B*, 66 (1984), 29–38; R. I. Woods and P. R. A. Hinde, 'Variations in historical natural fertility patterns and the measurement of fertility control', *Journal of Biosocial Science*, 16 (1984), 309–21; R. I. Woods, 'The fertility transition in nineteenth-century England and Wales: a social class model?', *Tijdschrift voor Economische en Sociale Geografie*, 76 (1985), 180–91; R. I. Woods, 'Approaches to the fertility transition in Victorian England', *Population Studies*, 41 (1987), 283–311; R. I. Woods and C. Wilson, 'Fertility in England: a long-term perspective', *Population Studies*, 45 (1991), 399–415; and R. I. Woods, 'Working class fertility decline in Britain', *Past and Present*, 134 (1992), 200–7.

²⁷Woods and Shelton, 'Disease environments in Victorian England and Wales'.

²⁸W. T. S. Gould and R. I. Woods, 'Population geography and HIV/AIDS: the challenge of a "wholly exceptional disease"', *Scottish Geographical Journal*, 119 (2003), 265–81.

²⁹R. I. Woods, 'Physician, heal thyself: the health and mortality of Victorian doctors', *The Society for the Social History of Medicine*, 9 (1996), 1–30; R. I. Woods, 'Dr Smellie's prescriptions for pregnant women', *Medical History*, 52 (2008), 257–76.

³⁰R. I. Woods and P. R. A. Hinde, 'Nuptiality and age at marriage in nineteenth-century England', *Journal of Family History*, 10 (1985), 119–44.

³¹Woods, *Population Analysis in Geography*; R. I. Woods and P. H. Rees, 'Demographic estimation: problems, methods and examples', in Woods and Rees, *Population Structures and Models* (London, 1986), pp. 301–43; C. Galley, N. Williams and R. I. Woods, 'Detection without correction: problems in assessing the quality of English ecclesiastical and civil registration', *Annales de Demographie Historique*, 2 (1995), 161–83.

in which twenty-five of the forty-four publications assigned a definite time reference are located; twelve are located in the twentieth century. Bob started off as a population geographer using contemporary census, register and administrative data sources but then refocused in the 1980s and thereafter as a historical demographer on the nineteenth century or more precisely the Victorian and Edwardian eras when census information along with vital events data was available for the whole population.

What *locations* interested Bob Woods? He started off in his home city of Birmingham in which his immigrant studies were placed, along with a couple of excursions to London. Then his geographical horizon expanded to England, England and Wales and Britain as he developed his historical demographic research. 'Britain' means that Scotland was added to England and Wales as a country of interest. Note that these scales refer to the study 'universe'. He was very interested in the variation within the universe by detailed spatial unit, as befits a population geographer. The studies of Birmingham used small areas from the 1961, 1966 and 1971 Censuses, which were called enumeration districts (EDs). For operational reasons (land use changes, shifting populations and efficiency measures) the boundary definitions of a large proportion of EDs changed between censuses and so the population counts from successive censuses are for areas which cannot be directly compared. Bob solved this problem by using uniform one kilometre grid cells to which the ED populations were assigned. His studies of the geography of demographic processes in the nineteenth century were based on the Registration District. England and Wales were divided into forty-five registration counties and varying numbers of registration districts. These were harmonised in the *Atlas of Victorian Mortality*,³² which he and colleagues reduced to a comparable set of circa 614 common registration districts for some analyses so that time series analysis could be carried out across successive censuses. Bob's international studies outside Britain were based on countries or groups of countries, drawing on international sources and a wide range of previous studies.³³

³²R. I. Woods and N. Shelton, *An Atlas of Victorian Mortality* (Liverpool, 1997).

³³Noin and Woods, *The Changing Population of Europe*; Gould and Woods, 'Population geography and HIV/AIDS'; Woods, 'Urbanisation in Europe and China during the second millennium'.

