Willy Østreng, editor

Complexity

Interdisciplinary Communications 2006/2007

Centre for Advanced Study
at the Norwegian Academy of Science and Letters

CAS OSLO

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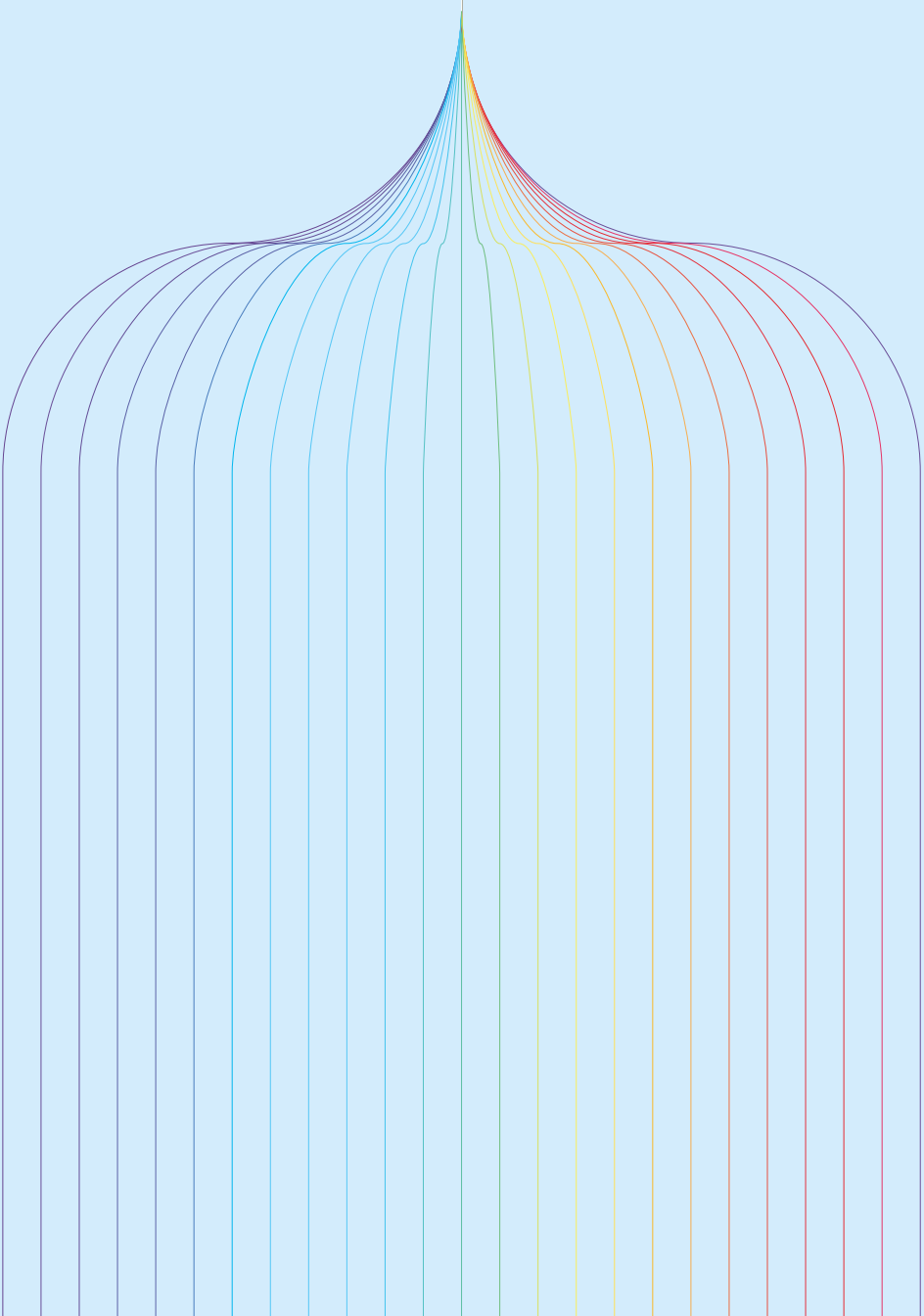

Centre for Advanced Study in Oslo

The Centre for Advanced Study (CAS) is an independent private foundation which was established by the Norwegian Academy of Science and Letters in 1989. Its purpose is to promote basic research – disciplinary as well as interdisciplinary – on the highest international level within the humanities/theology, the social sciences/law and the natural sciences/medicine/mathematics. The Centre's academic activity is of a long-term nature and is to be permanent and academically independent of political and economic influences and the influence of research policy.

Outstanding researchers from Norway and abroad are nominated for one-year stay to engage in research in the Centre's premises in the Norwegian Academy of Science and Letters' mansion in Oslo. The activities are organized in three groups – one in the humanities, one in the social sciences and one in the natural sciences – each with from six to ten members whose affiliation is long-term. In addition come numerous researchers who spend shorter periods conducting research, altogether some 40–45 fellows of around 15 nationalities a year. Each group is planned and organized around a unifying theme and headed by one or two recognized Norwegian researchers. The groups have no other obligations than their own research and to take part in internal seminars. They receive administrative and financial support from the Centre in formalized cooperation with six Norwegian universities and one high-level research college, i.e. the University of Oslo, the University of Stavanger, the University of Bergen, the University of Tromsø, the Norwegian University of Science and Technology in Trondheim, the Norwegian University of Life Sciences in Ås and the Norwegian School of Economics and Business Administration in Bergen.

The Centre has a Board appointed by the Norwegian Academy of Science and Letters, the Norwegian Association of Higher Education Institutions and the Research Council of Norway. The every day operation of the Centre is conducted by a four member-administrative staff.

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Research groups 2006/2007

Spin and Charge Flow in Nanostructures
Group leaders:
Professors Arne Brataas and Asle Sudbø, NTNU Trondheim

A team was formed to investigate the novel and intriguing phenomena that occurs in nanoscale systems. By a combined broad experience in nanoscale systems as well as semiconductors, normal metals, ferromagnets, low- and high-temperature superconductors, and exotic new metals and insulators, a rich research environment for top-rate research was created. We developed improved theoretical methods for describing transport and other phenomena, and used these methods to increase our understanding of experiments. We studied the properties of novel pure or hybrid systems containing normal metals, ferromagnetic metals, low-temperature superconductors, high-temperature superconductors and low-dimensional systems in semiconductors. Spin-injection into normal metals, semiconductors, superconductors and other novel metals as well as the electronic properties of low-dimensional systems were investigated.

Changing Family Patterns in Norway and Other Industrialized Countries: Determinants, Consequences and Projected Trends
Group leaders:
Professors Nico Keilman and Øystein Kravdal, University of Oslo

Norway and other industrialized countries have experienced massive changes in family behaviour over the last few decades: the age at marriage has increased, a larger proportion has remained unmarried, informal cohabitation has become more common, and rates of union disruption have escalated. At the same time, women got fewer children, and those who became mothers did so later in life. These changes are, of course, closely linked to each other. For example, people who do not live in a stable relationship usually do not want a child, and conversely, the childless may see little need to formalize a consensual union and they may find it easier to dissolve a relationship.
The intention of the project was to learn more about the reasons for and consequences of these changes in the development of family structures, with special emphasis on the Norwegian setting. The drift away from the formal marriage has been particularly pronounced in Norway and other Nordic countries. Yet, fertility is relatively high. This situation makes Norway very interesting from an international perspective. In addition, the country has quite unique register data that allow detailed exploration of demographic behaviour. However, it would obviously also be important to contrast the development in Norway with that seen in other industrialized countries.
Another goal of the project was to develop better tools for analysing and forecasting future family patterns.

Metamorphoses: Resurrection, Taxonomies and Transformative Practices in Early Christianity

Group leader:
Professor Turid Karlsen Seim, University of Oslo

The project aimed at exploring how ideas and experiences of transformation were expressed in Early Christianity. It assumed new patterns of interpreting Pre-Constantinian Christianity not so much in uniform and evolutionary terms but as a diversity of groups and beliefs. Despite a claim to exclusiveness and experiences of conflict and persecution, the early Christians depended upon and actively exploited existing forms of thought, speech and behaviour. They yielded to given discourses while slowly establishing new ones. What were the frameworks within which transformative ideas such as resurrection and also experiences of having become "a new being" were shaped; the analogies to which they referred; and the parameters by which transformation was being noted and actually asserted? How was Christianity conceived and received by people not already culturally and religiously informed or shaped by it?

The focus on transformation helped connect areas of research that so far have been studied separately, and the project covered the following main areas:

1. Transformation and Taxonomy – a study of how various constructions of cosmological order accommodated or challenged transformative movements. We explored the interplay between spatial and temporal categories; the terms used to express differences and likenesses between terrestrial and celestial realms; and the role these terms served as boundary-markers.
2. Resurrection, Recognition and the Resurrected Body. A comprehensive and nuanced reading of a variety of Greco-Roman, Jewish and Christian sources affirmed that faith in resurrection was a hallmark of Christian identity but that the way in which resurrection and the resurrected body was perceived and explained varied greatly but yet had – also in the case of Jesus - an emphasis on transformative change and polymorphism/multiformity rather than on the solid bodily continuity that gained ground in later Christian doctrine in the West.
3. Resurrection Rehearsed. The focus was on asceticism as transformative practice -including transformation as designed by a hierarchical configuration of gender; martyrdom and the ascetic agon as transformation, and the idea that likeness to the angels might be attained and life in paradise rehearsed already before death. By Jesus' resurrection death was rendered invisible as one always looked past and beyond it. The capacity to see what is spiritually true already in this life of the flesh and past the flesh, was cultivated. Yet flesh and sense perception continued to be observed as the visible surface on which, with proper vision, one could discern the state of the invisible, spiritual interior.
4. The Generation of a Third Race: The focus was on transformation through conversion into a new social order. In antiquity human agency was conceptualized not so much in terms of individual, autonomous freedom, but in terms of "instrumental agency" to spiritual forces both good and evil. In this area especially the pedagogies and practices regarded as necessary for ongoing development and change were studied. Since exorcism, baptism, and chrism were important

as practices that signified and performed transformation, this will be further pursued in a follow-up workshop May 2008 on Rituals of Transformation.

The group worked extensively and collectively with primary sources in Greek, Coptic, Syriac and Latin, and a diversity of Christian sources was interpreted in a comparative interplay with Jewish and Greco-Roman texts. The project did not presume an overarching theoretical model as each participant had the freedom to contribute from his or her own position and field of expertise,

The results will be published by DeGruyter in 2008 as a large collective volume.

Content

Content

Foreword

The Centre for Advanced Study (CAS) in Oslo has two paramount long-term objectives. The first is to raise the quality of Norwegian basic (fundamental) research to the highest international calibre and standards, not least by improving in-depth specialization and penetration. The second objective is to promote high quality in an effort to reach the same level of excellence when it comes to interdisciplinary basic research. This calls for a holistic approach, i.e. for integration in breadth as well as in depth, to improve basic complex system science. The two objectives relate equally to the humanities, the social sciences and the natural sciences, and the intention is that they find expression within and between the three fields of academe.

CAS has no scientific staff of its own. Consequently, to meet its objectives, the Centre recruits among the most distinguished, accomplished researchers, and provides first-rate working conditions that enable them to devote themselves completely to research. Six Norwegian universities and one high-level research college contribute towards this end (see the presentation of CAS at the back of the title page). Through formalized cooperation arrangements, these institutions nominate candidates for an annual competition among leading scientists. The winners will spend one year at the Centre as heads of international research projects and teams. The rather lengthy selection process is guided by one criterion only: *scientific quality*. It involves multiple screening phases and international peer reviews of the more promising nominees. After eight to nine months of screening and assessment, three outstanding scientific groups are selected by CAS' Board of Directors for a one-year stay at the Centre. The Board selects one group in the humanities, one in the social sciences and one in the natural sciences. In cooperation with its partners, the Centre provides full funding for these groups.

There are no preferences regarding the topics chosen for research at the Centre. As long as the topics are researchable and the project proposals and team members can be held to high scientific standards, any topic is eligible for nomination. Thus, CAS has no enduring thematic profile. CAS' profile is compositional, in that humanists, social scientists and natural scientists are present at the Centre at all times. This opens up interesting opportunities for interdisciplinary work, not least because CAS' premises are physically restricted, i.e. the logistical structure is one of oneness. This means that CAS is located in one building, and has one seminar room, one luncheon room, one administrative staff and one scientific director. This is a new situation for most of CAS' guest professors. Most of them are used to working at different faculties located in different buildings and in different departments located on different floors, using different seminar rooms, auditoriums and dining facilities. On an ordinary campus, professors are separated by lawns (do not step on the grass?), asphalt (hard to walk on?) and floors (linked by steep stairs and out-of-order elevators?). All such small but telling obstacles must be overcome to meet with colleagues in other departments. At CAS, the fellows are all located in the same multidisciplinary faculty. They share all facilities, so there are no obstacles to overcome. This mix of academic special-

ties, the physical closeness of the groups and the oneness of the infrastructure, makes CAS an ideal arena for science dialogue across disciplinary boundaries and academic fields.

This book embraces the results of a series of weekly luncheon seminars at which the Centre's fellows have presented their respective specialties for the purpose of fostering multidisciplinary dialogue between the groups and across disciplinary delineations. Three scientific groups were in operation throughout the 2006/2007 academic year. The humanists addressed the topic of *Metamorphoses: Resurrection, Taxonomies and Early Transformative Practices in Early Christianity*. The social scientists aimed at developing a more comprehensive understanding of the *Changing Family Patterns in Norway and other Industrialized Countries: Determinants, Consequences and Projected Trends*, while natural scientists were concerned with *Spin and Charge Flow in Nanostructures*.

It turned out that the central topics of discussion at the seminars focused on differences and overlaps in methods, theories and approaches. World views were contrasted. The social and natural scientists had a common denominator in quantitative methods and mathematically based statistics, whereas the methodological tools of the humanist group involved qualitative assessments and the interpretation of ancient texts and archeological finds. This made up a highly diverse and varied basis for the intellectual interchange of ideas between partly contrasting research cultures, highlighting their pros and cons, flaws and strengths.

To provide an overall synthetic perspective on the book, the editor has contributed an introductory article on *Crossing Scientific Boundaries by Way of Disciplines*, arguing that disciplinary specialties have become *de facto* mergers of scientific disciplines acting as the first principle of interdisciplinarity. To succeed in synthesizing bits and pieces across disciplinary boundaries, we must consider the nature of disciplines in light of hybridization.

All the articles in this book have been peer reviewed and adapted to preserve a reasonable standard of popularization without compromising the high standards of sound scientific and scholarly research and reporting. Altogether, specialists from eight countries took part in the evaluation process.

CAS is publishing this book for two reasons: first, to make the multi- and interdisciplinary discussions of the groups available to a wider readership, nationally as well as internationally. Hopefully, providing the e-mail addresses of the authors will facilitate communication between readers and authors. Second, and closely related to the first point, we aspire to help break down the alleged "ivory tower of basic research" by disseminating a scientifically reliable book written to appeal to readers outside the realm of pure experts.

Enjoy!

Oslo, January 2008
Willy Østreng
Scientific Director and Editor

Acknowledgement

This booklet involves the work and involvement of many individuals. Bjarne Røsjø at *Bjarne Røsjø Media* has effectively coordinated the work process between the designer, CAS and the printer, whereas Ketill Berger at *Film & Form* is responsible for the attractive design of the book. The language editing has been competently done by our language consultant Linda Sivesind at *Informatic Translations*, whereas Unn H. Hagen at *CAS* has invested long hours in a most conscientious proof reading process. Marit Finnemyhr Strøm has – as always – assisted where and when need be. A special thank goes to Maria M. L. Sætre who took care of all the organisational and planning matters involved in producing the book. She also took all the nice looking portraits of the authors, and made the proof-reading process smooth and effective. Indeed, she has filled the function of an assistant editor compensating for all the shortcomings of the editor. The referees – whose names for obvious reasons can not be disclosed – took time off from hectic workdays to secure the popularized scientific quality of the publication. They deserve the collective gratitude of CAS. Last but not least, the Board members of the Centre should be commended for forging a book policy that complies with the strict scientific standards embedded in the overall objectives of the Centre. To all these individuals, the editor would like to express his deep appreciation.

WILLY ØSTRENG

Crossing Scientific Boundaries by Way of Disciplines

Several of the articles in this book address topics at the interface of disciplines. The focus of this introductory article is thus on the characteristics of disciplines and their ability to interact with each other to achieve interdisciplinarity in complex matters.

What is a scientific discipline?

The Latin term *disciplina* dates back to antiquity and refers to the instruction of disciples. Initially, it referred only to teaching and learning in the domain of the liberal arts, whereas research based on experiments or other form of empirical exploration was not added until the period from 1750 to 1850. The term 'discipline' currently includes both the production of new knowledge through research, and its transmission in an educational and organizational context.

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At present, a discipline has a distinct subject matter, a research agenda, a curriculum, an associated theoretical framework and a common approach to study using appropriate techniques for understanding and discovering new knowledge. This means that disciplines are relatively delimited contingent of researchers who work within the academic and intellectual bounds considered theoretically legitimate among themselves. Biologists are supposed to concentrate on biology, psychologists on the mind, theologians on God, political scientists on politics, etc. In extreme historical cases, topics and issues were claimed the 'property' of designated disciplines, not to be shared or touched by others. Change is long overdue.

There is nothing absolute or sacred about disciplinary boundaries. They have not been established by intellectual consensus among representatives of adjacent disciplines, and there is simply no single criterion that dictates the setting of such boundaries. Thus, the delimitations are to some extent arbitrary, elusive, constantly disputed and artificial. Disciplines are not homogeneous units, and the stability and orderliness associated with mono-disciplinary research are often overstated and idealized.

The structure of disciplines is in a permanent state of flux: new disciplines emerge, established disciplines may shrink and fade away, or they may grow and recombine with others or disintegrate into several independent specialties. Thus the border areas, i.e. the peripheries, of disciplines act more like *transition zones* for the overlapping of disciplines than as distinct boundary lines (Matthews and Herbert, 04: 383). In the sociology of science, disciplines are defined as conglomerates of several subfields with multiple kinds of links to other disciplines and their subfields. From

this point of view, a discipline is a 'cluster of specialties' – a multidimensional network in which it is difficult to identify a pure core that is independent from other disciplines (Bruun *et al.*, 05:27). Thus, the disciplines are to a large extent connected horizontally to each other through their respective specialties. This is to say that disciplinary specialties, which provide depth to research, are the backbone of interdisciplinarity, which provides breadth to research. The very concept of interdisciplinarity presupposes the existence of disciplines, which are the bureaucratic unit around which education, research and teaching are organized and implemented in most western universities. Thus, a discipline is best defined by its actual use and integrative ability as an *organizational unit for teaching and research, containing a network of professional links to other disciplines through its respective specialties*. In this way, disciplines constitute lasting entities of knowledge integration and organization.

Crossing boundaries

Disciplinary boundaries can be transcended in two partly interconnected ways: by *boundary-breaking* and *boundary-bridging*.

Boundaries are broken when practitioners of one discipline turn to a different discipline for a new way of construing their own discipline or seek to bring part of the territory of another discipline under their own wings. Such boundary-breaking practices, long declared to represent subversive imperialism, have now become the accepted mode of behaviour for disciplinary researchers. We witness 'trespassing' on the turfs of others when psychologists extend their field from the human psyche to include humanistic disciplines such as art, religion and morals, or when political scientists study the political implications of novel technology, culture, religion, etc. Here, the same topics are addressed by many disciplines, and similar methodologies are applied across starkly contrasting fields. We witness what is known as *extended mono-disciplinarity* in which the role of boundaries is played down.

Boundary-bridging takes place when representatives of one discipline draw upon the work of related disciplines to solve problems as these problems are defined within their own discipline. These crossovers happen in the interface where two or more disciplines meet. These zones are the venue of fields, the fuzzy area where parts of disciplines, mingle, blend, change and multiply. These zones are where *hybridization* occurs.

Hybridization implies an overlapping of and contact between segments (specialties) of more than two disciplines, a recombination of knowledge and competence in new specialized fields and an activation of the multidimensional network of specialties. Specialization has given rise to a number of interactions when disciplinarians approach each other's borders. It is the combination of specialties that produces integration between disciplines and reconfiguration of the disciplinary structure (Klein, 90:43). Many of the most creative specialties are hybrids. Re-combinations among them arise in the borrowing of concepts, theories and methods. In the history of science, a two-fold process can be observed: specialization within disciplines, accompanied by their fragmentation, is the first process, whereas the recombination of specialties across disciplinary borders is the second (Dogan, 01: 14851–14855). Hybridization, which has also been labelled the *genetic recombination of science*, takes place because specialization leaves gaps between disciplines and specialties and those gaps have to be

filled. This gap-filling process creates *hybrid disciplines* or *multidisciplinary disciplines*, i.e. a conglomerate of specialties sharing a common focus and/or object of interest or study. Political science is an example of a multidisciplinary discipline established in the interface between history, sociology, international law, geography, ethnography, social psychology and economics. This being the case, political analysis applies the methods and concepts of many disciplines interchangeably. At the same time, it is a distinct discipline in its own right through its defined and delimited focus on *politics* as a human phenomenon. The difference between *political science*, *political sociology*, *political economy*, *political-geography*, etc. is one of emphasis rather than kind, and the delimitations between them are indicative of the arbitrariness of disciplinary boundaries. Many of the hybrid disciplines also bridge the assumed gorge between natural and behavioural sciences by spinning off from their parent disciplines and finding new expressions in fresh settings or conglomerations. As a mix of cognitive psychology, artificial intelligence, linguistics, anthropology, genetics and philosophy, *cognitive science* is one of several examples of hybridization across the hard and soft sciences. Socio-biology is another.

Summing up

Disciplines are conglomerates of specialties penetrating, bridging or breaking the soft and elusive borders erected between their parent disciplines. Disciplinary specialties have resulted in mergers of scientific fields – the first principle of interdisciplinarity. Thus, in the extended monodisciplinary structure in which disciplines are subject to continued hybridization, specialties have become the dominant feature.

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ARNE BRATAAS

Schrödinger's Cat in Nanoscopolis

Schrödinger's cat

Schrödinger's cat is a provocative thought experiment that illustrates the novelty of quantum physics. Published in 1935, Erwin Schrödinger described the cat paradox shortly after co-fostering the invention of quantum mechanics [Schrödinger, 1935]:

> "One can even set up quite ridiculous cases. A cat is penned in a steel chamber, along with the following diabolical device (which must be secured against direct interference by the cat); In a Geiger counter there is a tiny bit of radioactive substance, so small that perhaps in the course of one hour one of the atoms decays, but also, with equal probability, perhaps none, if it happens, the counter tube discharges and through a relay releases a hammer which shatters a small flask of hydrocyanic acid. If one has left this entire system to itself for an hour, one would say that the cat still lives, if meanwhile, no atom has decayed. The first atomic decay would have poisoned it. The Psi function for the entire system would express this by having in it the living and the dead cat (pardon the expression) mixed or smeared out in equal parts."

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Quantum physics, through the wave function Psi, describes the quantitative behaviour of microscopic particles and their interactions. According to quantum physics, a system is allowed to be in a simultaneous superposition of two or more states. This appears to be at odds with the nature we observe in our daily life. Schrödinger's cat illustrates what happens if a macroscopic object would behave as a single microscopic particle. Our naïve intuition tells us that the cat cannot be dead and alive at the same time, yet, for simple and small enough entities, the analogue of this is exactly what occurs.

The macroscopic world is also determined by quantum physics, although its quantum nature is seldom directly encountered. A macroscopic object consists of a very large number of microscopic particles, and in order for the macroscopic object to exhibit measurable quantum features, all microscopic particles must be in coherently related states. For a huge number of microscopic particles that are the building blocks of a macroscopic object, macroscopic quantum behaviour is often extremely unlikely. Usually, macroscopic quantum behaviour is so rare that for all practical purposes, even by waiting as long as the age of the universe, it is impossible to observe it. Besides, macroscopic objects are also coupled to other macroscopic objects that further decrease quantum coherence.