Contributions as a model builder

While the bibliographic analysis is helpful in showing the broad expanse of Bob Woods's opus, it is useful to look in detail at particular outputs to identify his unique and important contributions to demographic and geographic knowledge. I concentrate on 'models' (in the broadest sense) used and developed by Bob Woods, as suggested by Bill Gould.³⁴ Others will be able to review Bob's contribution to historical demography more thoroughly.

'Model' is a contentious term with lots of different meanings for different people. My understanding is that a model is a representation of reality using various devices (words, graphs, equations, numbers, materials, roles, pictures or computer program logic). Inevitably a model is a simplification of reality but is something that can be tested against reality. Often the model embodies a set of testable hypotheses in a way that shows how variables to be accounted for are linked to explanatory factors. The variables that are often included in a demographic model come in several layers—for example: population structures and the components determining the pace of population change; the factors that directly influence the components; and the system variables that affect the factors and their relationship with the variables to be explained. The variables to be included in an explanation can be demographic, social, economic, cultural, behavioural and political (affected by policy). I think Bob would agree with this catholic definition, to judge from his frequent employment of variables of all these types. I exemplify his contribution by looking at five selected publications.

A graphical model: conceptualisation of the demographic transition

In a book chapter, Bob outlines a framework that we should use to understand the demographic transition model as a representation of demographic regime changes that play out differently depending on context (e.g. Britain from the 1870s versus India from the 1950s).³⁵ He uses a set of six carefully constructed graphs to convey his arguments. One of these

³⁴Bill Gould organised a Bob Woods Memorial Symposium, 9–10 March 2012, University of Liverpool, <http://www.liv.ac.uk/environmental-sciences/bob_woods_memorial_symposium/>. I gave a talk entitled 'Bob, the model builder'.

³⁵R. I. Woods, 'Spatial and temporal patterns', in Woods and Rees, *Population Structures and Models*, pp. 7–20.

summarises his characterisation of demographic regimes, particular combinations of fertility and mortality levels and structures (Fig. 1). Previous representations had just plotted the birth rate and death rate against time. Bob uses the two components, mortality and fertility, as two axes of the same graph in which empirical observations of the Crude Birth Rate (CBR) and Crude Death Rate (CDR) can be plotted. Lines of equal rates of growth (actually natural increase rates) can be represented on such a CBR versus CDR graph as diagonal lines which show increasing growth as you move towards the top right corner and decreasing growth as you move in the opposite direction towards the bottom left corner. No lines are added beyond the -1% (or $-10/1000$) line to indicate that demographic regimes in that region are rare and are likely to disappear fast. Bob uses this basic construction in his text books and in his historical demography papers, with refinements of the variables plotted on the two axes. So the total fertility rate or the gross reproduction rate may be used on the fertility dimension (y -axis) and variables such as life expectancy at birth on the mortality dimension (x -axis).³⁶ On these graphs lines of equal growth are curved reflecting non-linear relationships between the variables plotted. Note that the direction of the mortality axis is reversed in Figure 1 with high values on the left-hand side and low values on the right. When life expectancy is used as the mortality indicator, this reversal is not needed as low life expectancies correspond with high mortality and high life expectancies with low mortality.

Bob was not content with just plotting the distribution of populations for a particular time period but extended this to plot the paths through time of particular populations. In Figure 1 clusters of populations are represented by circles which move to new positions in fertility-mortality space over time. So cluster *A* contains countries where natural fertility prevails subject to high mortality; these experience, at a first stage of the demographic transition, a reduction in mortality accompanying an increase in fertility linked to improving maternal health prior to any limitation on the number of children. The countries move to larger circle *B*, which suggests more dispersal of demographic regimes. Fertility and mortality then decline in tandem so the cluster of populations moves along the same growth line until a steeper decline in fertility sets in. The arrow from circle *B* to circle *C* curves back, indicating that CDRs increase in the later stages of the demographic transition because the age structure becomes older.

³⁶ Figure 3.2 in R. I. Woods, 'The spatial dynamics of the demographic transition in the West', in Woods and Rees, *Population Structures and Models*, pp. 21–44.

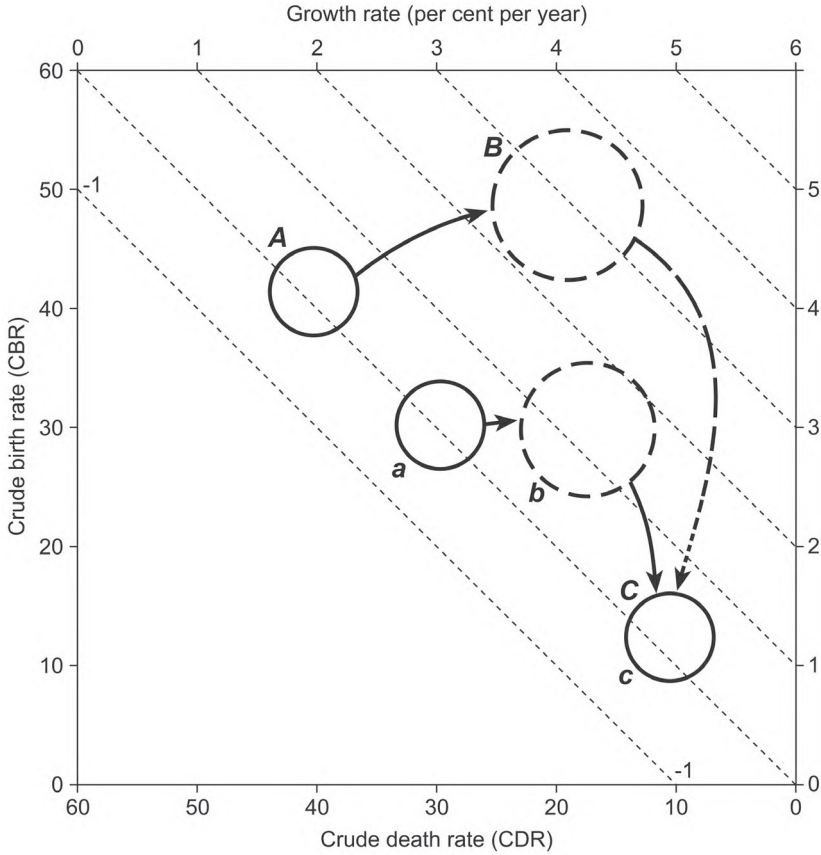


Figure 1. A definition of demographic regimes.

Source: Figure 2.3, p. 12 in R. I. Woods, 'Spatial and temporal patterns', in R. I. Woods and P. H. Rees (eds.), *Population Structures and Models* (London, 1986), pp. 7–20.

This curve back does not happen when life expectancy is used as the indicator for mortality, although there may be some slowing of the increase in life expectancy as very high levels are approached (this is the subject of current debate). The different regimes through time for European populations are indicated by the smaller circles *a*, *b* and *c*. The starting position of European countries is different because of the role of marriage postponement on fertility. Over time fertility increases only for some countries but not for others so circle *b* is larger than circle *a*. European populations then see substantial decline in fertility and a small decline in mortality moving them to circle *c*.

What Bob's graphical representation does is summarise a set of hypotheses about demographic changes in populations in a fruitful way that can be tested against available data and refined if found wanting. Further information can be added to the graph by attaching dates to the observation points which provide some idea of the speed of transition for particular places if the points occur regularly through time. Closely spaced points indicate slow change; widely spaced points indicate fast change. In principle, though I don't think Bob did this, line symbols could be used to indicate different speeds of change.

Maps as models: the *Atlas of Victorian mortality*

As a geographer, Bob Woods was acutely aware that national demographic averages hide a rich spatial variation in the measures of interest and that plotting those rates for subnational areas was an important way of suggesting hypotheses for further investigation. The maps in *An Atlas of Victorian Mortality*,³⁷ co-authored with Nicola Shelton, were constructed with skill and scholarship. The 614 registration districts employed were a common set harmonised across six decades. The boundaries of the registration districts were simplified to aid in presentation of the statistics, though all contiguity relationships were preserved. A final feature of the maps is the very careful choice of class intervals, each of which contains roughly a quarter of the observations pooled over the four decades represented.