In contrast, in the classical world, the world as it was understood before the invention of quantum physics, the universe is intuitive and predestined, and there is clarity over where a particle or wave moves and resides. This picture agrees more with our daily intuition. For these reasons, quantum physics might appear for many as philosophical, controversial, complicated and not well understood. However, most researchers in the field of quantum physics have a more pragmatic point of view: quantum physics is a mathematical, precise, and universal tool for describing various natural phenomena.

Technology

In 1965, the co-founder of Intel, Gordon Moore, observed that the number of transistors on an integrated circuit roughly doubles every two years [Moore, 1965]. Four decades later, we still benefit from this continued technological progress. The resulting exponential growth is known as Moore's Law and is followed by an exponential miniaturizing of nanoelectronics components. Today (2007), the minimum feature size of a transistor in an Intel Pentium processor is around 50nm. This is a very small length scale that should be compared to the distance between the atoms in silicon which is around 0.5 nm. If the exponential reduction in transistor size continues, a transistor will be as small as an atom around the year 2020! It is therefore unlikely that the same growth can continue in the same way for the next two decades. This technological growth will come to an end, or completely new concepts will have to be introduced.

Moore's Law, and the rapid miniaturization towards atomic size, pose technological challenges: First, envisage a computer with one atom per bit, and an efficient transfer of information with one photon (the smallest light quanta) per bit. Second, consider an even more exotic scenario: Develop a quantum computer with less than one atom per bit, and less than one photon per bit quantum information transfer.

Classically, information is stored as '1' and '0'. This is typically represented in a computer by a high or low electric voltage. These high or low electric voltage signals are induced by millions of charged electrons. The resulting '1' and '0' information bits are classic since they result from the average properties of a huge number of microscopic particles that are unlikely to be in one unique macroscopic quantum state. A quantum bit can store '1' and '0' in the same way that the cat is dead and alive in Schrödinger's thought experiment. Even more important, two or more quantum bits can be in *entangled states* in which the quantum bits must be described with reference to each other and not individually. Some important computer algorithms are much faster on a hypothetical quantum computer. For example, Shor's quantum algorithm factorizes a number much faster than known classical algorithms [Shor, 1997]. This might appear as an academic problem, but is in practice significant because it implies that public key cryptography can be broken. Many cryptography schemes use a public key number which is the product of two large prime numbers. These codes can be opened by factoring the public key, which is impossible on a conventional computer because it takes too much time, but feasible on a large enough quantum computer. Similarly, a quantum computer can also solve other problems that are impossible to handle

on conventional computers. However, Dell and HP do not sell quantum computers. So far, prototype experimental work has only realized less than 10 quantum bits that work coherently together.

Nanoscopolis

The subject of quantum physics was invented in response to the observed behaviour of atoms. Atomic physics is therefore the prime example of applied quantum mechanics. It is microscopic since the elementary particles, the nucleus and the electron, set the natural length unit at 0.05 nanometres, which is the radius of a hydrogen atom. With atoms as building blocks, we have explored the properties of condensed matter surrounding us and what is often termed the macroscopic world. Quantum physics dictates the behaviour of materials, e.g. the common metals Al and Cu, semiconductors Si, and ferromagnets Fe. The macroscopic features are results of intricate quantum mechanical behaviour at the level of the inter-atomic distance between atoms in a solid, typically on the order of 0.5 nm. For instance, semiconductors and magnets cannot be understood without invoking quantum physics. However, although quantum physics dictates material properties, phenomena such as quantum entanglement and quantum interference are usually not seen in macroscopic materials like Al, Cu, Si and Fe. The properties of most material compounds in nature are already determined by nature in the sense that they depend on the exact arrangement of the atoms.

The existence of an interesting intermediate world of phenomena where the bizarre rules of quantum theory are measurable with techniques normally applied to macroscopic matter, is the key issue in an exciting new field: physics on the nano-scale, or physics in nanoscopolis. For instance, electrical resistance can become quantized for sufficiently small semiconductor devices [van Wees, 1988].

Allow me to illustrate how small a nanometre is. The road from Trondheim to Oslo in Norway is about 500 kilometres long. Let us imagine that we put coffee cups in a row along the road from Trondheim to Oslo. We can then take a satellite picture of the road with the cups and print it out on a normal sheet of paper in front of us. In nanoscopolis, the objects are as small as the coffee cups in this picture. They are much larger than the interatomic distances, yet very much smaller than objects that we can observe with our eyes.

In 1989, Don Eigler wrote nano-history. The IBM scientist used 35 xenon atoms to spell the IBM logo [Eigler, 1990]. This signalled a new trend in which technology can change the arrangement of atoms down to the atomic level. The quantum features that occur in nanoscopolis are fundamentally interesting and could possibly also be used in modern technology. State-of-the-art technology enables material growth atom by atom. This unprecedented precision allows the construction of new materials with desired electrical, magnetic and mechanical behaviour.

In nanoscopolis, researchers are able to use precise tools to construct *artificial atoms*. These *quantum dots* are areas where electrons are confined in materials. By manipulating these materials, *artificial atoms* can be constructed with desired properties. A major part of the motivation for research on materials in nanoscopolis has less ambitious aims. The goal is to design devices with new degrees of freedom arising from their quantum nature, less energy loss, and reduced size. One such 'new' degree of

freedom is the electron spin. The electron was discovered by J. J. Thomson in 1897, making it the first sub-atomic particle ever detected. It has an electrical charge. Two types of experimental evidence which arose in the 1920s suggested an additional property of the electron and an intrinsic angular momentum as if the electron were spinning around its own axis. This quantum property was called electron spin.

An electron has a spin as well as a charge. The recognition of spin as binary variable analogues to electrons and holes in semiconductors has opened new fields of science and technology that have already led to commercial devices and hold great promise for nanoscale science and information technology. The giant magneto resistance (GMR) in magnetic metallic multi-layers discovered only fifteen years ago was applied to magneto-resistive read heads for hard disks in high-end desktop computers five years ago and is the dominant technology in this field [IBM, 1997].

Conclusions

The quantum world is very different from our intuitive understanding of the classical world. Technological needs and scientific curiosity are going to drive the miniaturization of magnetic structures into the mesoscopic and nanoscopic regimes in which the basic physics has still to be explored. In the not too far distance, the technology might take into account the bizarre nature of quantum physics. It is far from clear whether quantum computers will ever actually be made, but on the way to such a paradigm, we will get a better understanding of quantum physics on a larger scale and with a higher degree of precision than ever before.

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HUGO LUNDHAUG

Cognitive Poetics and Ancient Texts

The problems facing us in the study of antiquity are manifold. For a start, our written sources are often preserved in languages that are no longer in use, such as classical Greek, Latin or Coptic. Furthermore, the societies that produced them differed significantly from our own and are far removed from us in time. This causes all manner of interpretive problems, for it means that a significant number of the concepts and categories that are referred to or simply presupposed by the ancient authors, are foreign to us. In addition, like modern literature, ancient literary sources are often highly allusive, and frequently directed to an audience of insiders – people in the know who would be able to understand both subtle and not-so-subtle references to, e.g. the literature, politics and religious life of the day. While the intended recipients' knowledge of these matters was taken for granted, such references are often far from obvious for us as modern readers. For in relation to us, *all* ancient texts may in a sense be regarded as directed to an audience of insiders. Moreover, the lack of contextual information, such as a certain date and provenance for the texts, often contributes to making the task of interpretation even more difficult.

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Since we do not have access to the heads of the ancient authors or readers, and have at best only limited access to the ancient context(s), we need of analytical tools to help us map out, and become aware of, the various interpretive possibilities of the ancient texts. We also need them to help us outline potential patterns of interpretation, taking into account the presence of various hypothetical allusions and references, both subtle and not so subtle, in our delineation of the meaning potential of the ancient sources.

A cognitive turn

While the study of ancient texts may seem far removed from modern-day theories of mind, the former enterprise may in fact benefit substantially from insights gained within the latter field of study. Although the ancient societies and the sources we have at our disposal are indeed far removed from our own day, these ancient societies were populated with people possessing, from a biological and evolutionary point of view, essentially the same brains and bodies as we do. A new approach to tackling the above-mentioned problems is thus to take into account recent theories of the workings of the human mind in categorization, conceptualization, creativity, and even emotion – in thinking and feeling – developed within the cognitive sciences – disciplines that deal with human and artificial

minds, focusing especially on the conscious and unconscious representation, organization and use of knowledge. This brings us to *cognitive poetics*, a term that covers all applications of the cognitive sciences to the study of literature. This is a relatively new, but rapidly expanding, interdisciplinary and multi-methodological field of study that has its main roots in linguistics, psychology and literary theory, and draws broadly on research within the cognitive sciences (see Stockwell 2002; Gavins and Steen 2003; Kövecses 2006, 5). It thereby constitutes an attempt to ground the study of literature in the study of human cognition (cf. Turner 1991, viii).

Construction of meaning

It is a major presupposition of cognitive poetics that meaning is not something that resides *in* a text, but is rather something that is constructed by the recipient in his or her encounter with the text. From this perspective, meaning is not a property of words, sentences, or texts, or of their relation to some kind of objectively defined state of affairs, or truth conditions, but rather something that "arises from a dynamic process of meaning construction" (Evans and Green 2006, 396). "Expressions do not mean; they are prompts for us to construct meanings by working with processes we already know", as Mark Turner puts it (Turner 1991, 206). This also implies that words, sentences, and texts cannot meaningfully be analyzed apart from discourse context, nor can semantic meaning meaningfully be separated from pragmatic meaning. Words, sentences and texts certainly guide the production of meaning, but they do not determine it (cf. Fauconnier 1994, xxii–xxiii; Turner 1991, 206). The process of making sense of a text, then, is not to be regarded as a matter of *decoding* meaning that is *inherent in* the text, but rather as a process of *constructing* meaning *on the basis of* it. Now, how can such mental processes of meaning construction be modelled to help us analyze texts?

Mental spaces and blending

One of the most promising recent developments in the cognitive study of literature is constituted by the emergence of Blending Theory. This theory deals with how the selective combination of two or more mental spaces create new mental 'blended spaces' that also contain new elements not derived from any one of the contributing input spaces, but which emerge from the combination itself (see Turner 2002, 10; the most comprehensive formulation of Blending Theory is found in Fauconnier and Turner 2002, but see also esp. Fauconnier and Turner 1998; Coulson and Oakley 2000; Grady 2000; Kövecses 2002, 227–238; Kövecses 2006, 271–293; Evans and Green 2006, 400–444). We may use the framework of Blending Theory to model any kind of interpretation, including the interpretation of texts, ancient and modern alike. From this point of view, interpretation is understood as a process of meaning production involving the construction and combination of mental spaces cued in the experience of reading and structured by context, understood in a broad sense, and the reader's prior knowledge and memories.

The 'mental spaces' referred to here can be described as 'small conceptual packets' that are continually being constructed mentally while thinking, "for purposes of local understanding and action" (Fauconnier and Turner 1998, 137; Fauconnier and Turner 2002, 40, 102). Since the composition of mental spaces is fundamentally tied to the process

of memory recall, important insights of memory research should be taken into account, not least the realization of the fundamentally interpretive of *any* memory recall. The recall of memories is not analogous to simply taking an object out of a container or playing back a video clip, but involves rather the construction of mental representations that are "attempts at replication of patterns that were once experienced" (Damasio 1994, 100–101; cf. also Schacter 1996). It is not only the process of blending itself, then, that has a constructive and interpretive quality to it, but also the very process of calling up and assembling the basic mental spaces that are the constitutive parts of that process. This recall and construction of memories is also crucially dependent on the way in which the recalled memory fragments have been encoded in the first place (see, e.g., Schacter 1996), and on mechanisms such as 'priming,' which may be described as the process by which the activation of one memory partially, and often unconsciously, activates – primes – related memories for easier subsequent recall (Snyder 2000, 262; on priming, see also Hogan 2003; Tulving and Schacter 1990; Knowlton 1997, 222–228). This helps us understand the way in which mental spaces are constructed and called up to the blending processes taking place in working memory and not least the function of context and memory encoding in this regard.

These theories provide us with general models for the description and analysis of "interconnections between parts of complex conceptual structures" (Sweetser 1999, 134–135), and the creative production of new and complex structures of meaning on the basis of simple constituents in processes that follow a limited number of general principles. Cognitive poetics, then, provides us with tools that enable us to "describe the systems that allow specific examples of human representational complexity and creativity to emerge" (Spolsky 2004, ix–x).

Conclusion

If we want to get to grips with, say, how the idea of bodily resurrection was understood by various individuals and groups in Christian antiquity, we need to have some ideas as to the categories and concepts that are operative in the literary sources they produced. Using methods based on current theories of how the human mind works in categorizing and conceptualizing the world, and in producing meaning on the basis of literary texts, may help us in two distinct ways. It may help us understand how we, as modern readers, make sense of, i.e. produce meaning on the basis of, the ancient texts, and thus to be aware of what goes into our own understanding of the material aspects of terms of our own categories and concepts, and those we attribute, consciously or unconsciously, to the ancient authors. Secondly, it may help make us aware of additional interpretive possibilities – interpretive possibilities that may have been intuitively apparent to the intended ancient readers, but which are obscure to modern scholars.

An awareness of how the mind works in creating, making connections between, and blending mental spaces should help us in analyzing the various possibilities of meaning construction available also in antiquity. While it should make us painfully aware of the impossibility of gaining any kind of firm knowledge concerning the interpretation of ancient readers, not to mention the intentions of the ancient authors, the application of the above outlined analytical tools may help us map out various

possible readings of the ancient texts and to discover possible webs of meaning that are not immediately available to us as modern readers. Using Blending Theory, for instance, we can more easily experiment with different readings by adding and subtracting different input spaces, frames and cognitive models to try out various hypothetical interpretive possibilities.

The use of cognitive poetics in the analysis of ancient texts does not solve our interpretive problems, but it does furnish us with theoretical frameworks that should heighten our awareness of the problems while helping us cope with them in a systematic and methodologically sound manner, grounded in multi-disciplinary research on human cognition.

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NICO KEILMAN

Using Deterministic and Probabilistic Population Forecasts

The relevance of probabilistic population forecasts

Population forecasts inform us about the size of a population and the numbers of men and women that will be in various age groups in the future. These forecasts are important for planning purposes, for instance, to analyse future educational facilities, public pension expenditures, housing needs, etc. Other social and economic variables also play a part, e.g. participation rates for college and university students, retirement behaviour, and household size. But given a particular time frame for a forecast, the size and the age pyramid of a population are generally easier to predict than the other social and economic variables a planner needs, hence population forecasts are routinely made by statistical agencies in most countries of the world.

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Figure 1 shows an example of such a forecast, which was recently computed by Statistics Norway (Statistics Norway 2006). Norway's population is expected to increase from 4.6 million in 2005 to 6.1 million in 2060. However, we cannot exclude stronger or weaker growth. Therefore, we see two additional forecast variants, one resulting in 7.4 million persons in 2060 and the other arriving at a figure of 4.9 million. These three forecast variants are based on different assumptions for fertility, mortality and international migration. In the main variant featuring moderate population growth, the forecasters assume for 2060 a fertility level of 1.8 children per woman on average, a life expectancy of 86 years for men and 90 years for women, and net immigration of 16 000 persons. The other two variants result when one assumes higher or lower values for fertility, life expectancy, and immigration.[1]

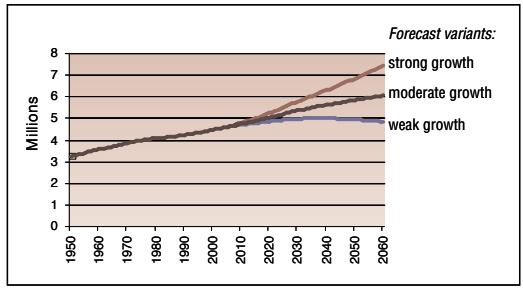

Figure 1. Population size, Norway. Registered 1950–2005. Forecast 2006–2060.

1: Statistics Norway has also published nine other combinations. One example is the so-called 'Strong ageing' variant, which results from combining low fertility, high life expectancy and low immigration.

Forecast variants

The practice of computing more than one forecast variant is standard among statistical agencies (Keilman and Cruijsen 1992). It goes back at least to 1947, when Whelpton and colleagues published their forecast for the United States. Statistical agencies follow this practice because they want to account for the fact that the future is inherently uncertain, and that different forecast assumptions will lead to different forecast outcomes. However, one major problem is that the conventional approach is entirely *deterministic*, i.e. statistical distributions are not included in the forecasting model. Hence, no probabilities are attached to the variants and this poses a problem for the user of the forecast, who has to select one of the variants as input for his analysis.[2] Therefore we advocate the use of *probabilistic* population forecasts which state the likelihood of the various outcomes. Probabilistic forecasts give future population size and age pyramids not as one number (or perhaps a few, depending on the number of variants), but as a whole range of probability distributions. The future is inherently uncertain, yet some demographic developments are more probable than other developments. The probability distributions tell us *how much* more probable. Thus, the user of a probabilistic forecast is informed about the likely magnitude of the errors, and how these errors vary across age groups or between the sexes. When a decision maker is able explicitly to deal with forecast uncertainty, this will lead to better decision making. As soon as he knows the expected costs involved in decisions based on forecast results that turn out to be wrong at a later stage, an optimal strategy can be chosen. Unfortunately, nearly all official forecasts are deterministic, not probabilistic – Statistics Netherlands is the only known exception (Alders and De Beer 1998). However, demographers and statisticians have developed methods to calculate probabilistic forecasts. By way of illustration, I shall present a probabilistic population forecast for Norway, discuss its advantages for the user compared to a deterministic forecast, and show how a probabilistic forecast can be used in practice.

A probabilistic forecast for Norway

The probabilistic forecast for Norway is part of a recently completed research project, called "Uncertain Population of Europe" (UPE). The aim of the project was to compute the probability distributions of future demographic variables such as population size, age groups etc. for 18 countries in Europe, including Norway. Details can be found at http://www.stat.fi/tup/euupe/, in Alho *et al.* (2006) and Alders *et al.* (2007). I will provide some selected results for Norway.

The results show that the odds are four to one (80 per cent chance) that the population of Norway, now 4.7 million, will number between 4.79 and 5.16 million individuals in the year 2020, and 4.84–6.76 million in 2050; see Figure 2. The interval for 2050 illustrates that long-term uncertainty is quite large; see also Figure 3. Continued growth to 2050 is probable and a decrease in population size is unlikely, but we cannot exclude such

2: Instead of uncertainty variants, the alternative interpretation of variants is that of scenarios which depict alternative futures. In this case, too, the user does not know the probability of these variants.

a trend. The probability for a population size in 2050 below the current 4.7 million is an estimated 6 per cent. Similar probability results were computed for men and women of all ages.

How do these probabilistic forecast results compare with those obtained by a conventional deterministic forecast? Statistics Norway's moderate growth forecast predicts a population size in 2050 of 5.84 million. This is slightly higher than UPE's median forecast of 5.68 million, but well inside the 80 per cent prediction interval; see Figure 2.

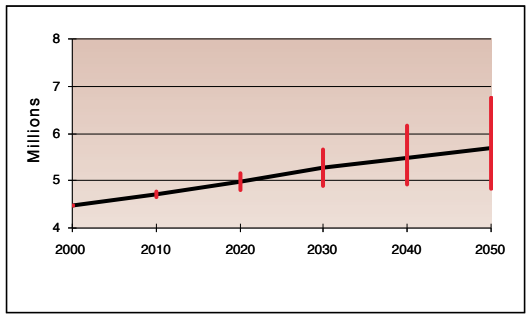

Figure 2. Total population, Norway. Median forecast (black) and 80% prediction intervals (red)

Problems related to deterministic population forecast

a) A limited number of variants leave room for politically motivated choices by the users

A probabilistic forecast forces the user to consider a whole range of results, with probabilities attached to them; see, for instance, Figure 3. The probability for one single number is zero. In contrast, a deterministic forecast includes only a limited number of outcomes, typically three or four, and no probabilities. A forecast user, when confronted with the choice between these few variants, is likely to take his decision based on subjective or political grounds, depending on vested interests. The construction firm that plans the building of a new school is more likely to use a high forecast for the future number of pupils than the school board that has to bear the costs.

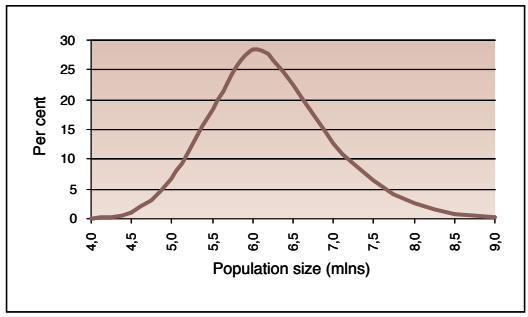

Figure 3. Predictive distribution total population size, Norway 2050

b) Two variants that are extreme for one variable are not necessarily extreme for another variable

The legal pensionable age in Norway is 67. In 2050, the population aged 67 and over will number between 1 090 000 and 1 388 000, depending on low or high population growth, and according to the deterministic forecast computed by Statistics Norway (2006). However, the Old Age Dependency Ratio (OADR), i.e. the number of 67+ as a ratio of the number aged 20–66, equals 0.377 for low population growth, and 0.368 for high population growth. The gap between these two is much smaller than one would expect based on the absolute numbers. The reason for this inconsistency is that the population of working age in this forecast

is perfectly correlated with the number of elderly. In the high growth variant, for every year in which life expectancy is high, immigration is also high, and *vice versa* for the low growth variant. A probabilistic forecast does not necessarily assume perfect correlation between these two age groups. Starting from the high and low numbers for the over 67 mentioned above, the probabilistic forecast for Norway predicts a 60 per cent probability for the population aged 67+ to total 1 090 000 to 1 388 000 individuals in 2050, corresponding to a 60 per cent interval for the OADR in 2050 stretches from 0.343 to 0.446. Thus the relative width of the interval for those over 67 as well as for the OADR in 2050 in the probabilistic forecast are of comparable value, as opposed to the narrow relative distance between the same variables in the deterministic forecast. In general, two variants in a traditional forecast that are extreme for one variable are not necessarily extreme for another variable (Lee 1998).

c) When interpreted as uncertainty intervals, coverage probabilities are small in the short run and large in the long run

As noted above, Statistics Norway has formulated a low growth and a high growth variant. These result in 4.9 and 6.8 million inhabitants in 2050, respectively. The UPE results tell us that the interval between 4.9 and 6.8 million in 2050 has a coverage probability of 78 per cent. But for 2010, when the low-high interval in Statistics Norway's forecast ranges from 4.72 to 4.78 million, the coverage probability is a mere 47 per cent. Coverage probabilities for the low-high interval that increase rapidly with increasing forecast horizon are a common problem for deterministic forecasts. The reason is that these forecasts implicitly assume perfect correlation over time. In the high variant, fertility (or life expectancy or migration) is assumed to be high in one year, and it is 100 per cent certain that it will also be high one year later, and the same applies to the low variant. This is not a realistic assumption. A probabilistic forecast does not show this defect.

Using loss functions to assess the results of a probabilistic forecast: An illustrative example

The Norwegian system for public old-age pensions is not sustainable in the long run. Therefore, the Norwegian government proposed a pension reform in the spring of 2007 (see Report No. 5 to the Storting 2006–2007). An important element of the new system is the so-called life expectancy adjustment: when mortality is low and people live longer, annual pension benefits will be lower than when mortality is high, all other things being equal. In the proposed pension system, the annual pension benefits for a retired person are equal to the total earned pension rights at the time of retirement divided by the remaining period of life expectancy in the population. Individuals may account for a possible increase in life expectancy (and thus lower annual pension benefits) by retiring later or by saving more. To fix ideas, assume that a person aged 55 plans to retire at the age of 62, at which time he expects to have earned certain pension rights. The planning consists in determining how much additional saving will be required up to age 62, given a desired level of annual pension benefits. Remaining life expectancy at age 62 has to be predicted years into the future. Write that forecast as Fe62. When this person reaches age 62 and the actual period of life expectancy Ae62 turns

out to be higher than the forecast, the actual annual benefits will be lower than predicted. This will imply a loss for the individual, which will be larger the stronger the underprediction is. When life expectancy is overpredicted (Fe62>Ae62), the individual has saved 'too much'. The person's *loss function* quantifies his loss as a function of the forecast error. When a probabilistic forecast is available at the time the decision is taken, Fe62 is a stochastic variable, as is the loss function. Thus, one may compute the expected loss, and the individual will select a life expectancy value which minimizes his expected loss. For simplicity, assume that the individual's loss function is in accordance with the following linear form

$$\begin{aligned} \text{loss} &= c(Fe62 - Ae62) \text{ for } Fe62 > Ae62 \\ &= \lambda c(Ae62 - Fe62) \text{ for } Fe62 \leq Ae62. \end{aligned}$$

c translates the forecast error Fe62-Ae62 into costs, while λ reflects the degree of symmetry in the loss function. $\lambda>1$ implies that an underprediction is more severe than an equally large overprediction (i.e. the individual perceives having saved 'too much' between ages 55 and 62 as less severe than receiving too low benefits after age 62). For this particular form of the loss function, the optimal choice of the forecast variable is that value for which the predictive distribution of Fe62 equals $\lambda/(\lambda+1)$ (e.g. Alho and Spencer 2005). Thus for a risk-neutral person who has symmetric loss function, $\lambda=1$ and the median is the optimal choice. When loss is non-symmetric, the optimal choice depends on λ and on the form of the predictive distribution of Fe62. Figure 4 plots the optimal value of the remaining life expectancy for changing λ, assuming that Fe62 is normally distributed with expectation equal to 20 years and standard deviations (denoted as s), equal to two and four years. For s = 2 years, a person whose λ equals 2.25 selects a remaining life expectancy of 21 years – one year higher than the median. When the uncertainty in the predictions becomes larger, the individual becomes more cautious. For instance, for s = 4 years, this person would select 22 years – the shift compared with the median value becomes twice as large.

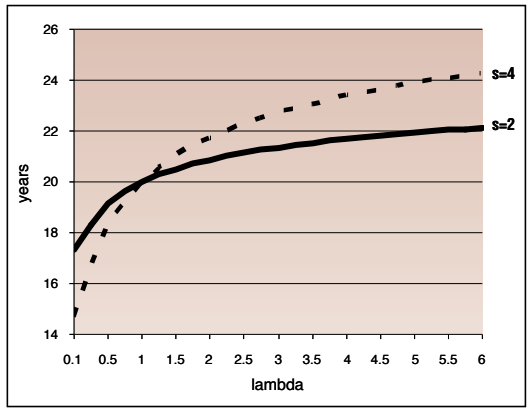

Figure 4. Optimal choice for e62

Loss functions in general are difficult to establish, in particular when non-monetary variables are of central concern. However, an important first step towards a full analysis is to check the degree of symmetry in the loss function. Is an underprediction more harmful or less harmful than an overprediction of the same magnitude? In the context of public old-age pensions, predictions of life expectancy that are too low imply a deficit in the pension fund. All else being equal, this could result in a cut in the benefits or in other welfare programs, or a rise in taxes. This compares unfavourably with a life expectancy prediction that turns out to be too

high, *ex post facto*. Hence, the managers of the public pension fund will most likely select life expectancy values that tend to be too high, rather than too low.

Final remarks

Although probabilistic forecasts are well suited to reflect forecast uncertainty, there are certainly issues connected with such forecasts. One important one is that the uncertainty parameters for probabilistic forecasts themselves are uncertain. Frequently, they result from extrapolations of observed uncertainty statistics, either model-based extrapolations or ones that are more intuitive. Thus, a possible strategy is to be cautious and not underestimate the uncertainty of the forecast (Alho *et al.* 2006). One practical issue is that the users have to know how to handle forecast results in the form of probability distributions, rather than one number. In the short term, forecast uncertainty is not important, at least not in general for most forecast results at the country level. In the long run, however, users should be aware of the costs attached to employing a forecast result that subsequently turns out to be too high or too low, see above. They should ask themselves whether an immediate decision based on the uncertain forecast is necessary, or whether they can wait for a while until a new forecast possibly shows less uncertainty. If an immediate decision is required, they should try to determine the most essential features of the loss function, and base their decisions on that.

In his British Academy Annual Lecture on 1 December 2004, the Bank of England's Governor Mervyn King stressed that in a wide range of collective decisions, it is vital to think in terms of probabilities (King 2004). We must accept the need to analyse the uncertainty that inevitably surrounds these decisions. In order to frame a public discussion in terms of risks, the public needs to receive accurate and objective information about the risks. Transparency and honesty about risks should be an essential part of both the decision-making process and the explanation of decisions. If population projections are to inform policy decisions, then uncertainty of these projections must be assessed. In some areas, greater uncertainty might lead to postponement of actions. In other policy arenas, e.g. education planning, greater uncertainty might indicate that the best polices would be those most easily changed as the future unfolds. For example, a school planner facing uncertain projections of enrolment growth might decide to rent additional space for schools rather than building or buying space. Explicitly estimating the degree of uncertainty in population projections encourages consideration of alternative population futures and the full range of implications suggested by these alternatives (Lee and Tuljapurkar 2007).

However, the public has great difficulty in understanding probabilities, and handling them. Whether occupied with weather, or inflation, or population trends in the future, forecasters should develop appropriate techniques for communicating uncertainty to the users of their services. The type of charts presented in Figure 2 for future population size of Norway are commonly used by Norges Bank in its monetary reports, and meteorologists use them for their weather reports. Population forecasters should also consider using such charts.

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FLAVIO NOGUEIRA

The Symmetry-Breaking Paradigm

In physics and philosophy, the creation of concepts plays an extremely important role. In philosophy, concepts are essentially created to enable people to think beyond common sense. As typical concepts in philosophy, we can cite the Being and the Becoming, Existence, Space and Time, among many others. In physics, concepts are created to be able to understand experiments in both quantitative and qualitative terms. Concepts in physics are often as abstract as those in philosophy, but they are usually motivated by experiments. This paper addresses a concept that is important in both physics and philosophy: the concept of symmetry and its (spontaneous) breaking.

Symmetry has been one of the most important components of human culture since antiquity. We see its presence in many constructions and objects from antiquity. Its importance was emphasized in Western philosophy for more than two thousand years. One good example of the symmetry paradigm in philosophy is Plato's *Timaeus*. There, the conjectured elementary constituents of the world, i.e. earth, water, air and fire, were associated with the so-called regular polyhedra. Thus, earth, water, air and fire were associated with the cube, octahedron, icosahedron and tetrahedron, respectively. Interestingly, more than 1000 years later, the German astronomer Johannes Kepler proposed a model of the solar system based on these regular polyhedra, now known as Platonic solids (only five planets were known in Kepler's day).

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Like Plato, physicists of the 20th and 21st centuries have used symmetries as a way to understand the universe. The way this is done in modern physics is, of course, much more involved than in Plato's time. Now we know that the four elementary constituents proposed by Plato are not elementary at all, but are themselves constituted by even more basic elements. Our present knowledge states that matter is composed of atoms, each of which is composed of a certain number of electrons, protons, and neutrons. In turn, protons and neutrons are composed of particles called quarks. As in the case of Plato's 'elementary constituents', a symmetry theory underlies the physics of the elementary particles. However, the symmetry paradigm of modern physics contains an additional ingredient known as *spontaneous symmetry-breaking*. This revolutionary new concept of physics is very important, also outside the physics of elementary particles. It is also fundamental in other fields of physics such as solid state physics, for example. Let us try to understand this concept.

Mathematically speaking, symmetry is characterized by the invariance of some mathematical object under some transformation. For example, the parabola $y=x^2$ is symmetrical with respect to the y-axis, since it is invariant under the transformation that takes the variable x and trans-

forms it into –x. In physics, mathematical symmetries imply conservation laws. For instance, translation invariance implies momentum conservation, while rotational invariance implies angular momentum conservation. What is interesting about symmetry in physics is its universal aspect: the conservation laws implied by them occur in classical as well as quantum physics. This aspect of the symmetry paradigm survives quantization. But what is the symmetry-breaking paradigm? If symmetries are so attractive and lead to conservation laws, why break them?

There are two ways of breaking symmetry: explicitly and spontaneously, the latter being more subtle than the former. To understand the difference in simple terms, let us imagine that we are watching people walking in some square downtown in Oslo. On a sunny day, many people will be walking in random directions. Some walk south, others east, while yet others walk towards the northwest. In other words, there is no preferred global direction for the crowd as a whole. Now suppose that someone suddenly starts to do something spectacular from the top of a building in front of the square. Most of the people will simply stop and look up, very impressed. They will all look in the same direction, instead continuing on their ways in different directions. This is an example of explicit symmetry-breaking, where some action external to the behaviour of people in the square makes all of them to behave in the same way, i.e. they all look up. Spontaneous symmetry-breaking, on the other hand, involves a more subtle mechanism. As a general example, we can imagine that a single person among the people walking randomly in the square stops and starts simply to look up in a very curious manner. When someone else notices this, he or she also stops and looks up. This induces others to do the same, i.e. to stop what they are doing simply to look up like the others. Eventually, everyone (or almost everyone) will be looking up and the symmetry will be broken once again.

The difference from the first situation is that it was the interaction between the people there in the square rather than an external agent that led to the uniform behaviour of the crowd. People looked up not because there was something up there that deserved attention, but simply because they saw others looking up. This is an example of spontaneous symmetry-breaking.

One standard example of spontaneous symmetry-breaking in physics is ferromagnetism. Everybody knows that permanent magnets exist. However, not everyone knows how the phenomenon works. In a ferromagnet, the magnetization of the individual atoms composing the material all point in the same direction. In a paramagnet, on the other hand, the magnetization of individual atoms points in random directions. Since the number of atoms is extremely large, all possible directions occur and the system has rotational invariance. This situation is similar to our example of many people walking in different directions. However, in the case of a ferromagnet, there is a preferred direction in space, since the magnetizations of individual atoms point in the same direction. In this case, rotational invariance is broken. Permanent magnets are said to have *spontaneous magnetization,* since no external magnetic field keeps the sample polarized. This is the result of the spontaneous symmetry-breaking caused by the rotational invariance of the magnetization. In ferromagnets, this occurs if the temperature is low enough. In a ferromagnetic substance, an external field is applied to polarize the sample and, as the temperature

is lowered below a certain critical value, the external field is switched off and the magnetization still remains. One important aspect of this phenomenon is that the ferromagnetic state is *ordered*, i.e. the magnetizations all point in the same direction. Thus, this example shows that less symmetry implies more order!

A mechanism similar to the one in our example of ferromagnetism occurs in a much more complicated way in a standard model of elementary particles. Here too, less symmetry implies more order. This is actually the main signature of spontaneous symmetry-breaking in general. In the context of the physics of elementary particles, spontaneous symmetry-breaking provides a consistent mechanism by which the masses of particles are generated. Thus, the symmetry-breaking pattern in the standard model explains why some particles have mass while others have not. Most of the remarkable predictions in respect of the standard model are based on this paradigm.

The building blocks of matter, i.e. elementary particles, are understood through symmetry principles. Thus, we see that we owe a great deal to Plato, who believed that symmetry is the key to understanding the universe. Modern physicists agree.

YAROSLAV TSERKOVNYAK

Objective Reality with Quantum Mechanics:

Can Spins Really Dance?

Introduction

Although our understanding of nature constantly improves and the fundamental concepts in science have been extended and refined, the opportunities in basic research are not becoming more scarce. On the contrary, there is always an abundance of fascinating problems. After some 'stagnation' of fundamental physics at the turn of the 19th century, when it seemed that all basic questions were being sorted out, mainly under the impression of the successes of the Lagrangian formulation of classical mechanics and the ground-breaking theories of statistical mechanics and classical electromagnetism, the 20th century ushered in the era of Einstein's special and general relativity and the quantum-mechanical formulation of microscopic phenomena. The following discussion concerns an interplay of special relativity and quantum mechanics in electron transport in semiconducting structures, so-called spin-orbit interaction. Please note that a full merger of relativistic and quantum paradigms yet to be achieved. More specifically, the gravitational forces have not being incorporated into the 'standard model' of elementary particles and interactions. However, these issues are beyond the scope of this paper, and, in fact, outside the field of condensed matter physics as a whole.

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Spin

Let us start with a quick digression into discussing what spin is and the role it plays in physics. Spin, or the intrinsic angular momentum (which characterizes the amount of rotational motion within a particle), is a fundamental quantum-mechanical property of elementary particles. First of all, according to its magnitude, spin divides all elementary particles, as well as most known compound particles, such as atoms, and many effective quasi-particles in collective phenomena, into two categories: bosons and fermions. Bosons are particles that have integer value of spin in terms of the spin quantum $\hbar$, which is called Planck's constant. Fermions are particles with half-integer value of spin. In other words, the former have spin 0, 1, 2, … while the latter $^1/_2$, $^3/_2$, $^5/_2$, … Planck's constant $\hbar$ is one of the most celebrated fundamental constants in modern physics, appearing, e.g. in wave optics, quantum mechanics, statistical mechanics, and the knowledge of its value is being continuously improved. It equals approximately 1.05×10^{-34} J s, in the SI units. The main qualitative difference

between bosons and fermions, besides their spin, is their quantum statistics. Quantum statistics, which has no analogs in the classical view of nature, describes what happens to the wave function (which reflects the state of quantum systems similarly to the way particle positions do for the classical systems) when two identical particles exchange positions. Although nothing physically observable should happen to the system when the positions of two indistinguishable particles are exchanged, the quantum formulation allows for an overall sign of the wave function to be flipped. It turns out the fermions do flip the sign, while the bosons do not. This may not seem like that much of a difference at first glance, which is true at high temperatures, but as the system starts to cool down, quantum statistics start having a profound impact on the macroscopic properties of matter. In particular, fermion statistics dictate that two identical particles cannot fall into the same quantum state, i.e. the Pauli exclusion principle. Boson statistics, on the other hand, do not suffer from this restriction, and particles tend to exploit this freedom at low temperatures to minimize the total energy. In fact, at sufficiently low temperatures, a macroscopic body consisting of identical bosons may undergo a phase transition into a different state of matter when a sizable portion of particles collapse into the same lowest-energy quantum state. This is known as Bose-Einstein condensation, resulting in a macroscopic object with pronounced quantum properties.

Figure 1: Rotating top: Its moment of rotation is closely analogous to the spin property of quantum-mechanical particles, especially for large spins.

Although it follows from this discussion that spin is intricately related to the formulation of quantum mechanics, this does have an obvious classical analog (as most quantum 'observables' do). It turns out, nevertheless, the large spins (on the scale of one $\hbar$) are very similar to the classical top sketched in Fig. 1. This analogy, however, has to be taken with caution for small spins, such as electron's spin $\hbar/2$. I will say a bit more about the relationship between the classical top and the spin in the next section.

Quantum mechanics

One can follow the development of most quantum mechanics theories by starting with the 'modern', i.e., Lagrangian formulation of the classical

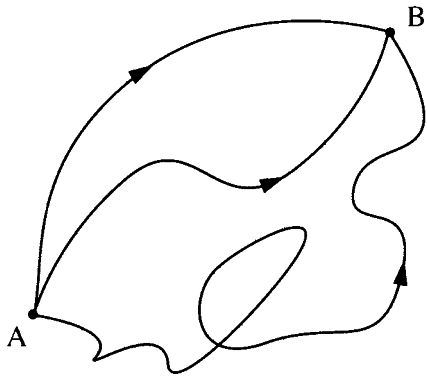

Figure 2: Quantum 'propagation' from A to B: All possible trajectories interfere, similar to wave interference in optics. There is always a path along which this interference is mostly constructive, which corresponds to the classical path. At high energies, almost all quantum weight lies close to this 'classical' path, which is only slightly 'fuzzy', as required by the Heisenberg's uncertainty principle.

mechanics (which dates back to the 18th century), based on the principle of the least action and defining the quantum-mechanical propagation of particles in terms of path integrals. This approach, which lays foundation to a very useful view of quantum mechanics, is ascribable to Richard Feynman [1]. A cartoon of path-integral formulation is shown in Fig. 2: While the classical propagation between two points *A* and *B*, separated in space and time, is given by certain deterministic trajectories, the quantum propagation is determined by an interference of all possible trajectories, which do not have to satisfy classical laws of motion.

It is also possible to cast the spin property of elementary particles in terms of the path-integral formulation for the classical top mentioned in the previous section. This is quite awkward, however, since one has to map from three-dimensional classical rotations to the quantum-mechanical representation of spin rotations, which gets mathematically involved and is rarely pursued in practice. Instead, one is completely comfortable thinking of spins as purely quantum-mechanical objects, without worrying too much about the exact classical-to-quantum mapping. As already mentioned, the difference between the quantum and classical spins diminishes for larger spins. That is why the classical rotating top can be very accurately described by classical mechanics. Even small spins, however, like those of elementary particles, still preserve some of the similarity with their classical analogs, so that the classical point of view can often be useful for qualitative purposes.

Spin-orbit interaction

One of the most fascinating properties of spin dynamics is the so-called spin-orbit interaction. It stems from the fact that spins, in addition to mechanical rotation, also carry a 'magnetic moment'. Loosely speaking, because the mechanical rotation is performed by the internal charge of the particle, we can envisage it as a tiny loop with circulating charge, essentially a solenoid magnet. This little magnet responds to the magnetic field, much like classical magnetized particles do: They precess and tend to align with the field as a compass arrow. To introduce the spin-orbit interaction, we only have to add one last ingredient: Einstein's special relativity.

Special relativity comes into play when particles move at speeds which are at least somewhat respectable as compared with the speed of light. Everyday phenomena around us are, however, too slow to reflect their fundamentally relativistic nature. That is why, not surprisingly, the Newtonian mechanics based on the Galilean theory of relativity (which is only approximately correct) has survived without challenge for centuries. It is natural that the theory that subjected Galilean relativity to doubt at the close of the 19th century involved Maxwell's equations of electromagnetism: The theory that describes the propagation of light. Classical electromagnetism subsequently formed the foundation for the special theory of relativity. According to the latter, all reference frames moving at a constant velocity in relation to each other are completely identical. At the same time, going from one frame to another can transform electricity into magnetism and vice versa, making the two phenomena fundamentally intertwined.

Spin-orbit interaction is one of the most illuminating consequences of this principle: In the frame of reference of a moving particle, an electric

field is transformed into a mixture of electric and magnetic components. This means that a particle moving in the presence of an electric field will acquire a torque on its spin, corresponding to the spin precession in its rest frame magnetic field. Particle motion (also called orbital motion) and its spin dynamics are thus entangled. This turns out to be very important for electronic structures and transport in real materials, especially semiconductors. Although electrons do not diffuse too fast on average, they do undergo intermittent accelerations upon approaching positively charged atoms of the crystal lattice. This adds up to appreciable relativistic corrections to electron motion, reflected in the spin-orbit coupling. In summary, as an electron steps through the crystal lattice, it undergoes an intricate "dance" where its spinning motion is correlated with its trajectory through the lattice. Figure 3 shows a schematic cartoon of this phenomenon.

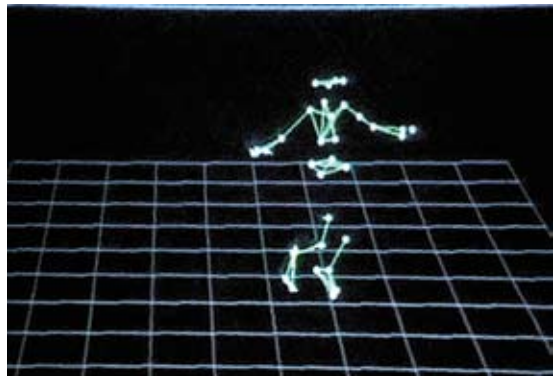

Figure 3: Spin-orbit 'dance': An electron's spinning is correlated with its motion through the atomic lattice. The phenomenon is possible due to an interplay of quantum mechanics and Einstein's special relativity.

The spin-orbit interaction has recently attracted considerable interest in the field of spintronics (the area which tries to utilize electrons' spin for novel nanotechnological devices). This stems in part from the possibilities to control spins with more easily accessible electric rather than magnetic fields. In particular, spin-orbit coupling can lead to the so-called 'spin Hall' effect, where a steady electron drift generated by an electric field induces a net transverse spin flow perpendicular to the drift direction. To understand this, imagine two teams of athletes competing in a marathon, distinguished by blue ('spin-up') and red ('spin-down') shirts. Suppose the blue shirts are instructed to pass slow runners on the left while the red shirts do it on the right. This will result in the net spin flow perpendicular to the marathon direction, since the up spins tend to 'flow' to the left and the down spins to the 'right'. In the spin Hall effect, the selectivity of the 'skewed scattering' which is analogous to the blue shirts bending to the left and the red shirts to the right, stems from the spinorbit interaction. There are other, more anomalous contributions to the spin Hall effect, but the essence is not too dissimilar from the spin-dependent skew scattering. This phenomenon has recently ignited a lot of interest in the spintronic community as a mechanism for efficient spin injection. It turns out, however, that when the spins are drawn out at the sides of the Hall bar (i.e., forced to exit the marathon in our analogy), they encounter spin-dependent selectivity at the Hall bar boundaries that impedes the net spin injection [3]. In our marathon picture: The blue shirts which are piled up to the left are prohibited from exiting on the left, while the red shirts cannot exit on the right. We found, however, that this selectivity can be suppressed by incorporating disorder into the edges, making side contacts

more indifferent to the spins: The 'spectators' standing on the sidelines interfere with 'officials' trying to enforce the spin selectivity, restoring the spin injection.

During the program at the CAS, my colleagues and I have also worked on the problem of the interplay of spin-orbit interaction and quantum interference in ring-like structures [2]. We investigated spin-dependent phenomena which are governed by the interference, such as that sketched in Fig. 2, due to the trajectories propagating clockwise and counterclockwise along the ring. Unlike the spin-dependent skew scattering in the spin Hall effect, which is essentially a 'semiclassical' phenomenon, spin-dependent interference in rings is a purely quantum effect which reflects the wave-like nature of electrons. In both cases, however, the spin-orbit coupling plays a central role, leading to an amusing interplay between particle motion and its spin precession.

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MICHAEL MURPHY

Measuring and Analysing Household and Families in Contemporary Developed Societies

Households and families

The 'family' and the 'household' are such basic units in human society that they have been studied extensively from many perspectives and are used in day-to-day conversation, although not in a consistent manner. 'Family' may refer to concepts as distinct as a kin descent group ("our family has lived in this area for generations") or a nuclear family unit ("they are a two-child family"). A 'household' is a group of people who live together. In demography, family and household patterns may be the object of the explanations. For example, what family and household changes result from the (first) demographic transition from a high mortality and fertility regime to the low fertility and mortality patterns seen in developed contemporary societies? What about the more recent (second) demographic transition, characterised by reduced marriage and increased partnership breakdown? Families and households are also important determinants of demographic processes. Historically, in northwestern Europe, the ability to form an independent household (often following death in an earlier generation leading to inheritance) acted as a gatekeeper to marriage, which was in turn an important gatekeeper for having children, although never an absolute bar, of course. On average, married people not only have more children than others, but they also live longer. In Britain, household size started to fall only with the

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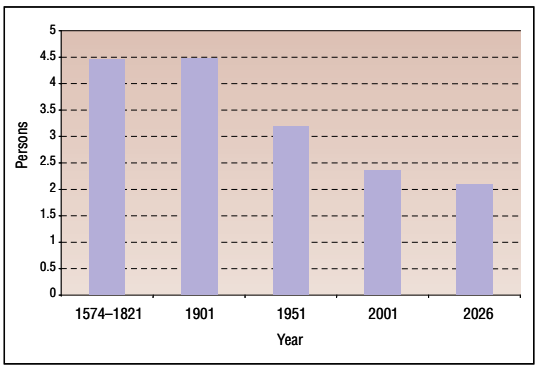

Figure 1. Average household size, Britain 1574–2026

Note: Geographical coverage varies between England and England and Wales

Sources: Table 4.4 in Laslett, P. & R. Wall (Eds.), 1972. *Household and Family in Past Time*. Cambridge: Cambridge University Press.