These mapping decisions provide a way of characterising the spatial patterns of the Early Childhood Mortality Rate (ECMR) in each decade and enable comparison across decades (Fig. 2). So looking at the distribution of shades on each map we can see immediately that the relative spatial structure of ECMR persists over four decades.³⁸ The dense urban, industrial and mining districts of the North West, North East, Yorkshire, South Wales, West Midlands and London have the highest rates in each map. However, the levels of ECMR shift downwards steadily because the lighter shades grow in importance in rural and southern England. The authors then go on to analyse the geographical patterns of the causes of death in early childhood, linking many diseases to the effects of high urban population densities and overcrowding which meant the rapid spread of measles, whooping cough and scarlet fever. The decreases in

³⁷Woods and Shelton, *An Atlas of Victorian Mortality*.

³⁸The original maps are in colour. In Figure 2 the colours have been converted to grey scale shades.

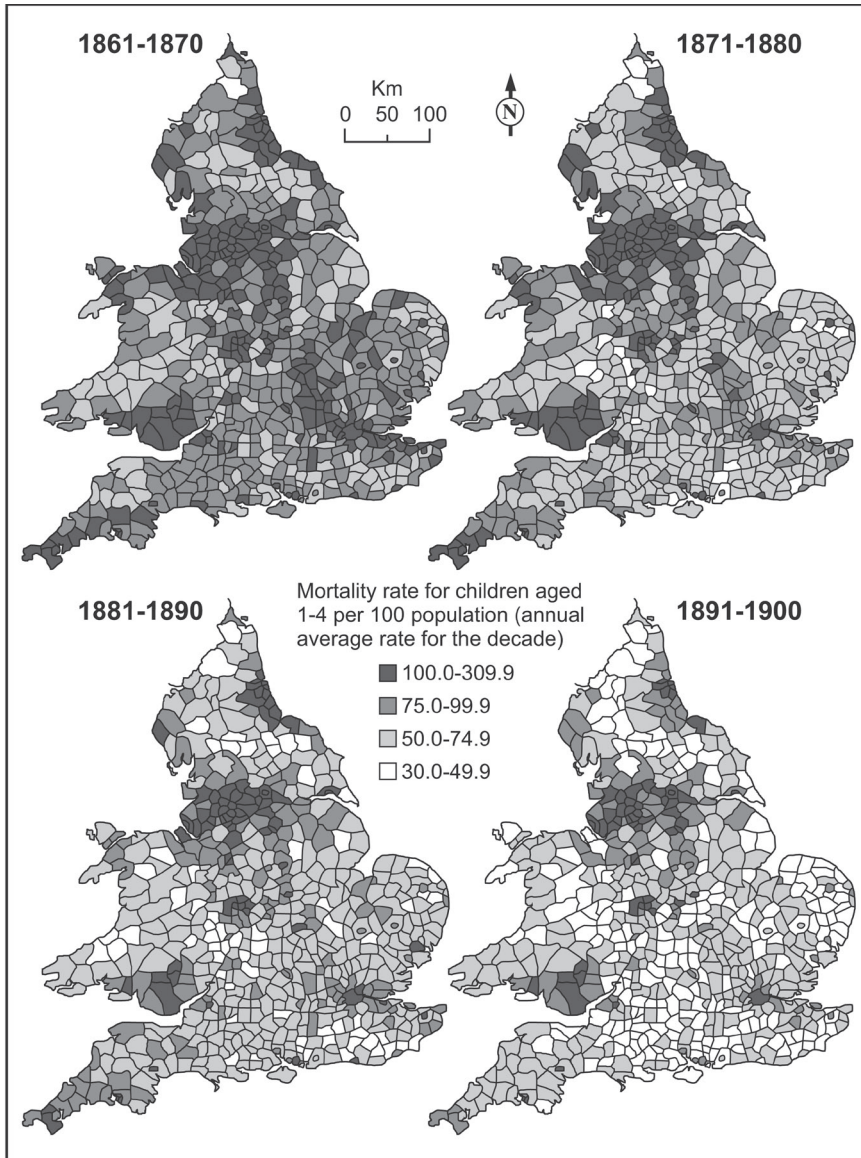


Figure 2. Early childhood mortality rates for ages 1-4, registration districts, England and Wales, 1861-1870 to 1891-1900.

Source: Map 11a, p. 67 in R. I. Woods and N. Shelton, *An Atlas of Victorian Mortality* (Liverpool, 1997). Reproduced with the permission of Liverpool University Press.

measles and whooping cough deaths were modest in the late nineteenth century. We had to wait until the second half of last century for protective vaccines to become available. By contrast, scarlet fever showed a dramatic decrease in virulence in the 1861–1900 period,³⁹ well before treatment with the antibiotic penicillin was available. Smallpox was essentially conquered in the twentieth century through public health programmes of immunisation and was declared eradicated in 1977 by the World Health Organization.

In his work on Victorian mortality, Bob Woods shows that previous accounts of change need revision because the processes at work were highly complex. He shows that the urban (worse mortality) to rural (better mortality) gradient meant that urbanisation slowed down the improvements in life expectancy that were being made. He stresses that the different age groups (infants and children, young adults and the old) had different