New Projections of households for England and the Regions to 2026. ODPM Statistical Release 2006/0042. Available at www.communities.gov.uk.

onset of fertility decline at the end of the 19th century. Rather than behavioural changes, demographic changes, such a population ageing, remain primarily responsible for the continuing decline in household size (Figure 1).

Definitions

Quantitative disciplines require that the topics under study should be meaningful and measurable, preferably in ways that are valid in different places and times. They should also be sufficiently simple and acceptable to be included in large-scale data sources of which traditional censuses are still the most widely used. The concept of the 'common cooking pot' underpins the notion of a household. The UN defines a household as a person living alone or a group of two or more persons living together who make provision for their own food or other essentials for living. The 'common cooking pot' is declining in importance as there is less pooling of resources and activities within households. In many European countries, in fact, a household is simply defined as the group of persons living together in a housing unit. These definitions refer to a particular point in time at which each person should be allocated to one particular household (or possibly to a non-household category, such as communal establishments or the homeless, depending on the particular treatment of these groups). The household was well-defined in Western societies when it was frequently an economic as well as a domestic unit, and the head of household had legal responsibility for and authority over members of the household. Indeed, the head of household had legal responsibility for ensuring that the census form was completed for all members of the household until 1981 in Britain, when the responsibility was widened to include all adult members. The idea of the 'head of a household' became increasingly anachronistic and had disappeared by 2001, a victim to more egalitarian household roles/political correctness/risk aversion by data collectors. It has often been replaced by a more neutral title such as 'household reference person' or 'householder'.

A further complication is that increasing numbers of couples are cohabiting rather than being formally married to each other. Cohabitation is a household-based concept requiring co-residence and also a sexual relationship, although questions on the latter requirement will usually not be posed in such blunt terms. Marriage, on the other hand, is a formal attribute which requires neither co-residence nor a sexual relationship, especially since many countries do not include a category such as 'separated' for non-co-resident married people. Cohabitation is difficult to measure, even if explicit questions are asked. The two nominal partners can (and do) disagree about their status. Moreover, people report very differently about cohabiting at the time and if asked in retrospect, since entry and exit are often gradual processes rather than a well-defined yes or no state.

Other emerging social trends such as increasing numbers of couples 'Living-Apart-Together' (LAT), i.e. people with a regular partner acknowledged by friends and relatives, implicitly including a sexual relationship, although not co-resident. Measuring its prevalence is effectively impossible with register or census data and very difficult with survey data. Since the status is not well-defined, it is easy to conceal and it may be sensitive. However, tentative estimates suggest that four million people under age 60 in Britain are in a LAT relationship, very similar to the estimated number

cohabiting (and such relationships are known to be relatively common in The Netherlands among older people). Statistical or administrative systems may require a single residence to be identified, but this may not correspond with people's actual experience, indeed until recently, only married (and by definition different sex) couples were identified as being in a partnership.

The question "Who do you consider to be a member of your family?" produces very heterogeneous responses. While these may informative about attitudes to family life among different groups, a consistent definition is required for making comparisons between groups. The statistical definition of a family unit corresponding to that of household discussed earlier is those members of the household who are related, to a specified degree, through blood, adoption or marriage. To add to the confusion, 'family' is derived from the Latin 'familia', which refers to what we would now designate as a 'household', i.e. the residential group, including non-relatives such as servants. In Europe, the definition of family is that of a nuclear unit consisting of a couple, with or without unmarried child(ren) or a single parent living with unmarried child(ren). Families are defined by data collection agencies based on information collected on topics such as partnership status (couples now usually include both cohabiting and married partnerships) and on kinship relationships within the household, rather than from information directly reported by the subjects themselves. There are some problems associated with a definition based on a maximum of two generations, e.g. how to categorise households which consist of three generations. The family defined as a 'co-resident nuclear unit' is operationalisable and meaningful but incomplete. Phrases like 'one-parent families' are widely used, but very few young children in developed societies do not have two living natural parents. In addition, the above definition does not distinguish children living with natural or step-parents, and provides no information on whether they have natural parents, children or sibs living elsewhere. It is possible to obtain such information relatively easily from mature registration systems, but it requires considerable additional information to be collected through censuses.

In practice, there is considerable overlap in these classifications. Most households consist of a single family unit as defined above (or a single person household – countries such as Norway define these as 'single person families'). In Britain, five out of six people living in the private household sector (a further 2 per cent are in communal establishments) are in a single-family household, and 12 per cent live alone. Other household types, multi-family or multi-person, are increasingly rare, accounting for only 5 per cent of the population, a proportion that has declined by half in the past three or so decades (Table 1).

Table 1. People in households (per cent), by type of household and family, Great Britain

	1971	2005
One person	6	12
One family households		
Couple with:		
No children	19	25
Dependent children[1]	52	37
Non-dependent children only	10	9
Lone parent	4	12
Other households	9	5
All people in private households (=100%) (millions)	53.4	57.0

[1] May also include non-dependent children. Dependent children are never-married children in full-time education in families; in 1971 under age 25, and in 2005 childless and under age 19.

Source: *Social Trends* 36, Table 2.3, London: The Stationery Office.

Families vs. households

This apparently closer relationship between families and households may be potentially misleading. The link between 'family' and co-residence is becoming weaker, as about one-third of dependent children in Britain do not live with both biological parents. The majority of them lives in lone parent families (Table 2). There are increasing numbers of former partners, step families and half-siblings. In some cases, rights and obligations are household rather than family-based. For example, for social security purposes, the resources of cohabiting couples will be aggregated when assessing eligibility for social benefits, whereas only married partners may be eligible for spouses' pensions benefits (although cohabiting partners may be eligible under discretionary rules). The legal position with respect to family responsibilities varies considerably across Europe.

Table 2. Families with dependent children, by family status England & Wales, 2001

Family type	Per cent
Lone parent family	25.3
Couple family:	74.7
of which:	
Married	63.0
Cohabiting	11.6
of which:	
Step family	9.9
Not step family	64.8
of which married and non step-family	57.6
Families with dependent children (000s) (=100%)	6,377

Note: a dependent child is a person aged under age 16 in a household (whether or not in a family) or aged 16 to 18, in full-time education and living in a family with their parent or parents.

Source: derived from Census 2001, National Report for England and Wales – Part 2 Table S007 Age of Family Reference Person (FRP) and number and age of dependent children by family type. Available at http://www.statistics.gov.uk/STATBASE/ssdataset.asp?vlnk=7504.

Household and family as longitudinal variables

Changes in family and household patterns are of great interest, but these apparently closely-related concepts are often analysed using different approaches (see the article by Keilman in this volume). A household is generally well-defined in space at a given point of time (since a household is directly linked a specific physical dwelling unit), but it has no clear longitudinal definition. If a couple splits up, is the household dissolved? If one of a number of children leaves 'home', does the household cease to exist? There is no obvious conservation law to guide us, in contrast from the balancing equation for individuals, which underpins much analysis of population change and forecasting:

> Population at time t+1 = Population at time t + Births in time period (t to t+1) - Deaths in time period (t to t+1) + Net migration flow in time period (t to t+1)

A 'family' in the broader non-co-resident sense can be well-defined in time. If we use each 'ego' as the reference point, it is possible to identify biological and marriage relationships in a straightforward manner in most cases, although even here, cohabitation may be difficult to identify and the paternity of babies may not easily be determined. Relationships are meaningful even when a link is missing –grandparents are still grandparents even if the intervening generation is dead, but the families so defined are not mutually exclusive. Given that everyone has or has had

two parents, four grandparents etc., we all have 10 billion ancestors 1 000 years ago, but these are not distinct. Each of these ancestors is likely to be an ancestor of a large percentage of the present population.

Postscript

In the post World War II period, the pattern featuring married couples with their dependent children (if any) living in a separate residence became increasingly common in modern societies. Marriage and longevity increased, while divorce and extra-marital childbearing remained relatively low. There was reduced pressure to share with others (apart from living with elderly relatives, which often remained common). In such situations, the benefits obtained from analysing families and households as separate variables were reduced. In more recent decades, trends such as increased partnership turnover have highlighted the importance of the distinction of the residential and kin/biological group, including rights, responsibilities and social ties extending beyond the household. The development of family analysis is facilitated in particular by register-based systems that include marriage and fertility information, whereas traditional censuses are based on the household as the principal group for which information is produced. Neither system is well-placed to elicit information on emerging topics such as LAT relationships. However, the tension between what can be reliably measured and what is important in behavioural and policy terms will remain a constant issue in future.

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OUTI LEHTIPUU

Resurrection as a Symbol for Self-Identity and Boundary Drawing

It is the winners who write history. This is no less true with a view to the history of Christianity. The prevailing myth about the birth of Christianity tells that in the beginning, there was the one, true, primal Christian teaching, represented by "one holy catholic and apostolic church". Only later did different heretical teachings emerge, distorting this original true faith and deviating from it. The diversity of beliefs in present-day Christianity (especially on the Protestant side) is seen as a late, unfortunate development and many still yearn for the alleged unity and harmony of the 'primitive' church.

This myth, however, is an illusion. There has never been a uniform faith or just one 'primitive' church. From the very beginning, there was diversity – diversity of experiences, beliefs and interpretations over such basic issues as who Jesus was, the meaning of his death, what it means to be a Christian, how the relationship to Jewish lifestyle should be defined, etc (Ehrman, 2003; Marjanen & Luomanen, 2005). In the first centuries of Christianity, there was no New Testament canon, no creeds, and no ecclesiastical organisations that would have set boundaries for different interpretations. All these developed gradually and they were not undebated. Even after the Constantinian turn in the 4th century, when one form of Christianity gained the power to set the canon and to formulate the creeds, the views that lost and were condemned did not disappear overnight.

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Building identity by drawing boundaries

In the first centuries of Christianity, the different Christian groups were small and always in a minority (Hopkins, 1998). Self-definition and identity building were crucial questions for them. One way a group defines itself is by boundary drawing, i.e. by distinguishing 'us' from 'them'. This involves a construction of 'the other' against whom 'we' are then defined (Sanders, 2002). The early Christian sources attest to the fact that this kind of boundary drawing was done on different levels. First, Christians had to define their place in the pagan society around them. Sometimes pagan culture or pagan philosophy was accepted, sometimes rejected. Sometimes it was condemned even though many of its features were adopted. Second, Christians wanted to define themselves against their Jewish background. Jews often served as 'the other' in Christian rhetoric, especially after the 4th century when society at large gradually turned to Christianity. This juxtaposition between 'we the Christians' and 'they the Jews' was always in favor of the first, of course, and fostered brutal anti-

Semitism over the centuries. Third, different Christian groups bolstered their positions by drawing boundaries between themselves and other Christians. In this intra-Christian struggle, one's own view was considered the only right one while all the others were wrong. After the Constantinian turn, one form of Christianity came to power, backed by the officials. It defined itself as 'orthodox' (literally: 'straight opinion' or 'right belief') and others 'heretics'. Present day scholarship avoids these terms since their use implies adopting the view of the winners (King, 2003). In reality, each Christian group considered itself 'orthodox'. No one used the term 'heretic' to describe themselves!

Controversy over belief in the resurrection

Belief in the resurrection is an example of a symbol that was used to define who belonged to the 'true church' and who did not. It involved two central tenets: the resurrection of Jesus, believed to have happened in the past, and the resurrection of believers, an incident yet to occur in an undefined future. The New Testament tradition was ambiguous concerning both. The Gospel writers emphasized a bodily resurrection. Jesus' resurrection meant that his body was not in the tomb anymore. Moreover, Jesus appeared to his disciples, urged them to touch him and ate in their sight (Luke 24:36–43). At the same time, however, he could suddenly appear and disappear – even moving through locked doors. When Paul reports his encounter with the resurrected Jesus, he reports seeing a light and hearing a voice – neither of which presumes any kind of a bodily resurrection. Similarly, there is ambiguity about the fate of the dead. Again, it is Paul who offers the fullest discussion on the matter. He speaks about the resurrection of the body – but of a 'spiritual' body (1 Corinthians 15). This kind of ambiguity yielded different interpretations that all could be claimed to have a biblical basis (Lehtipuu, 2007).

The fiercest battle was fought over the question of whether the resurrection involved the body or not (af Hällström 1988; Bynum 1995). In his treatise *On the resurrection of the flesh* (hence: *Res.*), the late 2nd century church father Tertullian gives several reasons why the salvation of the soul alone is not enough. Since the body is part of God's creation, it has intrinsic value of its own (*Res.* 5). It would be unworthy of God to save only a soul which is akin to God; a loving God saves the whole man, also the body (*Res.* 9 & 34). Since it is the body that is destroyed in persecutions or is affected by ascetic practices such as fasting or sexual abstinence, the body must be raised to receive its just reward. Similarly, it is the body that is responsible for the evil things it has done. God would be unjust if it were the soul that received either the reward or the punishment actually deserved by the body (*Res.* 8 & 15). For this same reason, resurrection must take place in the same body that has suffered or sinned (*Res.* 41).

Not everyone agreed. The very fact that several treatises entitled *On the resurrection* (or the like) were produced in the 2nd century shows that the question was prone to different interpretations. Moreover, we hear complaints that there are "…some who are called Christians, but who … say there is no resurrection of the dead, and that their souls, when they die, are taken to heaven". These should not be considered Christians at all (Justin, *Dialogue with Trypho* 80, 4). However, we also have texts whose writers seem to promote this kind of understanding and they definitely call themselves Christians. In some of the Nag Hammadi texts, for

example, belief in the resurrection of the earthly flesh – promoted, for example, by Tertullian – is flatly denied. "Some are afraid lest they rise naked. Because of this they wish to rise in the flesh, and they do not know that it is those who wear the flesh who are naked," writes the author of the *Gospel of Philip* (56, 26–30), for example. However, perhaps surprisingly, he also writes (57, 9–10): "I find fault with the others who say that it [= the flesh] will not rise." Thus, he is arguing for a correct understanding of the resurrection of the body against two different positions which he finds erroneous: first, that the present, earthly flesh will rise; second, that only the spirit will rise. In his view, the spirit can not rise alone, i.e. 'naked'. His ingenious solution is to intertwine resurrection with his teaching of the Eucharist. In the Eucharistic ritual, the believer receives the flesh and blood of Christ that provide him or her with proper 'clothing' for resurrection. Thus, even though actually representing a kind of spiritual resurrection, this belief is formulated using 'carnal' terminology.

How to distinguish 'true' faith from 'false' faith?

Little wonder, then, that those holding an opposing view complained that it was hard to distinguish 'heretics' from true believers since they "… speak like us but think otherwise" (Irenaeus, *Adversus haereses, Praefatio* 2). Moreover, they are at fault for "imitating our phraseology" and "transferring [expressions found in Scripture] out of their natural meaning to a meaning contrary to nature" (Irenaeus, *Adv. haer.* 1.9.4.). Tertullian speaks explicitly about the resurrection and claims that his opponents intentionally talk about the resurrection of the flesh, even though they mean something else by it, in order to deceive people (*Res.* 19).

Interestingly, the writer of the *Gospel of Philip* – who represents an opposing view – has a similar kind of complaint. According to him, names such as 'God', 'the father', 'the son', 'the holy spirit', 'life', 'light', 'resurrection', and 'the church' are deceptive, and those who have not learned their correct meaning perceive them incorrectly (53,23–44,13). In other words, those Christians who have not been taught the proper understanding of the term 'resurrection,' for example, are deceived by a wrong interpretation of it.

For outsiders, this must have sounded like incomprehensible nitpicking. Resurrection is a symbol which appears simple from the outside but is much more complex from the inside (Setzer, 2004). For insiders, mere talk about 'resurrection' was not enough. 'Resurrection of the body' was ambiguous as well. Even 'resurrection of the flesh' could be understood in different ways.

Strengthening boundaries strengthens identity

Bodily resurrection was not the only crucial belief in early Christianity, but it seems to have been an especially convenient shorthand for the Christian faith since many other focal tenets such as belief in the power of God, the Creator, and in ultimate justice were clustered around it (Setzer, 2004). But why was it so important to interpret the resurrection in the 'right' way? One reason might be offered by the insecurity of the small early Christian communities. Distinguishing those who belonged from those who did not helped enforce and maintain the boundaries of the communities struggling with questions relating to their own identity

and place in the society (Barclay, 1995). For the sake of internal coherence, then, deviant ideas were not easily tolerated. In addition, common beliefs created at least an illusion of unity among the scattered Christian groups who, in different cultural contexts, might have followed many different kinds of practices (Hopkins, 1998). For common self-definition, it was crucial to maintain that the interpretation of a given group was the only right one – and the one that had been taught ever since the time of the apostles. This was not only the claim of those who represented the view that later became the dominant Christian view but something every Christian group professed.

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Child Care Availability and Fertility

Numerous European and Asian countries have fertility levels that are well below the levels required for insuring population replacement, which has raised concern among policy makers and the public alike. Sub-replacement fertility rates lead to an aging population and a decline in population size. In 2006, Japan experienced a decline in population size, a prospect that will soon face several European countries. While those who are anxious about the environmental implications of population growth may welcome the prospect of declining population size, sustaining it below replacement fertility levels can confront countries with a number of problems, including labor force shortages as well as difficulties in affording the pensions and health care of the elderly. In confronting the issue of low levels of fertility, policy makers have considered and tried a variety of options, including cash subsidies for raising children, tax benefits for parents, and bonuses for having a second or third child.

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One policy possibility that has received considerable attention is making high quality child care available and affordable. To understand why child care centers might be needed now when they were not needed in the past, it is important to understand the dramatic changes that have occurred in the social context in which men and women of childbearing age are living today compared with when fertility was high. To describe these changes, I paint with a fairly broad brush.

Rather than living in rural settings and having agricultural occupations, most people in today's low fertility countries live in urban areas and have manufacturing, service or information jobs. People work in employer-provided settings rather than in family enterprises. Such jobs and job settings are not conducive to simultaneously watching and caring for infants, toddlers or children. Jobs are more complex, requiring increased levels of education, and hence later entry into the work world and parenthood. More and more interesting job opportunities have become available for women, who, with their increased investment in education, wish to take advantage of these opportunities. The social environment is more mechanized, impersonal and complex, requiring greater supervision of children for longer periods of their childhood. The range of goods and services considered 'necessary' for comfortable, everyday living has increased faster than wages, leading to a preference for both partners in a marriage to prefer employment. Thus, today's potential mothers also want to work, yet the changes that have occurred in workplace and residential settings have made it difficult to do both simultaneously.

Such changes have led sociologists and economists alike to the same child care and fertility hypothesis: as organized, center-based, child care becomes more available, affordable, and acceptable, the antinatilist effects of contemporary work opportunities, educational attainment and urbanization decrease. Sociologists and economists have come to this hypothesis based on different lines of reasoning. Sociologists consider the role conflict that has emerged between the mother role and the worker role, arguing that the availability of high-quality, affordable child care while the mother is working reduces this conflict and makes it more feasible to combine the two roles, including having children earlier and having more children. Economists are concerned with the opportunity costs incurred while the mother is out of the labor force. These costs include not only foregone wages while the mother is out of the labor force, but also the lost opportunities for gains in human capital that affect her future wages when she returns to the labor force. The availability of high-quality, affordable child care reduces parents' time out of the labor force and thus reduces the opportunity costs, again permitting earlier childbearing and having more children. The fact that both sociological and economic theories lead to the same hypothesis makes it more appealing than if it had arisen from just one discipline.

This is not a new hypothesis; it was found in the literature more than 65 years ago (Myrdal 1941). Yet to the surprise of economists and sociologists, it has received limited and mixed empirical support. The principal reason for the mixed results is that a careful examination of the hypothesis reveals steep data and statistical requirements. Researchers need data that follows women over their childbearing years. Since people can move to places with better day care availability, it is important to control for such movement during a woman's childbearing years. There are and always will be unmeasured variables, such as fecundity, that affect fertility. The statistical modelling strategy needs to account for such unmeasured heterogeneity. The availability of day care facilities varies and at least some of that variation is due to idiosyncratic, and hence non-measurable reasons. The statistical modelling strategy needs to allow for such unmeasured, macro-level variables.

Figure 1. Rural Thailand. Photo: Ron Rindfuss.

Figure 2. Day care centre, "Skillebekk barnehage", Oslo, Norway. Photo: Maria Sætre/CAS

Norway provides an excellent setting for testing the child care availability hypothesis. Child care centers have become increasingly available over the past 30 years. Generous financial subsidies for day care centers are available from the central government, which also sets high standards for day care centers, including the training needed by day care providers. However, day care centers are opened and run at the local level, thus producing heterogeneity across municipalities. Even though the political motivation for public transfers to child care centers was to facilitate female employment, one would still expect the expansion of their availability to be pronatalist.

Norway also has appropriate data for testing the child care availability hypothesis. The various Norwegian registers combined with the personal identification number system allow the construction of a data set that follows women during their childbearing years, recording births and changes in residential location, along with information on their education and their parents' educational attainment. The Municipality Database operated by Norwegian Social Science Data Services has information on child care availability and other variables for each of Norway's 435 municipalities, with the time series on child care availability beginning in 1973.

Using a statistical modelling technique that takes into account the idiosyncratic reasons why some municipalities might be more effective in providing more day care center availability, the results show that women living in municipalities with greater availability of day care start having children at younger ages (Rindfuss *et al.* 2007), which is exactly what the child care availability hypothesis predicts. Ongoing work indicates that women living in municipalities with greater availability of day care also have more children, again, exactly as hypothesized.

To what extent might these Norwegian results extend to other countries? The answer depends on the extent to which day care centers are structured to accommodate the working lives of parents. Norwegian day care centers are open year round, except on weekends and national holidays. They are open sufficiently early in the morning and late in the afternoon to accommodate the work schedules of parents. Further, ardent

attempts are made to enable siblings to attend the same day care center. To the extent that other countries adopt the same parent-friendly model, then increased availability of child care should lead earlier and greater levels of childbearing. If, on the other hand, the hours of operation are only for part of the day and no accommodations are made to allow siblings to be in the same child care center, as is the case in some countries, then a modest, at best, pronatalist effect is expected.

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Resurrection Revisited

– The Significance of a Spatial Perspective

A Resurrection of the Flesh?

In the mainstream of Western theological tradition, faith in resurrection and eternal life has not just been a core issue; it has also been conceived of in solid, material terms as a resurrection of the flesh [Bynum 1995, 5–17]. While death and decay have not been ignored, resurrection of the flesh has rather been seen as an affirmation of the (re)creative power of God and also of the material world, the physicality of existence, i.e. as principally good. The future and/or heavenly life has been perceived as paradise regained, a world not too different from this, but without pain, grief or struggle. The polemic front has primarily been over against an alleged dualistic understanding, where a certain human capacity such as the "soul" is regarded as immortal and survives the death of the physical body, yes, by this process it is released from the bondage of flesh [Jørgensen 2000]. This has resulted in a terminological usage where "flesh" and "body" misleadingly appear to be interchangeable.

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In the CAS-project *Metamorphoses: Resurrection, Taxonomies and Transformative Practices in Early Christianity* we contest such a doctrinal solidification. Early Christianity appears to have accommodated a complex interaction of different ideas about resurrection and the afterlife, and displayed an amazing flexibility in the conceptual blending even of seemingly mutually exclusive positions. This short article is only a trailer of a more full fledged presentation of the insights gained through the project in a forthcoming 2008 publication.

Apocalypticism

The concept of resurrection belongs to a wider conceptual framework called apocalypticism which concerns revelations or disclosure of divine secrets. This is a tradition which Christianity inherited from Judaism. The apocalyptic perspective may be linear and temporal (eschatological), or it may be cosmological and spatial (heavenly travel). Eschatology reveals what will happen at the end of this *aeon* – a Greek term used to signify both the known world (spatial) and time. It involves a certain set of stage props, and resurrection is a collective event.

Also the heavenly travel or ascent, sometimes in the form of a vision, involves certain scenery. In heaven – or in one of seven heavens – the traveler becomes privy to secrets to be revealed upon his return to earth. Indeed, the purpose of the travel is the revelation (the apocalypse), even if it may also develop in a distinctly mystical direction, like rapture into

a sphere where unspeakable words or things that are not to be told are heard and seen. The spatial perspective allows to a greater extent than the temporal for individual mobility, resurrection and even immortality. Jewish tradition, out of which Christianity grew, some figures from the past were said not to have died, such as Enoch (the father of Methusalem) whom "God took", and the prophet Elijah, who ascended to heaven on a chariot of fire, and also Moses whose grave was not known

As a general observation, a conceptualization which draws on the idea of immortality leads to less interest in eschatological chronology. It rather invites spatial categories and ideas about transfer and exaltation from an earthly to a heavenly sphere. In pre-modern times, however, the two perspectives were not mutually exclusive but spatial categories interchanged with temporal in ways that for a modern worldview are disturbing and inconceivable. The resurrection of the dead was not just transposed into an ever more remote future; it might equally well be conceptualized in individual terms of immortality and ascent into a heavenly realm.

Ascent, resurrection and taxonomy

It was not unusual in antiquity to describe heavenly bodies in terms of brightness and light, and by means of categories such as air, *pneuma* (spirit) or ether [Martin, 1995, 117–120]. These are all in various ways noticeable substances, yet without any tangible, carnal solidity. They mark difference rather than corporeal continuity and individual recognisability. In his teaching about the resurrection, another New Testament writer, Paul of Tarsus, explains this in his first letter to the Corinthians by drawing on an ancient Greek taxonomy, that is a classification or orderly arrangement of all objects/bodies which helped them not just describe but also comprehend reality [Asher 2000, 129–143]. This divided the cosmos into two opposite spaces of habitation, the terrestrial and the celestial. The genus of body (in Greek *soma*) was divided into two opposite species (heavenly bodies and earthly bodies) and under each species further subdivisions, sharing the same basic quality might be distinguished. The quality of all earthly bodies was carnal even if they do not share the same kind of flesh, whereas the heavenly bodies were characterized by their radiance (in Greek *doksa* which in Jewish tradition represents a divine quality). A certain kind of body belonged to a particular space; it had its own habitat. Within such a cosmological order, a transposition from an earthly existence to a heavenly was not conceivable without bodily transformation from flesh to glory. In order to move across this fundamental divide, radical change or transformation was necessary: "flesh and blood cannot inherit the kingdom of God, nor does the perishable inherit the imperishable" (1 Cor 15:50).

The resurrected Jesus

The belief that the crucified Jesus of Nazareth was resurrected is a root cause of the Christian preoccupation with resurrection. The way in which the resurrected body of Jesus was accounted for in the narratives about his post-mortem appearances to his disciples, has been taken to show the nature of a resurrected body. Prominent accounts of these appearances, such as those in Luke 24 and John 20–21 seem to emphasise corporeal continuity and recognisability. The risen Jesus is presented as the Jesus the

disciples used to know, again present among them. In some stories there is even a probing for proof of his continuous carnality, which is poignantly captured by Caravaggio in his painting of "the doubting Thomas" referring to the episode in John 20.24–29.

Figure 1. "The Incredulity of Saint Thomas" by Caravaggio.

The resurrected body of Jesus therefore substantiates that resurrection is not only a rescue operation of the spirit or the soul, but a restoration of the corporeal, carnal person which also entails individual recognisability. However, one should take into account that, according to the appearance stories themselves, the physicality applies only to a limited time span when Jesus is still with them "on earth". His earthly existence is prolonged beyond death but not forever. The closure of Jesus' earthly existence is in the two-volume work ascribed to Luke (Gospel of Luke and Acts of the Apostles), narratively explained by way of a spatial transfer from earth to heaven [Seim 2004]

Jesus' departure to heaven is told twice (Luke 24.50–53 and Acts1.9–11) in remarkably simple terms compared to many similar stories at the time. The narrative perspective is that of the disciples: he is taken out of their sight and away from their earthly existence. There is no speculation about the different spheres he may have to pass in his ascent; it is not portrayed as a symbolic conquest of the cosmos and there are no indications that he is transformed as he travels. Does this mean that the taxonomy of difference so important to Paul is of no consequence in New Testament writings such as Luke-Acts? However, in the following narrative of Acts, when Jesus on some rare occasions actively interacts with earthly humans, his identity is clearly maintained but not his bodily form. In the reiterated story of how he surprises Paul on the road to Damascus (Acts 9, 22 and 26), his presence is marked by a bright blinding light and compelling words. Indeed a striking contrast is established between the reference to the speaker being Jesus of Nazareth and the lack of any bodily appear-

ance by which he might be recognized. The heavenly body of Jesus is perceived as different in its matter, it is characterized not by flesh and bone, but by splendour and light.

Concluding remarks

Meaning and truth claims are to the so-called modern mind often intimately attached to a kind of scientific or empirical factuality which pre-modern presentations cannot possibly meet. Since a pre-modern cosmology no longer is regarded as scientifically sustainable, Christian theology has tended to submit and take refuge to the future as the last unknown. The temporal, eschatological perspective has therefore become all-predominant and "mythological" stories about spatial mobility between heaven and earth are left behind as embarrassing for

Figure 2. "The Resurrection Isenheim Altar" by Matthias Grünewald.

an age which no longer scientifically conceives of a heaven "up there". Nevertheless, one cannot possibly understand and certainly not draw doctrinal conclusions of early Christian ideas about the resurrection without appreciating the diversity of positions and addressing the significance of space.

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Theory-Forming in Biblical Studies:

Contributions to an Interdisciplinary Dialogue

In this short essay, I will consider how theory-forming in Biblical Studies is different from theorizing in the natural sciences, make suggestions about the underlying reasons for the differences, and give an example of using naturalistic methods in Biblical Studies.

Although natural sciences use a variety of methods to acquire knowledge about the world, the evaluation of hypotheses can be called a universally applied procedure. Based on available data, scientists put forward hypotheses, and then collect more empirical data (typically through experiments) to test them. Philosophers of science have examined various aspects of this basic scheme (such as inductive reasoning or reliance on paradigms), which we cannot rehearse in any detail in this contribution (cf. Popper 2002 [1934]; Polányi 1958; Kuhn 1962; Lakatos 1978).

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Various ways of theory-forming

In other parts of the academy, however, scholars use other ways of theory-forming which supplement or replace the above-mentioned style of scientific reasoning. Philosophy and mathematics, for example, can be seen as systems of thought based on widely accepted principles that can be changed by a new consensus at any time (and not just under the weight of empirical evidence). Law is also based on the application of widely shared principles but the implications of these principles for particular real-world situations depend on a kind of *ad hoc* reasoning that we call legal interpretation (e.g. Leyh 1992). Various other domains of human life are studied by disciplines that involve interpretation to different degrees – a style of theorizing that is heavily context-dependent and not necessarily verifiable by different observers (especially at different times and places). Whereas in mathematics or the natural sciences, learning a set of rules enables researchers to achieve original results, in the humanities, life experience is part of one's academic toolkit (Mérő 1990). Without further multiplying the examples, we can see that theorizing is domain specific and there are no universal rules of theory-forming in the academy (except for a shared academic ethos and institutional framework).

Biblical texts

The interpretation of biblical texts has played a crucial role in the history of Western theology, and it has often had important ramifications for other cultural domains. The study of sacred texts occupied a

central position in early Christianity, much more so than in the life of most ancient religions. A new style of interpreting the Bible (tied up with the Renaissance interest in ancient culture) contributed substantially to the success of Reformation. Ironically, such intensified interest in biblical texts also led to the questioning of traditional theological views on the Bible itself, with the rejection of the Mosaic authorship of the Pentateuch and the historical truthfulness of the Gospels being two salient examples. Today's academic study of the Bible is divided into branches that sometimes feature very different principles and methods. Such diversity is understandable, given the difficulties of textual reconstruction (which surviving version of a given passage shall we accept as the most authentic?), the enigmatic nature of many texts (how shall we translate a given passage into a modern language?), the scarcity of external information or archeological evidence about the earliest Christian movement, and the impact of scholars' ideological backgrounds on their work (which is more difficult to ignore than is the case in several other fields).

Instead of blaming cultural and historical factors for the methodological and, indeed, ideological heterogeneity of Biblical Studies, I will argue that it is the nature of the subject matter that prevents this branch of academic scholarship (and a number of others, as well) from achieving the kind of overall agreement on goals and theorizing styles seen in the natural sciences. To summarize my argument, *the phenomena which biblical scholars (and many of their colleagues in the humanities) investigate are more complex than the phenomena hitherto explained by natural scientists.* Let me 'unpack' this claim in the following paragraphs.

Complex systems

Complexity means that the whole is more than the sum of its parts (Nicoline and Prigogine 1989; Mainzer 1994). For example, society is more than just the sum of its individuals, i.e. studying individuals will not yield an understanding of society as a whole. Complexity is caused by factors such as heterogeneity (e.g. society is made up of individuals behaving in different ways), by the involvement of adaptive agents (e.g. individuals in society change their behavior in response to changes in the social environment), and interrelated causal structures (e.g. different social formations and institutions mutually influence each other's behavior). Systems displaying such behavior are called dynamic systems. In addition to society, we can mention the ecosystem or the weather as illustrative, everyday examples of such systems.

Scholars have developed various approaches to examine complex phenomena (Chu *et al.* 2003). Using mathematical models, physicists have described the behavior of various laboratory systems, but such tools have had limited applicability to real life phenomena. Another method is agent-based modeling, exemplified by the little model shown in Figure 1 that realistically simulates the behavior of a flock of birds (Parker 1995–2007; Reynolds 1995–2001). Such models are now widely used to study dynamic systems, yet one has to keep in mind that the models represent idealized and often hugely simplified versions of real-life phenomena. What makes real-life systems so difficult to analyze? Two factors have to be mentioned in particular (Chu and others 2003). (1) First, real-life systems show radical openness. In other words, it is very difficult to decide what to include in a model, and omitting a detail may substantially limit the relevance of the

model. (2) Second, elements can be parts of more than one system. For example, a religious agent is also an economic agent. This is called the problem of contextuality. We have to realize that many if not all existentially burning phenomena in the world display these two types of features. Society, ecology, and religiosity are precisely the kinds of dynamic systems that have evaded scholar's attempts to create reliable models of them.

Given this state of affairs, it is understandable that natural scientists regard explanations used in biblical studies, and in the humanities in general, as too weak and *ad hoc*. In these latter disciplines, academics consider naturalistic explanations applied to their domains to be unsatisfactory because of their limited scope and validity (usually stamped as 'reductionist', but that deserves a separate discussion).

Figure 1: Using the Boid model to simulate the flocking of birds.

Network theory

In the final part of my contribution, I will give an example of how systems of theoretical thinking in a broad sense can be used to better understand historical phenomena. Network theory, which is based on mathematical graph theory and has received growing attention in the past few years, offers new ways of modeling various real-life systems (e.g. Dorogovtsev and Mendes 2003). Ecology and sociology are two fields in which networks have been studied for a long time. In both domains (Granovetter 1973; Berlow 1999), so-called weak links have been found to serve to stabilize networks. Weak links are links that we can remove from a network without destroying its structure. For example, if a species feeds on various other species, some links might be removed without destroying the ecological system. When the network is under stress (imagine a natural disaster), weak links help the system survive. One additional benefit of weak links is that they hide diversity, that is, they enable mutations (such as genetic variations in an ecosystem or minority views in a society) to survive. In extreme situations, a great pool of hidden variations might help the emergence of new solutions and ensure the survival of a system (Csermely 2006).

My hypothesis is that the early Church developed a great number of weak links that stabilized it and facilitated its survival in the face of changing circumstances in late antiquity (Czachesz forthcoming). I can see at least three different ways of facilitating and maintaining weak links in the early Church, and it is important to note that we are not speaking of social engineering but rather of a spontaneous development. (1) First, mobility was an important feature of the life of the early Church. From the very beginning, we have information about migrant people, missionaries, apostles and church officials. (2) Second, women received a more important place in the institutional framework of the early Church than they did in most other religions. Women's role becomes especially

significant under stress, when they maintain social networks much more successfully than men. It is quite interesting to compare this with the also dynamically growing but later completely disappearing Mithraism, which was a men's organization. (3) Finally, charity also formed lots of weak links. These links were not essential for the institutional structure of the Church, but added a great number of weak social links.

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Possible Mechanisms behind Cross-Sibling Effects on Fertility Rates, and some Concerns about their Proper Estimation

Cross-sibling effects on fertility rates

All social scientists will agree that individuals' decision-making is shaped not only by their own characteristics and previous behavior, but also by social interaction with others through social networks. This contribution discusses some theoretical and methodological aspects of such phenomena in the context of siblings' fertility histories.

First, I provide some arguments for why we would expect influences on fertility decision-making based on siblings' corresponding behavior. Then, I raise some methodological concerns about problems that might arise when estimating effects of social interactions using typical models of demographic rates.

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Social influences between siblings on their fertility behavior

Several authors have emphasized the importance of social interactions for fertility choices. For example, Bongaarts and Watkins have argued that social interactions have at least three aspects: the exchange of information, the joint evaluation of their meaning, and social influence that constrains or encourages action.[1] To understand the divergence in the demographic behavior of different populations with relatively similar environmental conditions, arguments have been made for a combination of economic fertility theory (based on individual optimal and rational decision rules) and theories on social interaction (which incorporate the behaviour of other members of the community/society).[2]

Siblings should behave in fairly similar ways for several reasons. One is their shared biology. Their common genetic component may include predispositions toward certain types of behavior. Their socioeconomic characteristics and social environment during adolescence are also likely to be very similar. In addition to these similarities, it is clear that siblings may serve as examples and one sibling's behavior might be 'imitated' by the other sibling. Siblings are an obvious component of individual's social networks, as people are likely to keep close social relationships with their sisters and brothers. The experiences of one's siblings will be familiar, and thus constitute an important source of information on life course transitions such as union formation and fertility.

This tendency to imitate might be stronger when a childless woman is considering having her first child than for the choice of having her second or third child. Transition into motherhood constitutes a unique experience, and before giving birth and caring for a child, few people know exactly how and how much their lives will change. Through interaction with her sibling, a woman can experience the company of young children and see how her sibling copes with his or her new role of being a parent. This experience may trigger a stronger desire for motherhood. Once the woman has some experience with having and caring for a baby, she might be less prone to be influenced by social interaction with siblings and others. Thus, progression to a second child might be less influenced by these imitation effects. Moreover, it is easily conceivable that these relations, if they exist, depend on the time that has elapsed since the siblings have become parents. For example, it is likely that a birth to a sibling might have a positive effect on individuals' birth intensities in the short term, while having no effect or a negative effect in the longer term.

To summarize, it seems likely that there are cross-sibling effects on fertility; we would be surprised if that were not the case. For demographers and sociologists, the problem is to model these effects and to measure their strength relative compared with other factors we know play a part in fertility decisions.

Methodological challenges when estimating cross-sibling effects on fertility rates

The phenomenon in question is that individuals' behavior, in this case their childbearing decisions, is affected by the same behaviour in others, i.e. siblings. Whether you call the phenomenon imitation, social interaction, or social influence, it nevertheless falls into the category that Charles F. Manski has called 'endogenous effects'.[3]

How can we estimate the effects of social interaction? One obvious suggestion would be to model the outcome of one individual as a function of the earlier behavior of one or more other individuals. For example, it is possible to model an outcome variable Y as a function of several Xes plus the average Y in a reference group, e.g. the other people in the community. This type of model specification seems intuitive and theoretically appealing to many social scientists without advanced training in quantitative methods. It has been shown, however, that such setups can overestimate the importance of aggregate measures of the dependent variable.[4] In Monte Carlo simulation experiments, biases were found to be very large, affecting not only the estimated parameter for the reference group average, but also parameters for other contextual variables. The biases remained when the individual in question was left out of the reference group (the individuals on the basis of whom the aggregate measure is computed). More importantly, there was also a bias when the reference group consisted of only one person and, in effect, that person's outcome is included in the model on the right-hand side. This means that the bias arises even when the independent variable is not an aggregate, but the actual behavior of one unit of analysis.

Does this mean that we cannot use the most basic statistical tools to measure social interactions in general and cross-sibling effects on fertility in particular? Manski argues that with dynamic models, the prospects of identifying endogenous effects are better. Thus, using longitudinal data

and a dynamic statistical model, one could perhaps identify the effect on the outcome of one individual of the earlier outcomes of a reference group (or person). After all, an event can only be influenced by prior events. Once an individual has experienced the event, this individual no longer be affected by others' behavior.

Swedish sociologist Yvonne Åberg[5] described an interesting attempt to measure social influence effects, such as those outlined for siblings above, using standard methods in social demography. She examined how the proportion of unmarried co-workers in workplaces affects the likelihood of divorce. Her method was to estimate a parameter for the proportion of single co-workers using a Cox proportional hazard model. In this model, the rate at which an event is happening in the population at risk of this event is modeled as a function of other, potentially time-varying variables.[6] The family of hazard regression models is one of the main statistical tools used by demographers to study gradients by other variables in divorce rates and other phenomena. The most well-known and frequently used model is the Cox model. Åberg also added a random term to the model in order to capture unobserved factors at the workplace-level. She found positive effects of the proportion of unmarried co-workers on the divorce rate, indicating that social interaction is in part driving individuals' divorce decisions. The substantive conclusion is that divorce is 'contagious' at workplaces.

A similar study has focused on cross-sibling effects on fertility. A standard hazard model was estimated, quite similar to Åberg's model of divorce in workplaces. The results included a very strong effect of a woman's birth events on the first-birth rate of her sister. However, with the doubts expressed by Manski, how do we know whether these models are adequate for the purpose of estimating cross-sibling effects? As this type of approach becomes more common, some tests should be conducted to assess the reliability of standard models for measuring social interactions, possibly by way of simulation experiments. Sociologists should be content if standard methods, possibly with only multi-level extensions, can be used to study such phenomena. Unfortunately, if one has to resort to other types of techniques, the research will be less accessible to the wider audience of social scientists.

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ASLE SUDBØ

Superconductors and Superfluids
– Matter Wave Analogs of the LASER

Superconductors and superfluids are fascinating examples of so-called *quantum fluids*. A *quantum fluid*, as opposed to a *classical fluid*, is a liquid state where the *wave-like* nature of the particles constituting the liquid has emerged. Every particle has associated with it a so-called thermal de Broglie wavelength which increases upon lowering the temperature, whence the wave-like character inevitably emerges. As this wavelength increases and becomes comparable to the interparticle distance, the fluid changes character from being a classical fluid to a quantum fluid. When the wave-like nature of particles is important, it requires the use *quantum mechanics or wave-mechanics* to describe them. In quantum mechanics, we describe a system of particles by a wave function that in itself does not have any immediate physical interpretation. However, it can be used to *compute* observables. It has the strange property of being complex in the mathematical sense, i.e. it has a real and imaginary part. Alternatively, we may describe this function has having a length and a direction in a complex plane. This sounds abstract, but the very existence of superconductors and superfluids is a direct manifestation of an astonishing self-organization in the *direction* of this unworldly-sounding wave function. The direction, or the phase, of the wave function becomes the same throughout the system when a fluid becomes superconducting or superfluid. It is very much like phase-ordering in LASERs, which are phase-coherent light waves; superconductors and superfluids are macroscopically phase-coherent matter waves.

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The fluid in a metal that becomes superconducting is a fluid of electrons that flow in a background matrix of an ionic solid which may or may not have good crystalline order. They are charged elementary particles with the additional property of having spin, i.e. a little magnetic moment attached to them. The spin of an electron is as small as it can possibly get without being zero, namely ½, measured in units of Planck's constant, the natural unit for spin. A superfluid is comprised of atoms without charge, but which may or may not have spin. It is important to distinguish whether these atoms have integer (including 0) or half-integer valued spin.

In 1908, Heike Kammerling Onnes succeeded in liquefying helium for the first time. At ambient pressure, helium boils/condenses at 4.22 K, only about 4 degrees above the absolute zero of temperature (Fossheim 2004). A meticulous and continuous effort over many years led to the determination of the so-called isotherms of helium, and this was a key ingredient in achieving success. To quote the Swedish Academy, which awarded

Kammerling Onnes the Nobel Prize in 1913: "The attainment of these low temperatures is of the greatest importance to physics research, for at these temperatures both the properties of the substances and also the course followed by physical phenomena, are generally quite different from those at our normal and higher temperatures, and a knowledge of these changes is of fundamental importance in answering many of the questions of modern physics." These were truly prophetic words, in view of what was to come.

An important issue in physics around 1910, was what happened to the electrical resistivity of conducting materials as they were cooled down. Specifically, two possibilities were suggested, namely the gradual vanishing of resistivity as the temperature went to zero, alternatively that a residual resistivity would remain. It was natural to use helium-cooling of metals to investigate this issue. Mercury stood out as a prime candidate for this investigation, since it could be made extremely pure by repeated distillation. This is important, since resistivity at low temperatures is mainly determined by impurity scattering. Kammerlingh-Onnes therefore set out to investigate mercury's low-temperature transport properties. He found, to everyone's amazement, a sudden drop in the resistivity at 4.1 K, at which point the resistivity became immeasurably low. This phenomenon was called 'superconductivity'. The spectacular and sudden loss of electrical resistivity is basically the biproduct of a radical change, a phase transition, taking place in the liquid of conduction electrons in the metal. The sharply defined temperature at which the phenomenon takes place is called the critical temperature.

In 1933, it was found that in a superconductor, an externally applied magnetic field would be expelled from the specimen. If a too strong magnetic field was applied, superconductivity would break down. This is called the Meissner effect. Superconductors that completely expel magnetic fields and then suddenly break down completely for too large magnetic fields are called Type I superconductors. The expulsion of magnetic flux would not take place in a *perfect* conductor of free electrons, showing that 'superconductivity' is more than just 'perfect conductivity'. Based on this, Fritz London came up with the London phenomenological theory of superconductors, in which the current inside a superconductor was assumed to be proportional, not to the electric field as in an ordinary metal, but proportional to a quantity called the vector potential, whose rotation gives the magnetic field. This explains the Meissner effect. London was the first to suggest that the superconducting state was a state in which a metal had taken up a state in which the wave function of the system had developed 'rigidity'. This is essentially right on the mark! However, it remained a mystery what the wave function in question actually described. That mystery would only be solved much later (see below).

In 1938, Pjotr Kapitza found that liquid helium suddenly looses its viscosity when cooled down to 2.17 K (Khalatnikov 1989, Annett 2004). The loss of viscosity is the counterpart in helium to the loss of electrical resistivity in a metal. This loss of viscosity was called superfluidity. There is a fascinating analog of the Meissner effect in helium. Recall that a magnetic field couples to matter in two ways, either via the spin of a particle or via its charge. It is the coupling to charge which is important for the Meissner effect. However, helium is a noble gas made up of neutral (uncharged) and spinless atoms! The analog is as follows: Suppose

you rotate a bucket of helium. The superfluid liquid in the bucket remains irrotational if the rotational frequency is not too large. When it exceeds some critical value, the liquid remains irrotational except along certain lines parallel to the rotation vector, where specific quanta of rotation appear. These lines are arranged in a hexagonal pattern in the plane perpendicular to the lines, and are lines of quantized vorticity, or vortex lines.