experiences processed through the causes of mortality, which needed to be examined in detail. His work showed that the spatial variation in mortality in any decade in the nineteenth century was much greater than the changes occurring over the decades. Yes, there was progress in reducing water-borne infectious diseases in cities and nutrition did improve in the last quarter of the century, but big reductions in infant mortality were not made until the twentieth century.

The life table model and model life tables

The life table model uses a set of age-specific mortality rates for a population to compute a set of survival variables from which a life expectancy can be calculated, using some important assumptions. Accounts of the sequence of equations that generate the life table variables are given in most introductory demographic texts such as those written by Bob Woods himself⁴⁰ and by his student Andy Hinde.⁴¹ Life expectancy is the average age to which the population can expect to live in a stationary population, one fixed in size in which deaths are replaced by the same number of births and whose age structure is dependent on only the relationship between mortality and age. An important assumption is that the age-specific mortality rates observed in a period of interest persist for the lives of those for whom we generate the life expectancies—that is, the mortality rates are fixed over

³⁹ Woods and Shelton, *An Atlas of Victorian Mortality*, Map 16a, p. 85.

⁴⁰ Woods, *Population Analysis in Geography*.

⁴¹ A. Hinde, *Demographic Methods* (London, 1998); D. T. Rowland, *Demographic Methods and Concepts* (Oxford, 2003).

time. In reality, mortality rates vary over time and in recent decades in most European countries have been steadily declining, apart from some minor rises for young adult males associated with the HIV/AIDS epidemic that started in the 1980s. So if we were to use the mortality rates actually experienced by a cohort born in a year or set of years, then we would compute a higher life expectancy, which is termed the cohort life expectancy. We should label the conventional life expectancy as the period life expectancy. The data demands of the period life table are small, just mortality rates for one to five years; for the cohort life table we need one hundred years of deaths data after a cohort has been born.