Such vortex lines were later *predicted* to occur, even in superconductors subjected to an external magnetic field by Alexeii Abrikosov. It is a rare example of a correct, non-trivial *prediction* in the theory of quantum fluids (Fossheim 2004). The magnetic field in a superconductor plays an analogous role to rotation in helium. Abrikosov was describing what is called Type-II superconductors, which exhibit a complete expulsion of magnetic fields at low enough fields, followed by a partial expulsion of magnetic fields at intermediate fields, and finally a complete breakdown of superconductivity at high enough fields. For many years after the publication of this seminal work (which was awarded the Nobel Prize in Physics 2003), it was controversial whether such flux lines existed in superconductors. However, by depositing iron filaments on top of a superconductor in a magnetic field, it is possible to directly observe vortex lines with the naked eye. They are extremely important in determining the transport properties of Type-II superconductors.

The explanation for superconductivity in metals such as mercury, tin, lead, and aluminum, came in 1957 with the famous Bardeen-Cooper-Schrieffer (BCS) theory. They realized in a brilliant flash of insight that there was a tiny piece of *attractive* interaction between electrons, mediated by the lattice of ions that the electrons move through, which was able to overcome the large Coulomb *repulsion* between electrons in a metal, in such a way as to stabilize so-called Cooper electron pairs. This is the genesis of superconductivity. Compared with non-interacting electrons in a three-dimensional metal, even a strong repulsive interaction can be ignored. On the other hand, any tiny amount of attractive interaction is a completely singular addition to the free electron gas. After 46 years of searching, Bardeen, Cooper, and Schrieffer succeeded in correctly identifying the needle in the haystack required for superconductivity. They identified the wave function of a Cooper pair as the mysterious London wave function. 2007 marks the 50th anniversary of this major landmark of human intellectual achievement.

The explanation for superfluidity in helium as observed by Kapitza is quite different from the BCS theory, and in some senses simpler. The helium isotope in Kapitza's fluid has two protons and two neutrons in the nucleus, and is a boson. Bosons have the intrinsic property of preferring to *macroscopically* occupy one and the same single-particle state at low temperatures. This is called Bose-Einstein condensation. (Fermions such as electrons are quite the opposite. Two of them cannot possibly occupy the same single-particle state). Superfluidity in bosonic helium is simply Bose-Einstein condensation in a strongly interacting bosonic fluid. However, helium has another isotope with two protons and one neutron, which is a fermion. Superfluidity in this liquid, now in the milli-Kelvin regime, was discovered in 1972. The discovery was awarded the Nobel Prize in 1997. The theory for this is much more elaborate than for bosonic helium. Since this fluid is comprised of fermions, it is again a matter of making Cooper

pairs by some interaction (which has to be different in origin from the lattice-mediated interactions for the metals described above). The wave function for these Cooper pairs turns out to be a monster with no fewer than nine complex components, compared with one in the BCS theory of superconductivity. The phase coherence in such rich and complex matter waves will continue to intrigue researchers for many decades to come.

We cannot end without mentioning high-temperature superconductivity, discovered in cuprate oxides in 1987 by Alex Mueller and Karl Bednorz. This was one of the most important scientific discoveries of the 20th century. It is a great paradox that these materials, the best superconductors the world has ever seen, are also the worst metals! Even the normal metallic state of these wonderful compounds is enigmatic, and the quest for a theory of this phenomenon is perhaps the deepest problem in physics today. Finally, we mention predictions of novel quantum fluids that may be both superconductors and superfluids (Babaev 2004). This happens to be a possibility in the most abundant element in the universe, namely hydrogen, but only under extreme conditions. Researchers are working hard to realize this new state of matter.

Research on these fascinating quantum fluids over the last century has pushed the frontiers of science forward. The no less than 13 Nobel Prizes in physics that have been awarded to research on superconductors and superfluids bear witness to that.

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Why is Fertility in Norway so High?

A brief outline of fertility differentials

Birth rates vary greatly across Europe. The lowest levels are seen in central Europe as well as in the east and south. The former Communist countries now have such low age-specific birth rates that if women were to experience these throughout their lives, they would bear only 1.3 children on average (the so-called 'period total fertility') (Sardon 2004; European Demographic Data Sheet 2006). Women's ages when they give birth are increasing, which is typical in Europe. However, figures based on data for one or a few years give the wrong impression of how many children women who give birth during the period in question will actually end up with ('cohort total fertility' is defined as the completed fertility of women in one particular birth cohort, i.e. those born in one particular year). Based on certain adjustment formulae, it has been suggested that the completed fertility of Eastern European women who are currently fairly young may be in the 1.5–1.6 range (Sobotka 2004). However, this is still far below the 'replacement level' of 2.08 needed to avoid population decline in the long run without net in-migration. Given its very high mortality rate, Russia, in particular, is facing quite a collapse: Its population size may be reduced by ⅓ within half a century (Demeny 2003).

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Southern European countries currently have a period total fertility rate of around 1.3, and fertility has been low for so many years that a cohort total fertility rate of 1.5 is already about to be *observed*, e.g. in Italy, and not simply suggested as a possibility (Sardon 2004). The situation in the German-speaking countries bears some resemblance to the situation further south. In fact, Germany has a cohort total fertility that is even slightly below that in Italy.

Within Europe, fertility is highest in the Nordic countries (Andersson 2004), France, Be-Ne-Lux, the UK, and Ireland. Among these countries, only Iceland, Ireland and France are at higher levels than Norway, according to figures from 2002. In addition, the English-speaking countries outside Europe have fertility rates above the average for Europe, while another rich country, Japan, displays a very *low* period total fertility rate of 1.3, and will soon see cohort figures of about 1.7.

In Norway, the period total fertility rate was 1.84 in 2005 (Statistics Norway 2007a), and women born in the early 1960s who have recently completed childbearing, reached almost exactly the replacement level

(Statistics Norway 2007b). Why is fertility in Norway so high by European standards? Is there is a lesson to be learned for politicians in countries with much lower fertility rates? Many of them are concerned – rightly or not – about the consequences that this might have for the citizens' well-being in the long run.

A theoretical framework

A brief review of the factors that generally determine a woman's chance of having a child may precipitate a discussion of Norway's typical 'success story'. Obviously, the woman has to be in some sort of *sexual relationship* and be *physiologically able to conceive* (as must her partner) and to bring the pregnancy to term (i.e. be 'fecund').

Another key factor is whether she and her partner want a child. This *childbearing desire* in turn depends partly on their purchasing power and the expected costs of childbearing. There are two main components of the latter: 'direct costs' (e.g. clothes and food) and 'opportunity costs' (loss of labour income for the partner who has to stay home with the child (still largely the mother). Besides, given childbearing costs and purchasing power, there may be differences in the perceived emotional benefits from having and rearing children compared with the satisfaction one might get from an alternative use of time and money. Some people take great pleasure in being with children and seeing them grow up; others would prefer, for example, activities with friends, expensive hobbies or luxury goods. Naturally, these 'preferences' for childbearing also affect childbearing desire. Finally, people may feel pressure, at least if they are married, to have at least one and preferably two children. One may consider such norms about the number of children, or about appropriate timing, to be another determinant of childbearing desire. (In addition, there are norms about mothers working, for example, which has implications for childbearing costs.)

The third main determinant of the chance of having a child is the *access to and acceptance of abortion and various types of efficient effective contraception*.

Marriage and cohabitation affect fertility through most of these factors, though one should keep in mind that there also is an opposite causality: Couples may, for example, marry because they already have or are expecting a child.

Purchasing power

People who are wealthy will also feel that they should spend more than others on each child, and they may attach more value to the material luxuries that compete with childbearing. Thus, those with a stable high income do not necessarily have more children than those with a stable low income. However, a sharp *decline* in income as a result of unemployment, for example, is likely to depress fertility, because the aspirations may need time to change (Kravdal 2002). They may tend to reflect the higher incomes in years past, and perhaps the economic situation of other people, which may not have deteriorated. Similarly, insecurity about future income is likely to reduce fertility. One reason for Norway's high birth rates is probably that families have fewer worries about their economic situation than is the case in many other European countries.

Childbearing costs

Variations in childbearing costs are probably an even more important reason for the European fertility differentials (DiPrete *et al.* 2003). Norway subsidizes childbearing heavily. Child allowances, which are likely to influence fertility (Gauthier and Hatzius 1997), are quite generous, and there is a 10-month parental leave with full wage compensation, which is longer than in most other countries (OECD 2001). Moreover, subsidized high-quality day care makes it more attractive for parents to resume work quickly after parental leave is over, reducing the opportunity costs of childbearing. (Since 1998, a cash benefit has been offered to those who cannot find or do not want a place in day care for their child.) In many other European countries, it is much harder to find reasonably priced full-time day care of adequate standards. Also, relatively good access to part-time work and the opportunity to stay at home with a sick child, and even to leave work for a couple of hours each day to breastfeed, make it possible to combine work and responsibility for young children in Norway (Rønsen 2004).

While it sounds plausible that good access to day care centres increases fertility, this has been difficult to demonstrate empirically. However, a recent Norwegian study has shown that women who live in municipalities where many children are enrolled in day care have higher birth rates than those living in municipalities with poorer day care coverage (Rindfuss *et al.* 2007).

Improved access to day care may also have contributed to the diminishing educational differentials in fertility that have been seen in Norway. For example, women who have quite recently completed childbearing and who have the equivalent of a Master's degree, have given birth to about 1.8 children, which is only 0.3 fewer than those with only compulsory education (Kravdal and Rindfuss 2007). This gap was twice as large among those born a couple of decades earlier (and it is probably also larger among young cohorts in most other countries, but we know little about that). If mothers have to stay home with children, the childbearing costs are highest for the better-educated, who typically have the highest wage potential, and they may respond by having fewer children. (There are also other factors behind the educational gradients in fertility, of course.) However, when good child care is available at a price that depends little on the family income, childbearing costs do not vary so much in proportion to the woman's education.

To summarize, the efforts to subsidize childbearing and help parents resume work quickly after birth have probably made Norwegian fertility higher than it would otherwise have been, and perhaps especially among better-educated women.

Other explanations?

Is it possible that childbearing preferences are generally stronger in Norway than elsewhere? Do Norwegians, for example, have more tolerance than others for seeing the house messed up with toys or being kept awake at night by babies who cry, or are they less distressed by having to forego some of their own leisure activities? While one cannot reject the possibility of certain cross-country differences in these types of attitudes, there is currently no basis for answering the questions in the affirmative.

The attempts that have been made to measure the pleasure derived from family-life compared with alternative sources of satisfaction have rarely focused on international differentials (Crimmins *et al.* 1991).

Fathers' involvement may be a relevant issue when discussing childbearing preferences. In particular, mothers may see childrearing as more of a pleasure and less of a burden if their partner plays a more active role. In Norway, fathers' involvement with children has been actively promoted in recent years by reserving one month of the parental leave for them. However, it is difficult to find good statistical evidence to support a hypothesis that fathers in this country are more involved in child–raising than fathers elsewhere.

A large majority of the Norwegian population lives in cities, but the cities are smaller than in many other countries, and the cities are interspersed with parks and green areas. This might make it somewhat easier to raise children, although the rural-urban differentials in fertility seen in Norway and other countries (Kulu *et al.* 2007) could also stem from factors related to the labour market.

It is hard to imagine that Norway's relatively high fertility can be attributed to poorer access to or acceptance of contraception or abortion. Many pregnancies are unintended also in this country, resulting in a large number of abortions (Sardon 2004) or 'mistimed' or 'unwanted' births, but the situation is certainly not particularly bad by European standards.

Is the high fertility rate a result of a large proportion being married? No, that is far from the case. On the contrary, Norway has experienced a particularly massive drift away from marriage. There has been a sharp increase in the proportion who never marry, those who marry do so at a later age, and divorce rates are higher than ever (Statistics Norway 2007cd). This trend may have been driven by, e.g. women's independence, the generous welfare system and generally liberal values. However, these changes in the entry and disruption of marriages are compensated for by informal cohabitation (Statistics Norway 2007e) to a larger extent than elsewhere, and many cohabitants have children. Thus, out-of-wedlock fertility is very high, as in the other Nordic countries. In 2005, cohabiting mothers accounted for 42 per cent of all births and single mothers for 10 per cent (Statistics Norway 2007f).

The high out-of-wedlock fertility

Many cohabitants report in interviews that they want a child, even if they have no plans to marry (Kravdal 1997). Moreover, it is firmly established statistically that cohabitants with children have a much higher disruption rate than married parents (Jensen and Clausen 2003). Thus, it may seem that Norway's high fertility partly stems from 'deliberate' childbearing outside marriage that is potentially problematic for children. Since children's welfare is one of our most important societal responsibilities, one might therefore argue that it is time for a political discussion about whether we need to send different signals to young potential parents. However, the knowledge basis for such a discussion is weak. There is great uncertainty about how harmful a break-up actually is for a child (Amato 2000), and we do not know whether there is a sharp causal effect ensuing from the type of union on the chance of disruption, or whether the statistical association is primarily driven by a common underlying factor. Many cohabitants report that one major reason for not marrying is that they

want an easy way out, which may indicate a concern about the quality of the relationship (Kravdal 1997). If this concern is well founded and not merely a result of an excessively pessimistic attitude, the high disruption rate should come as no surprise. (Another issue is that a poor relationship between the parents may affect a child negatively regardless of union status.) However, there may well be completely different factors behind the instability of consensual unions. In particular, it has been suggested that changes in family behaviour over recent decades have been driven partly by increasing freedom to make choices based on rational individual considerations, as opposed to being pushed by (often religiously based) traditions (Lesthaeghe and Surkyn 1988). Some of those with relatively liberal attitudes may prefer cohabitation to marriage because of the expense of a wedding (Kravdal 1999), for example, without any particular concern about the quality of the relationship. If the relationship *does* turn sour, their liberal attitude may also make them more likely to split up, which they might have done just as easily if they were formally married.

Summary

Norway is blessed with a very strong economy, which probably contributes to the country's relatively high fertility. Individual families tend to consider their economic prospects as bright, and the State can afford to be generous with parents, not least with a view to day care. In addition, there is political willingness to spend some of Norway's national wealth on family life. This may in turn hinge on ideas about public responsibility for individual well-being that are strongly rooted in the Nordic societies (Esping-Andersen 1999), accompanied by widely accepted gender-equality ideals. The rejection of marriage is more pronounced in Norway than in most other countries, but this is counteracted by a large number of births to cohabitants. One possible explanation for the latter phenomenon may be that women are not overly afraid of single motherhood because they have their own resources and the country has supportive policies. The wide acceptance of this behaviour may also be a key factor. In fact, there is currently little public concern about the high out-of-wedlock fertility, as opposed to in the US, where more of these births occur to *single* mothers and the chance of falling into poverty is high (Sigle-Rushton and McLanahan 2002). However, perhaps we should allow ourselves to discuss whether we may be *too* accepting of modern family forms when children are involved.

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JORUNN ØKLAND

The Transformation of Corinthian goddesses[1]

The force of the flexible form

Concerning religious iconography, Albert Moore (1977: 96) points out that

> "in the polytheistic religions of ancient Egypt and Greece we can study two rich but very different developments … The Greek gods … are conceived and portrayed anthropomorphically; they are therefore more involved in and dependent upon the changing ideals of human culture…. Just as the surviving Greek images have come through the vicissitudes of history mainly in broken or derivative form, so their anthropomorphic vision itself has been more vulnerable to change."

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However, this divine 'vulnerability to change' could also be perceived as flexibility, a faculty of metamorphosis, i.e. an ability to transform and adjust to new cultural paradigms and ideologies without loosing the ability to capture the imagination of sympathisers. We will ask how Demeter and Kore, the Greek goddesses of grain, agricultural and human fertility, fared when transformed into the Roman goddesses of Ceres and Proserpina. More specifically, since cults varied locally, how did the transformation materialise in Corinth, a city located in the northeastern corner of Peloponnese, and re-founded as a Roman colony in 1st century B.C.E.?

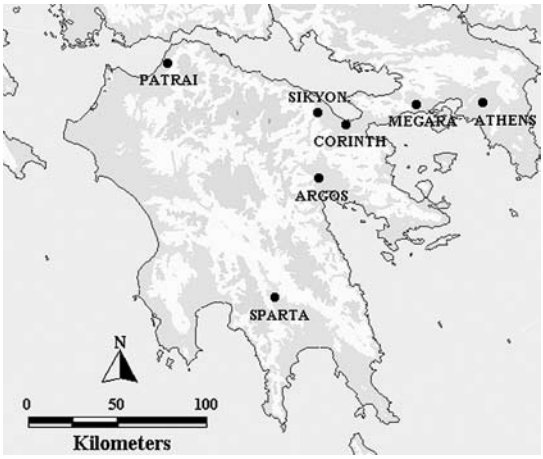

Figure 1: Map of Peloponnese showing the location of Corinth

1: This essay is a highly abridged version of an article by the same name that appeared in Corinth in Context: Comparative Perspectives on Religion and Society edited by Steven Friesen and Daniel Showalter. Cambridge, Mass.: Harvard University Press.

Demeter and Kore in Corinth

The centre of Demeter/Ceres' cult in Corinth was always the sanctuary located on the northern slopes of Acrocorinth.[2] Located outside the city, this sanctuary is typical of how Greek Demeter sanctuaries reproduced an environment of spatial isolation, even if they were located inside the city walls (Cole 1994: 213). This is important because the location of the sanctuary was the one thing that it was difficult for the Romans to do anything about. They could perhaps transform the space and its 'inhabitants,' but not the location.

The votive offerings, numerous terracotta trays with fruits of the earth, show that Demeter was very much perceived as the goddess of grain and agriculture in the Greek period. Central in her cult was ritual dining by women worshippers, an activity that celebrated the fruits of the earth but also promoted human fertility. More than 40 dining rooms have been excavated from the Greek period. Other excavated remains allude to the myth of the goddess of grain whose daughter Kore/Persephone was raped by Hades, the king of the Underworld, when she was out in the fields picking flowers. For revenge, Demeter did not let anything grow until she got Kore back at least part of the year (Bookidis and Stroud 1987: 8). This myth also established Kore as goddess of the Underworld and Hades' wife.

The meanings of names are also interesting when studying transformation: *Kore* means just 'the girl', while her other Greek name, *Persephone*, means she who beats the sheaves during threshing. Thus in her Greek hypostasis she was seen either as Demeter's daughter, and/or as her helper in the process of producing grain, i.e. food. Thus, both Kore and Persephone refer to Demeter as the central deity, but an interesting complication is that threshing and transforming natural grain to cultural food are human activities, which providing grain and fertility are not. Thus, Persephone was somehow viewed as easier to identify with for human farmers. All they could do with Lady Demeter was to pray for her goodwill. *De-meter* further includes the 'mother'-term, so the name not only reflects the mythology, representing her as 'the mother' of 'the girl' Kore, but also that she is a goddess of human fecundity. In the Greek sanctuary, this aspect of the goddess is confirmed e.g. by dedications of grotesque figurines representing pregnant women (Merker 2000: H357–361 p. 195 and Plate 53). The dedications of miniature (flower) baskets also allude to the myth of the flower-picking Kore.

The Roman Corinthian Ceres and Proserpina

After the re-founding of Corinth as a Roman colony, the *official* names of the deities worshipped in the sanctuary must have been *Ceres* and *Proserpina*. The Latin *Proserpina* has by some been assumed to derive from a term meaning 'to emerge'. Others assume it to be a Latinization of the Greek *Persephone*, and hence not meaningful in itself. The meaning of her Greek name *Kore* was, however, lost in translation. Similarly, the 'mother'-aspect of Demeter's name was also lost, but the connection to the earth that may have been inherent in the prefix, the proto-Indo-European Da/De- (distribution of land/earth), was retained. Her Latin name *Ceres*

2: This presentation is based on the excavation reports, see Bookidis and Stroud (1997); Merker (2000); Slane (1990).

denotes the goddess of grain, which grows out of the earth. If we view ancient pantheons as semiotic universes, it is likely that the translation whereby both 'the mother' and 'the girl' disappear out of their names' semantic fields, reflects a pantheon of a different culture. On the other hand, the two deities did not represent women's life-worlds as authoritatively as they did in the Graecophone pantheon, and where other Roman goddesses filled this function instead.

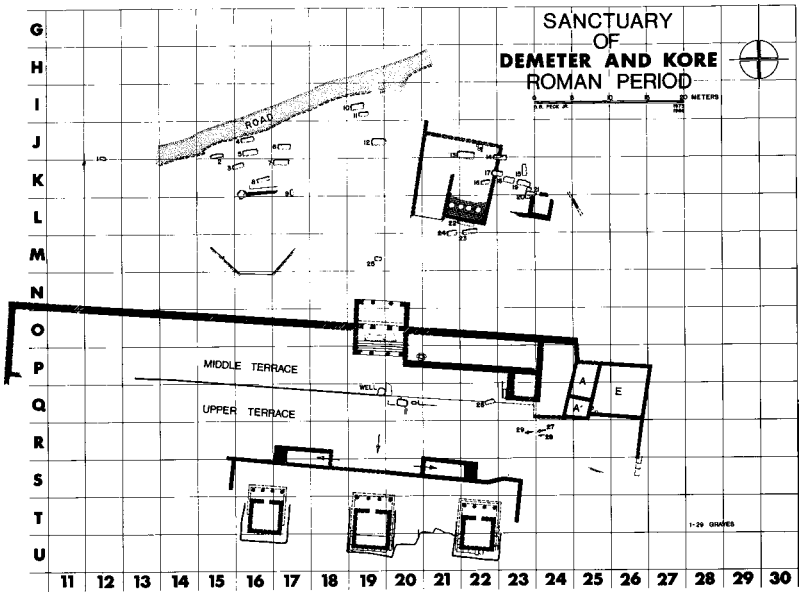

Figure 2: Plan of the Sanctuary in the Roman Period

The question is how pervasively the official Latin names of the goddesses affected the actual cult practices in Roman Corinth. Even if Roman infrastructure meant that cult practices were more assimilated across their Empire than across previous empires that controlled the inner basin of the Mediterranean, there was still considerable room for variation. As Roman marble was placed on top of local stone so that the totality of a building was given a new look, so also the blending of Roman beliefs and cult practices with local ones created new, hybrid phenomena.

In Corinth, even if the early inscriptions were in Latin, by the time of Hadrian the majority of official inscriptions were in Greek. There may be demographic reasons for this, but it was never a problem for people, least of all in polyglot empires, to speak more than one language if external circumstances so required. In light of this, it is striking that the evidence even from the Roman-period sanctuary is in Greek. If we look at the matter from the perspective of the Roman colonizers, we see that even though they changed the names of the deities into Latin ones, they were still viewed as old Greek deities. In Rome, it was the *Graecus ritus*[3] that was observed. However, since the Roman conception of the Greek past was not identical with the Greek past, it rather displayed a very Roman notion of it (Beard *et al.* 1998: 2 n.3; 173); we cannot assume straightforward

3: The Latin technical term the Romans used to denote rites that were *exempt* from following certain Roman religious laws because of their ancient Greek origin.

continuity from the Greek to the Roman periods. For example, according to the *Graecus ritus,* rituals and festivals were celebrated exclusively by women even if other Roman rituals of Ceres were gender-inclusive.

When the Roman colonists came to Corinth in 44 B.C.E., enough of the pre-Roman structures had survived to ensure certain identification of the deities worshipped there. After only 100 years or so, they started remodelling the old Demeter sanctuary. First, on the upper terrace, some previous buildings were covered over and three small temples were erected and protected by a retaining wall, dividing the former sanctuary space more sharply into two areas. Second, on the lower terrace, none of the former dining rooms was rebuilt in the Roman period as dining rooms.

Figure 3: Roman-period relief of the goddess imitating archaic style

The Roman retaining wall left the Greek dining area outside the protected space, and turned the upper terrace into the ritual centre. Third, there is a drastic fall in traditional votive offerings in the early Roman period. Fourth, the remains of an offering table were found in the central and largest temple. A floor mosaic in this temple carries a dedication to *Neothera.* Stroud's (1993:73 n.7) suggestion that *Neothera* (the younger) was an epithet of Proserpina in the Roman period (like *Presbytera*, the elder, was the corresponding epithet of Demeter) has more or less gained consensus.

Based on this evidence, I want to make three points: First, this means that the main temple in the Roman period might have been dedicated to the daughter and not to the mother.[4] Second, the name Neothera and the symbolism surrounding the inscription integrated Egyptian elements,

4: In a forthcoming study, Barbette Spaeth argues on the basis of the cult of Ceres elsewhere, that this cannot have been the case. A sanctuary with the daughter rather than the mother as the main cult focus would have been an anomaly. Spaeth is surely correct, but my problem with this view is that Roman religion during imperial times provided a space for conversation and negotiation between imperial centres and margins, ancient Roman traditions and ancient colonial ones. Since religious standards were not reinforced from the top down, there was considerable variation between the Roman pantheon worshipped in today's northern England or Greece, and the Roman pantheon worshipped in Rome.

which is an indicator of syncretism. Third, the mother-and-daughter aspect of the cult that might have been relatively weakened in the cult in its Latin reinvention/re-naming, is re-activated if *Presbytera* and *Neothera* are indeed Demeter and Persephone. These epithets are not only applied to Egyptian goddesses, but also documented in Eleusis. Fourth, it is noteworthy that this inscription is in Greek because, whatever the intention, it shows that by the 2nd century at the latest, a Latin-Roman cult of Ceres was not seen as appropriate. This raises the question of whether it ever was. Indeed, the most 'Roman' thing about this Greek inscription is its ambiguity, calling upon and thus integrating the universes of the Egyptian and Greek cults, in a Roman context.

Conclusion

When studying the transformation of the goddesses from Greek to Roman Corinth, we pointed out that their identity was dependent on the language in which they were worshipped, by whom, and the functions they fill within the system that is a pantheon (Staples 1997:8). We have observed continuity in content and perhaps even in the names used within the cult (as different from the names used to describe the sanctuary in official records). However, there was discontinuity in functions and some cult practices. If 'disambiguation' is "to remove uncertainty of meaning from" (*Oxford English Dictionary*, *s.v.*), then what the Romans were doing with provincial pantheons to integrate them into their larger system was often the opposite.

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JAN PETTER MORTEN

Quantum Physics and the Boundaries of Space and Time

"An object is influenced directly only by its immediate surroundings."
"An object has pre-existing values for any possible measurement before these measurements are made."

Do you find these statements about reality plausible? Historically, most physical theories have adhered to such principles which, in combination, are referred to as 'local realism'. Local realism corresponds so well with our everyday experience of the world that most people intuitively assume it to be an essential part of any natural scientific theory. The quantum theory developed in the early 19th century was therefore controversial at the time, since it did not comply with local realism. This was addressed by Einstein, Podolsky and Rosen (EPR) in their seminal paper "*Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?*" [A. Einstein *et al.*, 1935]. EPR constructed a thought experiment that reveals a peculiar feature of the quantum theory: In special situations, measurements performed on two particles with arbitrary separation can have an instantaneous influence on one another. This effect is known today as the 'EPR paradox' and is in violation of local realism. Despite this apparent inconsistency, quantum theory could not be disregarded since it accurately described new experiments probing the properties of light and atoms. Early discussions of the EPR paradox were of a metaphysical nature as the questions raised could not be experimentally investigated. A very important discovery was made in 1964 by John S. Bell, who formulated a mathematical inequality governing the possible outcomes of EPR experiments [J. S. Bell, 1964]. This analysis provided a test to see whether local realism could be falsified. The stage was set for experimentalists to answer the questions posed by EPR.

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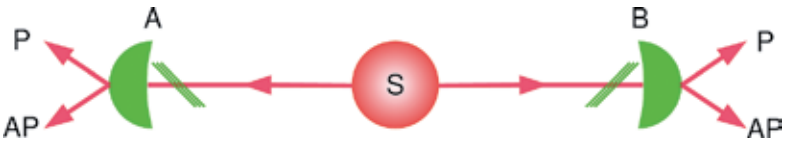

Figure 1: Schematic of the EPR experiment. The source S produces pairs of entangled photons (light particles) that are sent in opposite directions to measurement apparatus A and B. The polarization of an incoming particle is measured in a direction (triple lines) determined independently at A and B, and a measurement gives either outcome parallel (P) or antiparallel (AP) to this direction.

The Einstein-Podolsky-Rosen thought experiment

Let us now describe the EPR thought experiment in more detail. Imagine that two particles have been emitted from the same source and travel in opposite directions, eventually reaching the widely separated measurement apparatus denoted A and B, see Fig. 1. Precisely which particle property to measure at A and B (in Fig. 1, this property is the direction of polarization for light particles) is decided upon after the particles have traveled far away from each other. Now if we choose a separation of A and B that is large enough, no information about the measurements at A can reach B in time before the measurement has been made there. In this case, the measurements at A and B should be independent. According to the special theory of relativity, no information can travel faster than the speed of light. So to obtain independent measurements, the separation of A and B should be large enough that no light can travel from A to B during the time it takes to make the measurements, see Fig. 2.

Surprisingly, quantum theory tells us that the above mentioned criteria do not guarantee independence between measurements at A and B. If the pair of particles are in a so-called "quantum entangled state", they can no longer be assigned individual properties. Rather, the pair of particles must be considered a single non-separable object. This introduces the possibility for dependence between measurements at A and B, regardless of their separation. Moreover, in quantum theory the actual outcome of a measurement is not always given in advance, but determined statistically when actually taking the measurement. Generally speaking, we might say that when a measurement is made on one of the particles, we also modify the possible outcomes of measurements on the other. So there appears to be some communication between the two particles: the measurement on the particle at A influences the particle at B instantaneously, independently of the distance between them. This feature of the quantum theoretical description is described as 'nonlocality' and is in contradiction with local realism, which states that only events in the vicinity of B can affect measurements there. The skeptical Einstein referred to nonlocality as "spooky action at a distance", regarding the possibility for nonlocal influences - a fatal blow to quantum theory.

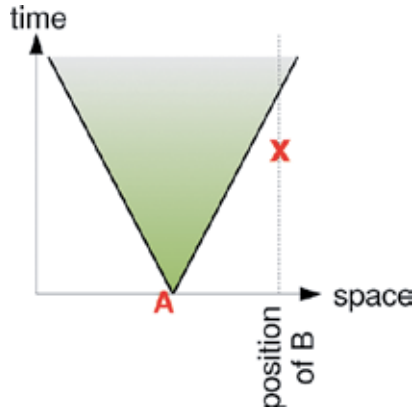

Figure 2: Spacetime diagram illustrating the conditions for measurements at A and B to be independent according to special relativity. The measurement at A takes place at point A. Information about this event spreads out into the green area at the speed of light, eventually reaching the position of B. If the measurement at B is done before the green area intersects with B's position (e.g. at position x), the measurements at A and B should be independent.

Bell inequalities

The EPR thought experiment did not immediately suggest an experimental quantity that could be used in a measurement to demonstrate any

nonlocal influences. Three decades after EPR's paper, J. S. Bell derived a mathematical inequality that defines the conditions under which the measurements cannot be explained by any theory where the particles are treated as unconnected and independent [J. S. Bell 1967]. Bell's analysis opened a new direction for research on the EPR paradox, and "Bell inequalities" were derived for realistic implementations of the EPR experiment [J. F. Clauser *et al.* 1969]. In principle, Bell's reasoning was the following [N. D. Mermin 1985]: Assume that an EPR experiment has been implemented so that the measurements at A and B cannot influence each other according to special relativity. Then, calculate the statistical probability that measurements at A and B would give the same result given that only local interactions exist. When the experiment is repeated millions of times, the fraction of agreeing measurement pairs should be maximum at this probability - this constitutes the Bell inequality. If the fraction of agreeing data collected from A and B exceeds the probability, there must be something wrong with the assumptions made to calculate the probability. Careful scrutiny of the calculation will show that the only possible explanation for a violation of the Bell inequality is the assumption of locality. In case of a violation, the conclusion would thus be that some nonlocal influence must be taken into account. Bell even calculated what the agreement, or more generally the correlation, between data from A and B should be according to quantum theory. This prediction violates the inequality. A theorem accredited to Bell states that "no physical theory of local hidden variables can ever reproduce all of the predictions of quantum mechanics", thus establishing that if the nonlocal effects predicted by quantum theory in the EPR experiment were measured, a local realist theory would be falsified.

Experiments to test Bell inequalities

Various experimental setups were devised to test Bell's inequality. The measurement apparati used are usually polarization filters that measure the polarization direction of pairs of photons (light particles) emitted from laser stimulated atoms, see Fig. 1. The measurement outcomes are stored on a local computer, and data from A and B are compared after the end of a run. Under the assumption that the polarization measurement at e.g. A cannot influence the measurement on the photon at B, a Bell inequality gives the statistical limit for how often pairs of measurements can give the same outcome. Technological progress has enabled experimenters to test the Bell inequalities with impressive precision. A first series of tests in the 1970s gave results that violated the Bell inequalities and agreed with quantum theory, but the experimental inaccuracy was large. More elaborate experiments were performed in Orsay, France, in the early 1980s. They convincingly showed violation of the Bell inequality [A. Aspect *et al.*, 1982]. However, skeptics have pointed out a number of weaknesses in the experiment, often called 'loopholes'. One of these concerns is nonlocality, i.e. the particles were not sufficiently separated that communication between them could be ruled out as a mechanism for correlating measure-

ments. This was improved upon in an experiment in which the measurement apparati were separated by a distance of 400 m across the Innsbruck University science campus [G. Weihs *et al.*, 1998]. This precludes communication between A and B during the measurement process at a velocity less than or equal to that of light.

Nature is nonlocal

Today, the accumulated knowledge from EPR experiments overwhelmingly show that Bell's inequalities are violated [A. Aspect 1999 and W. Tittel *et al.* 2001]. The experimental data provide a fatal blow to the local realist theory, and are also taken in favor of quantum theory.[1] Some of the current focus of research into Bell inequalities is directed at detecting quantum entanglement rather than ruling out local realist theories. This task is different since one accepts quantum theory at the outset. One research direction that assumes this position is aimed at implementing EPR experiments in nano-electronic devices. The experimental system could in this case be put on a micrometer-size piece of semiconductor; a violation of Bell's inequalities is understood as a signature of nonlocal pairs of quantum entangled electrons.

The success of quantum theory has also motivated research in philosophical directions. For example, some philosophers question the notion of a reality that exists independently of human observers, and others advocate a "many-worlds interpretation" where every possible outcome to every event defines or exists in its own 'history' or 'world' [A. Goswami 2001].

To conclude, we have followed a scientific endeavor where impressive progress has been made. What started as a metaphysical debate over the validity of quantum theory was brought into the realm of experimental physics by the Bell inequalities. In the end, technological achievements made a decisive conclusion possible after 60 years: Local realism is dead. How to reconcile this fact with human perception of reality is still an open question.

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1: Although the experiments exhibit nonlocality, this does not open for superluminal communication between observers at A and B. The observer studying the measurement outcomes at A will see a random sequence of data. Only by comparing her data to those measured by observer B will she be able to discover the nonlocal influence. To do this, the data from B must be transmitted to A by conventional means, like a radio signal.

SAMUEL RUBENSON

Marriage – What Difference did Christianity Make?

In modern popular debate, marriage has often been seen as an ancient institution based on patriarchal structures and supported by religious authorities, in the West by Christianity and the authorities of the Church. In spite of awareness that marriage customs and rules have undergone historical change, it has generally been taken for granted that Christianity mainly enforced already existing ancient traditions and customs in society. The aim of this paper is to look at what evidence we have for changes that can be attributed to the Christian tradition, and how these changes can be explained.

Since Christianity is itself a product of historical development, and not an ideology independent of its historical context, there was no well-defined Christian understanding of and practice in regard to marriage from the beginning of Christianity in the first century A.D. Instead, Christian marriage traditions were formed on the basis of the social and historical setting of Early Christianity and became fairly fixed in Western as well as Eastern Christian tradition only towards the end of the 8th century (Rubenson, 2007). To speak about the differences to marriage related to the emergence of Christianity, we must compare marriage views and regulations in the non-Christian late Roman empire with established Christian tradition in about 800 A.D. (Hunter, 1992).

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To isolate changes due to Christianity from those due to economic, social and political developments, we need to restrict ourselves to the points where there is a clear tension between specific Christian ideals and Roman traditions, and where Church authorities were seen to have promoted change. This is much clearer in relation to the fundamental issues of what marriage means and how it is legally construed, than in relation to views on gender and sexuality, or social and economic patterns of households in general. What we are looking at is marriage as a socially institutionalized and legally regulated union of a man and a woman, including their responsibilities for their children.

The basic thesis I will argue here is that there is a fundamental difference between the laws regulating marriage in the later Roman Empire in about 200 A.D., that is, before the impact of Christian tradition, and the laws in the established Christian Germanic and Byzantine empires in the Early Middle Ages in about 800 A.D. Second, this difference is strongly related to fundamental Christian ideas promoted by Christian authors and authorities. I am well aware of the fact that laws and ideals are not

the same as social reality. However, although only slowly and partially, the underlying Christian interpretation of marriage led to basic changes in the understanding of and finally also to practices in relation to marriage.

Roman marriage

Under Roman law, marriage was restricted to free Roman citizens. In other words, slaves and non-Romans could not be married and thus did not share in any of the privileges or responsibilities connected with marriage (Treggiari, 1991). In Latin, marriage was called *matrimonium* (from *mater* = mother), indicating that it was the status of the woman and the children she bore that changed in marriage as she became a married woman and the mother of her husband's children. She now shared her husband's social status, the children she bore were his children, and any sexual relationship with a Roman citizen who was not her husband was adultery. The man was not a married man, but a man with a wife. His status did not change and he had no obligation to remain sexually faithful to his wife. Marriage was strongly supported by the state in order to promote the bringing up of children who could be charged with official duties and thus uphold the state and guarantee succession. There was no formal act to be married or to be divorced. Any man and woman who were old enough, were Roman citizens, and lived together with marital affection and the intent to bring up children were considered married. If they separated, the marriage had ceased to exist, independently of who took the initiative and why (Reynolds, 1994, 44–49).

Marriage in the Christian empires

Although the last remnants of the exclusion of slaves from marriage did not disappear until the 10th century, we have evidence of Christian authors opposing the limitation of marriage to free citizens already from the 3rd century (Reynolds, 1994, 159–162). In the early Christian communities, there were free citizens as well as slaves. As long as the Christians were an occasionally persecuted minority, loyalty to the group was generally stronger than to social class. Although the growth of Christian communities gradually reintroduced social differentiation, it was difficult to deny basic equality between all believers. Moreover, slaves could not be exempted from the moral obligation of sexual fidelity that was part of Christian ethics.

Beginning already in the first centuries A.D., Christians began to think of marriages as instituted by a formal act blessed by the Church (Stevenson, 1983). A formal wedding finally became required in the East in the 9th century. Although generally accepted much earlier, formal weddings were not required until the 16th century in the West.

These changes are related to a more general and fundamental change in perspective. Jewish tradition and Biblical texts made the early Christians regard the couple as a unit forged by God and their common offspring as part of the work of the Creator. Man and wife no longer had individual rights and responsibilities and no longer belonged to different families, but became one unit established by the sexual union that could not easily be dissolved again (Rordorf, 1969).

According to the strict Jewish tradition promoted in the New Testament, a marriage could only be dissolved as a result of adultery, i.e. of sexual infidelity on the part of the wife. This inequality between man

and wife was, although biblical, regarded as problematic by the dominant Christian authors. Gradually, male and female infidelity became legally equivalent, although the specific penalties differed (Reynolds, 1994, 173–226). In the West, sexual equality was finally interpreted to mean that neither wife nor husband had the right to divorce even in case of infidelity. In the East, the right to divorce was maintained for the man as well as for the woman.

Summary

The basic changes in the understanding of marriage introduced by Christianity can be said to have been:

a) social equality in respect to marriage rights;
b) gender equality in respect to demands for sexual fidelity;
c) rights of children to their father.

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VIGDIS SONGE-MØLLER

Metamorphosis and the Concept of Change

– From Ancient Greek Philosophy to the Apostle Paul's Notions of the Resurrection of the Body

Ancient Greek philosophy and the paradox of change

The notion of the resurrection of the body involves some kind of metamorphosis or radical change, i.e. a change from one state of being to another. Yet insofar as the object, or person, undergoing transformation remains in the same state of being, there has to be some kind of continuity. If there were no continuity, the object, or person, would just disappear, and there would have been no change. In other words, metamorphosis presupposes both change and continuity, amounting to no less than a paradox. Change presupposes its own opposite, i.e. 'no change' or sameness. This paradox, or the *discovery* of this paradox, can be traced back to one of the first Greek philosophers, Parmenides, who lived in South Italy around 470 B.C. Unlike his predecessors, Parmenides did not search for the origin or the end of all things, but formulated problems involving these very phenomena in particular and, more generally: all kinds of change. Parmenides´ reflections on the paradox of change may have determined the course of Greek philosophy and, to some degree, the subsequent course of Western philosophy as well.

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The paradox of change, as formulated in Greek thinking, is based on a conviction of a certain relationship between human rationality and reality. This relationship was also first described by Parmenides: "… the same thing can be thought and can exist" (fragment 28 B 3[1]).

In other words, reality and human rationality follow the same rules. This does not imply that anything we can think of, e.g. a phantom or a man with three heads, has to exist, but it implies that phenomena that cannot be explained rationally cannot exist. Change is such a phenomenon, since it is based on a paradox.

The problem of change haunted Greek philosophy after Parmenides. Change is a phenomenon upon which all life is based: birth, growth and death involve change, even radical change, from non-being to being, and

1: The number of the fragment is according to Diels and Kranz, 1951.

from being to non-being. It was perceived as no less than a scandal that such a common phenomenon, experienced all the time, could not be explained rationally.

Plato's *Parmenides*: the instant as the inexplicable source of change

Plato (427 – 347 B.C.), the spiritual heir of Parmenides, can be described as having been obsessed with change, for the very reason that he could not properly explain it. For him, change belonged to the illusionary world of the senses, which was conceived as a mere copy of the real, and therefore rational, unchanging and eternal world to which our soul belongs. In his dialogue *Parmenides*, Plato comes closer than anywhere else to a means of dealing with the irrational phenomenon of change. Here, Plato situates change by invoking what he calls a 'very strange thing', a 'queer creature', a 'non-place' (*atopon*), namely, the *instant* (*Parmenides* 156 d-e). A transition from one state to another can only occur *instantly*, at a moment outside not only space but also time, i.e. a moment which is not a part of the world of the senses, nor of the ideal world of reason. The instant which, according to Plato, is the source of change, is beyond both. As a non-place it is an abyss, lacking a form, and as not belonging to any time, the instant has neither a before nor an after. It is not what we call 'now', or the present. In a way the instant does not exist, it just happens. Or rather: change happens, as an inexplicable event.

Paul: the mystery of the resurrection of the dead

As a contemporary of Jesus, Paul was born about 350 years after the death of Plato. This is a very long time span, and I will say nothing about any possible influence of Plato on Paul. In the light of Plato's reflection on change in *Parmenides*, I will simply try to look at how Paul, in his first letter to the Corinthians, describes and explains the transformation of the resurrected body. His central focus in this letter is the resurrection of Christ, our belief in the resurrected Christ, and the consequence of this belief, namely the resurrection of the dead on the last day (1 Corinthians 15, 16–17). The resurrection of Christ is the one paradigmatic event, which is a necessary but not a sufficient, condition for the resurrection of the dead on the last day.

For Paul, man is not composed of a rational, immortal soul and an irrational, mortal body, and does not therefore look at death as a split between the two. Rather, Paul distinguishes between a mortal body of the flesh and an immortal body of the spirit: death involves the death of the flesh, but after death the person who believes in the resurrected Christ will get another kind of body, a body that will live forever (1 Corinthians 15, 36–38). In other words, death involves radical change, but also, it seems, continuity: the person remains, in some way or other, the same before and after death. It is, however, difficult to say exactly what kind of continuity this is. It does not seem to depend on an unchanging element, be it a soul or anything else, i.e. an element which remains the same before and after death and which does not ever, and cannot ever, undergo any kind of change. One thing is clear: Paul's notion of the resurrection of the dead constitutes a radical break with Platonic thinking.

Paul is perfectly aware of this break and makes a point of it more than once in his first letter to the Corinthians (especially 1 Corinthians 1, 20

– 25). Paul says his words will appear as 'foolishness' to the philosophers, (1 Corinthians 1, 23). The reason for this seems obvious: Paul's preaching about the resurrection of the dead takes no account of the philosophical demand for an equation between reality and reason. The belief in the reality of the resurrection of the dead does not rely on reason and rationality, but rather on a mystery:

> *Behold, I show you a mystery: We shall not all sleep, but we shall all be changed – in a moment, in the twinkling of an eye, at the last trumpet. For the trumpet shall sound, and the dead shall be raised incorruptible, and we shall be changed. For this corruptible must put on incorruption, and this mortal must put on immortality.* (1 Corinthians 15, 51–53; 21st Century King James Version)

The mystery is this: the radical change of the body from being corruptible and mortal to being incorruptible and immortal.

Plato and Paul: beyond human reason

Ironically, the phenomenon of change was as great a mystery to the Greek philosophers in the Platonic tradition as the metamorphosis of the body was to Paul. Neither can be explained by human reason, or by *logos*, which structures reason as well as reality. Paul's 'foolishness' is perhaps no more foolish than Plato's 'explanation' of change. In fact, they deal with it in similar ways. Whereas Plato described change as an event which happens in a moment, Paul tells us that "we will all be changed in a moment, in the twinkling of an eye". The word which Paul uses for a 'moment', is *atomos*, which means something that cannot be divided, that cannot become any smaller. A moment is the smallest thing there is. Only at this moment, which escapes human reason, can this special kind of change – the resurrection of the body – happen.

Whereas Plato explains *all kinds of change* by the extraordinary and inexplicable moment, which is outside time, Paul explains *this extraordinary change*, the resurrection of the body, by a similarly extraordinary moment, which is also on the verge of time: at the last trumpet. Since all change is radical change to Plato, it might not be a complete coincidence that Paul here comes very close to Plato's way of thinking.

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Population Ageing:
Causes and Consequences

In most of the richer countries of the world and in an increasing number of poorer ones, population ageing is now a predominant demographic issue. Ageing at the individual level is a heterogeneous experience not necessarily involving serious disability, and there is no biological reason for choosing any particularly age to mark passage to elder status. However, here I follow convention and generally talk about the 'older' population as being those aged 65 and over. I examine the causes, course and consequences of population ageing, drawing mainly on the experience of England and Wales.

Figure 1 presents a historic view of population ageing in England and Wales and, for comparison, the USA and Japan.

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In England and Wales, the relative size of the population aged 65 and over doubled from five to 10 per cent in the first half of the 20th century. It increased by another five percentage points by 2000, and will grow by a further five points (or slightly more) by 2020. In Japan, by contrast, there was no increase in the relative size of the older population until the 1960s, but change since then has been much greater than in England and Wales, reflecting rapid falls in both fertility and mortality in the second half of the 20th century. Population ageing has been slower and less marked in the USA than in either England and Wales or Japan.