We tend to regard the life table model results as ‘reality’ but of course they are not. The results depend on the quality of the input mortality rates (which depend in turn on the accuracy of death registration and the estimation of a corresponding population at risk). There are assumptions about the force of mortality between ages, and about the time spent alive between ages by those who die, which have important influences on development of birth-first age survival probabilities and which affect how we finish off the life table after the last age (in the final open-ended age group). Bob Woods and Andy Hinde tackled the problems of estimating accurate life tables for registration districts in the Victorian period, given known age misreporting at older ages,⁴² using Model Life Tables (MLTs) building on methods used by Wrigley and Schofield,⁴³ who in turn used the empirical MLTs of Coale and Demeny.⁴⁴ MLTs were used to smooth out implausible empirical values or to fill in where complete data were absent. The Woods-Hinde model life table functions largely coincide with those of Wrigley and Schofield at the same mortality levels. However, curves associated with higher life expectancies were needed for estimating life expectancies by district after 1871 because they showed a different age pattern, with lower survival at younger ages and higher survival at older ages. It would have been interesting to have discussed with Bob these historical methods for estimating small population life tables and compared them with contemporary methods.⁴⁵

⁴²R. I. Woods and P. R. A. Hinde, ‘Mortality in Victorian England: models and patterns’, *Journal of Interdisciplinary History*, 18 (1987), 27–54.

⁴³E. A. Wrigley and R. S. Schofield, *The Population History of England, 1541–1871: a Reconstruction* (Cambridge, 1981).

⁴⁴A. J. Coale and P. Demeny, *Regional Model Life Tables and Stable Populations* (Princeton, NJ, 1966).

⁴⁵P. Rees, P. Wohland and P. Norman, ‘The estimation of mortality for ethnic groups within the United Kingdom’, *Social Science and Medicine*, 69 (2009), 1592–1607; M. P. Grayer, ‘Analysis of

Simulation models: representations of shifting populations

The graphs, maps and life tables which Bob Woods employed in his work were used in the main to develop a better understanding of the past. However, early in his career he published two important pieces of work which simulated the development of population systems forward over time: the first used Markov Chain analysis to project the distribution of primary schools in Birmingham by immigrant/native composition,⁴⁶ and the second used spatial simulation methods to project the populations of immigrant groups at small area scale (one kilometre squares) across Birmingham.⁴⁷ Population simulation is the process of implementing a model of a demographic system over time and space. Sometimes the system is specified at the macro-scale (counts of people in classes or at locations) or sometimes the population is represented at the micro-scale of individuals or households. The macro-simulation uses average probabilities of transition between system states whereas micro-simulation involves a method for deciding whether individuals make transitions or not.⁴⁸ Alternatively, a set of rules can be specified that lead to a decision or not to make the transition in situations where you have poor information about the probabilities of transition or about the determinants of those transitions. Simulation models normally derive the information for driving the model from one historical period, then use a second to test the validity of the simulations and in a third period allow the model to predict the future.

In his paper on 'Population turnover, tipping points and Markov chains' Bob uses data from Birmingham primary schools on immigrant/native pupil composition and classifies them into twenty percentage classes in 1961 and 1971.⁴⁹ He then counted the number of schools in each of the 400 cells to demonstrate how the country of birth composition of school pupils had changed. These tables were developed for pupils born in the New Commonwealth, in Ireland, in the West Indies and in India, Pakistan and Ceylon. Similar tables for 'coloured' pupils as a whole were assembled for 1966 to 1971 and for 1970 to 1971. He then derived transition prob-

Variation in Small Area Life Expectancy within London, 2000–2008', Ph.D. thesis, Queen Mary University of London, 2011.

⁴⁶ Woods, 'Population turnover, tipping points and Markov chains'.

⁴⁷ Woods, 'Spatiotemporal models of ethnic segregation'.

⁴⁸ Van Imhoff and Post show that macro-simulation and micro-simulation are two different representations of the same underlying model. E. van Imhoff and W. Post, 'Microsimulation methods for population projection', *Population: an English Selection*, 10 (1998), 97–138.

⁴⁹ Woods, 'Population turnover, tipping points and Markov chains'.

ability matrices from all these tables and used them in a simple Markov chain model to explore how school immigrant/foreign composition might change up to 2061.

This was an interesting and innovative analysis. It has been picked up in subsequent reviews but the methodology has not been applied subsequently for two reasons. Firstly, the projections referred to aspatial classes (primary schools in groups according to immigrant concentration) rather than to particular schools or school catchment areas, which would have been of greater interest to managers, heads and teachers. Secondly, change in the school ethnic composition is a symptom of underlying process of neighbourhood ethnic population change, school catchment area design and the respective roles of state and private schools. There is a growing literature on the ethnic composition of schools in England, on its potential effect on performance and community relations, the results of the Schools Census (National Pupil Database) which provides longitudinal data on the schools and residences of pupils of different ethnicity, and on demographic projections of ethnic group populations at different spatial scales. However, these have not yet come together to provide better forecasts than the ones Bob Woods attempted back in 1977.

In his paper on 'Spatiotemporal models of ethnic segregation and their implications for housing policy'⁵⁰ Bob Woods did take up part of the challenge. He projected the spatial distribution of New Commonwealth immigrants in Birmingham taking into account both internal migration within Birmingham and assumptions about the distribution of new immigrants. The models build on work by Hägerstrand⁵¹ and Morrill,⁵² in which people living in grid cell areas migrate to other cells through the application of a field of probabilities that reflects decay with increasing distance from origin. Bob developed several refinements of the basic model, changing the rules of migration behaviour in various ways and introducing new variables. Significantly, he subjected his simulations to careful tests by rolling forward the simulation from the 1961 Census to 1971 and then comparing outcomes with the 1971 Census using detailed maps. Simulation carried forward into the future is called 'projection'. Ideally, projections should be subject to the kind of validation exercise that Bob carried out but this is rather rare.

⁵⁰ Woods, 'Spatiotemporal models of ethnic segregation'.

⁵¹ D. Hannerberg, T. Hägerstrand and B. Odeving (eds.), *Migration in Sweden: a Symposium* (Lund, 1957).

⁵² R. L. Morrill, 'The Negro ghetto: problems and alternatives', *Geographical Review*, 55 (1965), 339–61.

This work has been cited not just in review papers but also in recent work on ‘complexity’ theory applied to urban residential populations.⁵³ This involves agent based micro-simulation modelling, which is useful when empirical data to power the simulation model are either lacking or flawed. This is the case for intra-urban migration which Bob simulated. He used surrogate marriage distance data to estimate the distance-decay parameter needed in the simulation model, for example. Bob’s model of the population of his native city was both innovative and complex, so he would have been pleased with the interest from contemporary complexity modellers.

Lessons from Bob’s research

This memoir has touched on only a few aspects of Bob Woods’s extensive work in population geography and historical demography over thirty-seven years. Each paper, book or edited collection was characterised by a thorough grasp of the relevant literature, by a scholastic diligence in citing sources and by an engagement in issues and debates of the topic being discussed. He had a deep interest in the theory and methods which informed his empirical work. He desired to test conventional wisdom and often found it wanting. He taught himself and used the most refined methods employed in historical demography, work which can inform contemporary demographic analysis. He realised that a well-constructed graph or map could convey a great deal of useful information in a compressed format. He gave attention to the detail of empirical measurement and index construction. To quote the words of two of his students, ‘he was the pre-eminent historical demographer of his generation’⁵⁴ and ‘the foremost demographic historian of later-19th century Britain’.⁵⁵ His work will continue to be read by new researchers in his chosen fields as guides to excellent analysis of issues that continue to be important.

PHILIP REES

Fellow of the Academy

⁵³ For example in I. Omer, ‘Demographic processes and ethnic residential segregation’, *Discrete Dynamics in Nature and Society*, 3 (1999), 171–84; H. Yizhaq and E. Meron, ‘Urban segregation as a nonlinear phenomenon’, *Nonlinear Dynamics, Psychology and Life Sciences*, 6 (2002), 269–83; and J. Barkley Rosser, *Complex Evolutionary Dynamics in Urban-Regional and Ecologic-Economic Systems: from Catastrophe to Chaos and Beyond* (Berlin, 2011).

⁵⁴ Chris Galley’s obituary in the *The Lancet*.

⁵⁵ Eilidh Garrett, quoted in Galley’s *The Lancet* obituary.