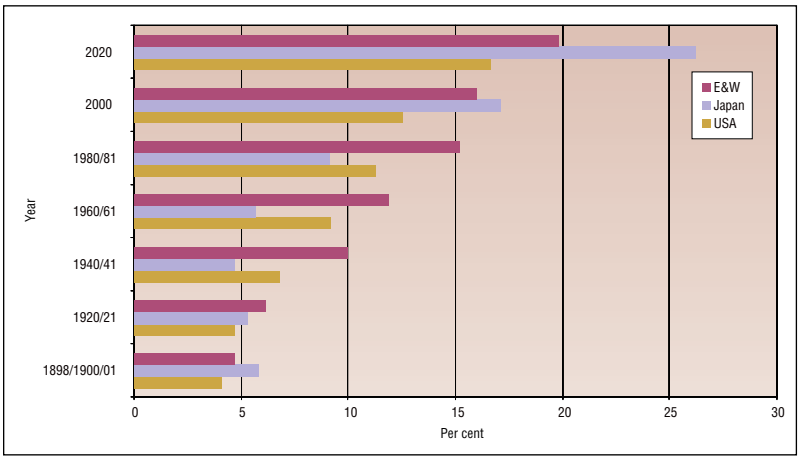

Figure 1. Proportion (%) of the population aged 65 and over, Japan, E&W, and the USA, 1900–2020

Source: Grundy E.: "The epidemiology of aging." In: Brocklehurst's *Textbook of Geriatric Medicine*, eds. R. Tallis & H. Fillit, Churchill Livingstone (from national and international series), 2003.

These differences reflect varying levels and trends in the demographic drivers of population size and age structure: fertility, mortality and migration. Numbers of older people reflect both how many births there were 65 to 100 years earlier and how many of those born survived to age 65 and beyond. What proportion of the overall population is represented by older people depends on these numbers and the size of the population as a whole. This is predominantly influenced by subsequent birth rates and it is long-term downward trends in fertility which cause the initial shift towards an older population.

Fertility trends

In England and Wales, and other North West European countries, this shift towards lower fertility was set in motion towards the end of the 19th century, as illustrated in Figure 2.

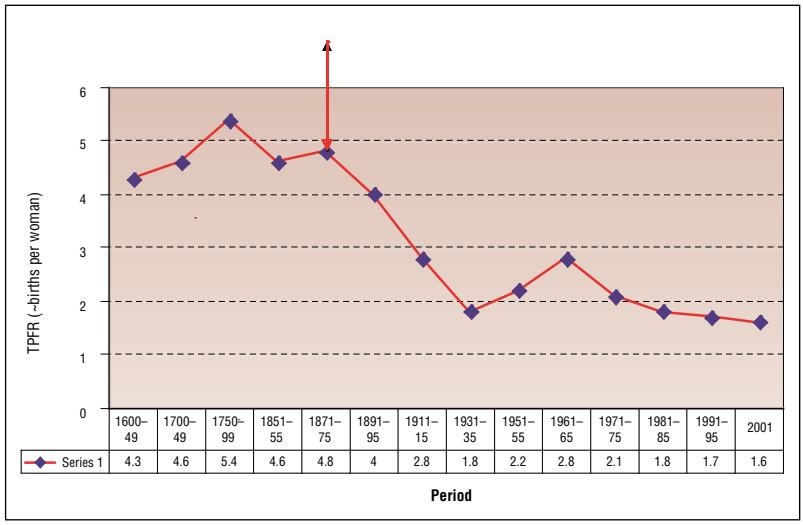

Figure 2. Long-term trends in fertility, England and Wales.
Sources: Wrigley & Schofield: *The population history of England,* 1981; ONS various years.

The arrow marks the start of the 'demographic transition' – a once and forever shift to lower fertility which set in motion the process of population ageing. However, whilst we have never returned to pre-transition levels of fertility, there have been subsequent fluctuations in birth rates – in particular, during the baby-boom of the late 1950s and early 1960s fertility rates were higher than in the inter-war period.

In some recent years, the Total Period Fertility Rate (TPFR) – an estimate of how many children a woman will have based on current trends, has fallen to as low as 1.6 in England and Wales (currently 1.8). But this is still higher than in countries such as Japan, as well as many countries in Southern and Eastern Europe. Japan now has one of the world's oldest populations, due to a combination of 'lowest low' fertility and low mortality. In 2004–5, for example, Japan's TPFR was 1.3, compared with 1.8 in England and Wales. By way of contrast, the US population is younger, because of higher fertility and continuing immigration.

Mortality trends

Death rates also influence age structures, although their potential effect is not as great. At roughly the same time as the fertility transition, there were

large declines in mortality, as illustrated in Figure 3. However, early improvements in life expectancy were mainly achieved through declines in death at young ages. Rather than contributing to population ageing, in fact, this trend to some extent offset the consequences of lower fertility, as it led to increases in the child population and in the proportions of women surviving long enough to have children themselves.

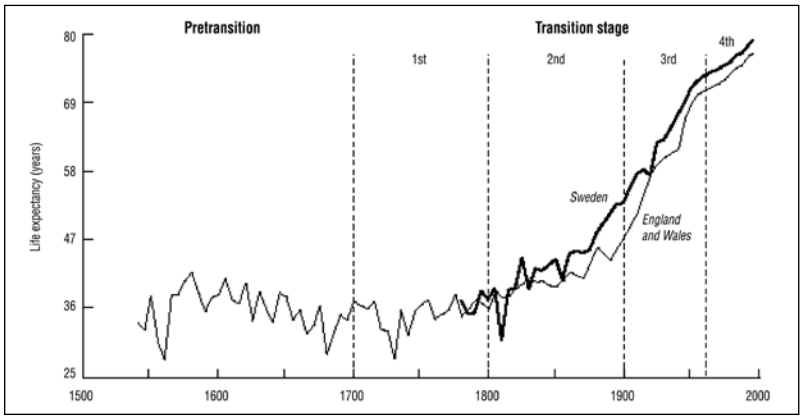

Figure 3. Long-term trends in life expectancy, England and Wales and Sweden.

Source: Wrigley and Schofield (1981) and Keyfitz and Flieger (1968), updated from U.N. *Demographic Yearbooks*.

In populations with low fertility and mortality and an already old age structure, declines in mortality at older ages assume a much more important role in determining the extent of further population ageing. As illustrated for England and Wales, recent declines in late age mortality (measured here by years of further life expectancy at age 65) have been quite considerable.

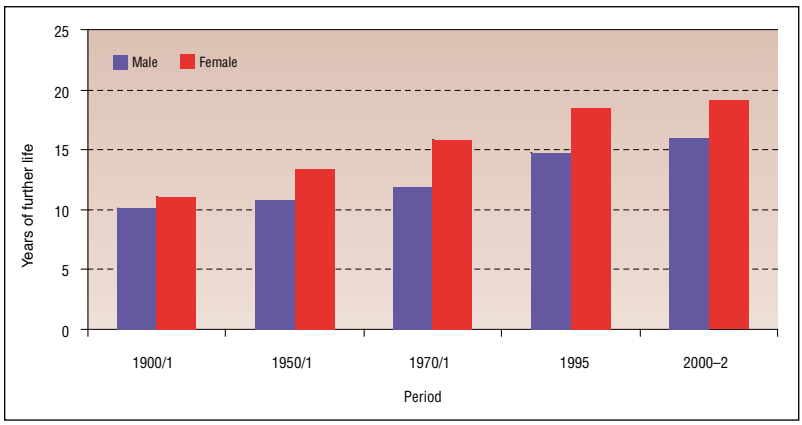

Figure 4. Trends in further life expectancy at age 65, England & Wales, 1901 to 2000–2.

Source: Grundy E.: "Gender and Healthy Aging." In: *Longer life and healthy ageing.* Zeng Yi *et al.* (eds.), Springer (based on data from Government Actuary's Department), 2006.

For men, the gain in further life expectancy at 65 between 1970–1 and 2000–2 was larger than throughout the whole period from 1900 to 1970. For women, improvements were more evenly spaced across the century. The gap between men and women widened at first, but recently has narrowed again. There are similar trends in some other countries, such as Italy and the USA, although elsewhere – particularly Eastern Europe – the gap between male and female is still widening.

The recent narrowing of differences in mortality rates, and the fact that there were disproportionate numbers of women in the population in previous periods because of events such as the World Wars and excess male emigration, means that the sex ratio, or number of males per 100 females, is now much more balanced than it has been – a trend predicted to continue.

This, and lower levels of mortality overall, mean that widowhood is being delayed, and the proportion of older people who are married has been increasing. This has positive implications as older couples are able to draw on each other for support. A further positive outcome of past trends is current declines in the proportion of older women who have never married. The baby boom was partly a consequence of a marriage boom. Much higher proportions of people (especially women) born in the 1930s and 1940s and now in early 'old age', married than was the case among those born earlier in the century. In 1971, 15 per cent of women aged 75 and over in England and Wales were single (never married) compared with seven per cent in 2001 – and a projected low of four per cent in 2021. In the longer term (2031 onward), trends will become less favourable, because by then the groups of people born from the mid-1950s onward will be in or entering later life. Among these, there has been some return to lower rates of marriage and much higher rates of divorce.

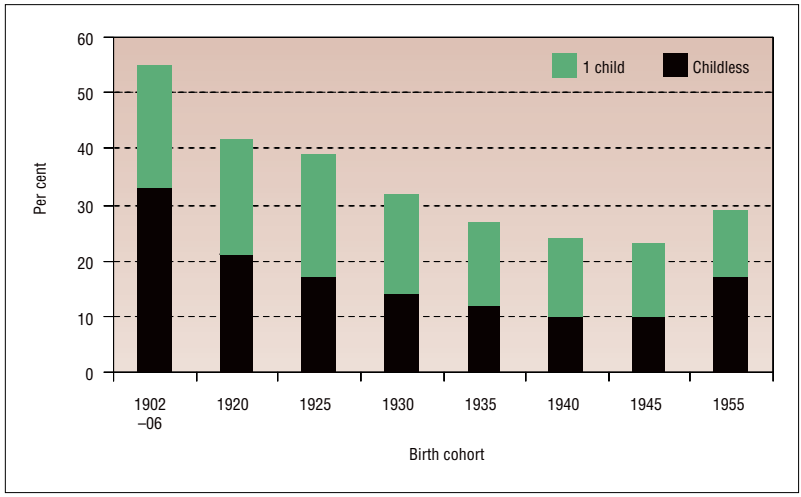

Figure 6. Women with no or only 1 child at age 45 by birth cohort, England and Wales

Source: Grundy E.: "Population Review: the population aged 65 and over." *Population Trends* 84, 14–20, 1996.

One consequence of past trends in marriage and other aspects of family formation is that the proportion of older women with at least one child is currently *increasing* and will do so until those born in 1955 onward reach old age (see Figure 6 above). This may seem at odds with falling fertility but, as already discussed, fertility rates were higher in the late 1950s and early 1960s than earlier in that century. Moreover, the distribution of family sizes has changed. The average number of children produced by women born around 1900 and in 1955 was much the same (about two each), but the earlier group included, as shown above, more women who were childless or with only one child, as well as higher numbers with very large families.

Predictions of the proportion of women who will still have at least one child alive at the age of 80, show that this will peak in 2027, when those born in 1947 reach that age. So in the coming quarter century, a higher proportion of elderly people are likely to have at least one living child than ever before – or ever after.

Having close kin, such as spouses and children, does not in itself guarantee family support for older people. Questions have been raised about possible changes in the willingness or ability of younger generations to provide assistance – concerns fuelled partly by major changes in the living arrangements of older people. The proportion of older people living with two or more generations of family has declined dramatically since 1971, particularly among the 'older old' while the proportions living alone have increased. In England and Wales, most women aged 85 and over now live alone, and the next most usual arrangement is residence in institutional care. Trends in other countries have been similar, although large differences remain between Southern and Northern Europe.

Although intergenerational co-residence has declined, all available evidence from Britain and elsewhere in Europe is that family interaction and support remain high.

Health in older populations

Clearly, the current and future state of health of older people is of vital importance. However, a long-running debate about associations between trends in mortality and those in disease and disability (morbidity) is still not fully resolved. From the negative point of view, if people with a poor history of health and high risk of frailty have a better survival rate than in the past, this may lead to a worsening of the overall health status of the older population, simply because the selection effect is reduced. Rather than postponing the onset of chronic disease or disability, interventions which prolong survival with chronic disease would also negatively affect population health. On the positive side, better past health legacies may mean people reaching old age now are in better health than their predecessors and medical interventions such as the treatment of high blood pressure may prevent or postpone some disabling conditions such as stroke. Evidence on trends in disability from the United States is generally positive, but trends in Europe are less certain and the knowledge base on trends in disability is still poor. There is, however, evidence that certain behaviours, such as avoidance of smoking and excessive alcohol consumption, 'Mediterranean' type diets involving consumption of lots of fruit and vegetables, and physical activity, are all associated with better health outcomes in later life.

Is population ageing a problem?

The main policy concerns arising from population ageing revolve around costs of income support (through pensions) and acute and long-term care. All of these are related to health and disability, which is why trends and differentials in health are so important. However, health and disability are not the only factors of importance. In many European populations, changes in the ages at which people retire have had a bigger effect on the relative size of the 'pensioner' population than demographic change. More recently, governments have realised that discouraging early retirement and promoting longer working lives is a growing economic priority

(there is also some evidence that working for longer may in itself be beneficial for health), but achieving this aim often presents political problems. Similarly, population ageing has not been the main influence on acute health care costs which increased during the latter 20th century largely because of the development of new, more expensive medical technologies. Long-term care costs, are, however, very strongly influenced by the proportion of older old people in the population (and by the availability of family support) and, as such, are to a large extent demographically driven.

Although population ageing is often portrayed negatively, it is important to recognise that increased survival to and beyond later life is a great achievement and that the inverse of population ageing is rapid population growth, which itself poses challenges. Similarly, although the needs of the young, middle aged and old are sometimes presented as being in conflict, in fact different generations are linked through shared family lives and of course expectations of the future – old people were once young and the only alternative to growing old is premature death.

The characteristics and resources people have in later life are shaped by their life courses, as well as by current circumstances. During my very enjoyable stay at CAS, I researched one aspect of such life course influences on later life, i.e. the effect of people's individual fertility histories on their late life mortality risks. I am very grateful to have had the opportunity to undertake this work in such a supportive and stimulating environment.

WENDY SIGLE-RUSHTON

Looking for Difference?

With the development of postmodernism, the usefulness of social categories such as gender and ethnicity has been questioned. As a result, feminist theorists have made a clear and convincing case against the use of gender, class or ethnicity as single analytic categories. The treatment of gender as a single category has arguably been afforded the greatest attention, and theorists have robustly criticised the unreflective and uncritical deployment of the category 'woman'. Feminists have been criticised, often (but not only) by other feminists, for erroneously homogenising the experiences of women and for ignoring other important sources of variation that cut across gender in important and complex ways.

Moreover, where multiple aspects of identity have been considered, researchers have been criticised for implicitly (and sometimes explicitly) treating multiple dimensions as additive and separable. In Spelman's (1988) seminal work, she refers to this as the "ampersand problem" – the problem that arises when researchers assume that the experiences of black women, for example, can be deduced by understanding separately the effects racial discrimination and the effects of gender discrimination. Multiracial feminist theory has played a crucial role in the development of these critiques, often referred to as 'interesectionality', arguing that their experience of race and gender could not be separated but rather needed to be considered as interrelated and inseparable aspects of identity. As Brown and Misra (2003) succinctly put it "Race is 'gendered' and gender is racialized', so that race and gender fuse to create unique experiences and opportunities for all groups" (p. 488).

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In an effort to accommodate these criticisms, some researchers have called for the adoption of analyses that focus specifically on within group differences. In contrast to anti-categorical approaches which emphasise the deconstruction of analytical categories and argue against the use of fixed categories as "simplifying social fictions" (McCall, 2005, p. 1773), the literature on intersectionality has motivated intra-categorical and inter-categorical approaches. The first takes the form of in-depth qualitative analyses of, for example, South Asian migrants. The latter approach attempts to analyse more directly how analytically defined categorical differences – gender, ethnicity, social class and age – intersect in practice and in relation to particular economic and geographical contexts. This way of thinking more obviously lends itself to large-scale quantitative analyses, suggesting that data should be analysed focusing on different combinations of characteristics as opposed to different, separate social categories.

Notwithstanding some notable exceptions, quantitative researchers have been less quick to adapt their methods and models to take into account

the concerns raised by feminist theorists. For the most part, demographers and quantitative social scientists continue to employ, often uncritically, methods that fail to acknowledge or address these concerns. All too often, researchers who want to carry out gender sensitive analyses estimate models that include separate controls (often in the form of discrete sets of dummy variables) for gender, race/ethnicity and age bands. In regression analyses, this modelling strategy effectively imposes the strong assumption that the 'effects' of gender, race, and age are separable and additive. In effect, modelling strategies often ignore the complexity and intersectionality issues that feminists have discussed for more than two decades and impose the additive logic of the ampersand problem. Demographers and other quantitative social scientists can and should begin to pay greater attention to issues of intersectionality and to reflect on the assumptions that underlie their choice of method and the models they estimate.

Applications of the inter-categorical approach can uncover important differences that are masked by more simplistic, additive approaches. For example, looking across cities in the United States, McCall (2000) finds that class and racial inequalities among men, racial inequalities among women and gender inequalities among the highly educated are likely to be higher in post-industrial rather than older industrial regions, the class inequalities between women show the reverse pattern, as does gender inequality among the lower educated. These patterns could not have been identified with the simple inclusion of linear and additive dummy variable controls.

While the inter-categorical approach offers quantitative researchers a way of dealing with intersectionality, it is important to stress that its implementation will always be partial and become ever more complex as additional dimensions of diversity are considered. For quantitative research, data availability can seriously limit the extent to which intra-categorical approaches can be applied. Sample sizes are often limited, especially for some population sub-groups, and data requirements increase substantially with each additional dimension. Although data limitations – both in terms of information and sample size – mean that it is not possible to account for all sources of difference and diversity using an intra-categorical perspective, it is nonetheless true that intersectionality could be far better accommodated than it currently is in much of the extant literature.

So what can researchers do? When estimating regression models, researchers should, at a minimum and wherever possible, interact different identity characteristics and examine critically the size and significance of their parameters. Additionally, depending on the research question, interactions with other key variables of interest should be tested, again wherever sample size permits. All interactions should be tested for significance (with careful attention to sample size problems and how they can affect measures of significance) and compared with the results from the more restrictive model. Obviously, where more simplistic models fit the data well, simplicity is a virtue. But simplicity should be confirmed rather than assumed.

Moreover, researchers who are interested in carrying out more gender-sensitive analyses should ask themselves whether the regression approach is always the best option. More person-centred approaches like classification and regression trees (CART) or cluster analysis can help researchers identify differences across more complex groups and may be better suited

in some instances (see, for example, Zhang and Singer, 1991). In some cases, person-centred analyses can be used as a preliminary step that can be employed to identify, inform and complement the other statistical techniques such as regression analysis.

Although some analysts make an effort to examine women and men separately wherever possible, or to examine broad racial groups separately wherever possible, the idea of intersectionality provides a theoretical motivation for this practice and stresses the importance of incorporating multiple axes of differentiation. Although the findings will never be comprehensive or definitive in the sense that we can conclude there are no other social structures that need to be incorporated in order to document and understand the outcome of interest, the value in adopting this way of thinking and linking it to how we carry out our work will help elucidate areas that need further attention in our own or future work. This is one the most important contributions intersectionality has to make to demographic research.

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LIV INGEBORG LIED

Land *and* Diaspora:
Spatial Perspectives

Over the past 50 years, numerous scholars have discussed the identity construction and sense of local belonging of the Jews who settled in various diaspora communities in the first centuries CE. The central questions raised in this discussion include: to what extent did Jews living in the diaspora continue to keep Jerusalem and Palestine, conceived as the Land of Israel (the Land), as the focal point of their spatial belonging; to what extent did they develop a sense of local affiliation; and in what sense could a longing towards the Land and a feeling of local affinity go together? The present contribution aims to add a new aspect to this ongoing discussion. I wish to suggest that a change of spatial epistemology may broaden and challenge the way we interpret descriptions of space and spatial affiliation in ancient texts. My question is: In what sense could Jews living in diaspora communities have entertained a notion of being in the Land while being *away* from Palestine?

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From 'territory' to 'localized action'

Recent decades have seen growing theoretical interest in the human conception of space and place. Contributions have come from several academic disciplines, including geography, sociology, and philosophy. Michael Foucault and Michail M. Bakhtin figure prominently on the list of contributors, as do Henry Lefebvre, Jonathan Z. Smith, Doreen Massey, and Edward W. Soja.[1] The sketchy presentation that follows here presents some core ideas from the theories of Lefebvre and his follower Soja, but does not dwell on the specifics of their theoretical contributions.[2]

The main aim of the theoretical approaches developed by the French philosopher Henri Lefebvre and the American geographer Edward W. Soja has been to propose a change of spatial epistemology. As reactions to the typical modern 'Western' idea of understanding space as a given and passively existing materiality 'out there', they deny that space is something neutral, and hold that humans are not only affected by space, but also create space by their practices. Instead of understanding space as a given territorial void, or a stage where humans act, Lefebvre and Soja have suggested that space should be studied as a cultural construct. This understanding of space implies that space is always 'space for someone', that the understanding of space is never static, and that the conception of

1: Cf. Foucault (1986); Bakhtin (1981); Lefebvre (1974/1991); Smith (1978); Massey (1994); Soja (1996).

2: Cf. Flanagan (1999) and Lied (2005) for more detailed presentations.

a given place can always be redefined by different groups and generations. Thus, Lefebvre and Soja suggest that instead of studying space in terms of territorial/material aspects alone (territorial epistemology), we should study space as a phenomenon created and recreated by human action in the broadest sense, as part of a continuing construction and reconstruction of reality.

The change of spatial epistemology proposed by Soja and Lefebvre may challenge the way scholars commonly conceive of the spaces described and constructed in ancient texts. Instead of taking it for granted that these spaces can be identified only as reflections of presumably given territories, their epistemological shift would suggest that spaces presented in the texts could rather be studied as descriptions and constructions of localized action. In the context of this particular study, their epistemological shift should make us reconsider whether descriptions of the Land in ancient texts are always identified as Palestine[3], or whether the Land could also be construed in the texts as the spatial outcome of the localized practices of diaspora settlements.

Take Syria and Babylonia…

This study takes its examples from the Mishna and the Babylonian Talmud, both of which are authoritative Jewish text collections containing complied, diverse and extensive descriptive rules and interpretation literature.[4] Two methodological reservations must be noted initially. Firstly, I have deliberately chosen examples from the expansive rabbinic literature, which question the fruitfulness of assuming a territorial epistemology. I am not saying that a territorial epistemology would never provide interesting readings of the texts, or that a study that sees space through the lenses of localized action would account for all the tendencies in the material. I wish to argue that several tendencies may be observed side by side and to point out some descriptions in the material which are hard to account for unless we change spatial epistemology. Secondly, it is important to bear in mind that the texts in question are discursive. They do not provide any direct access to the socio-historical world of the period in which they were written. They probably discuss that world – they possibly opt to make worlds – and tend to let several interpretations coexist.

My first example is Syria. In the article "The Significance of the Land of Israel in the Mishnah", R.S. Sarason draws attention to the ambivalent position of Syria in various tractates of the Mishna. In a discussion of *m. Yad.*[5] 4:3, Sarason argues that Jewish settlements outside Palestine, e.g. in Syria, may have given tithes, a regulation which biblical laws would ascribe to the Land only. He concluded that "this scenario also supposes a symbolic transfer of attributes of the Land of Israel to large Jewish settlements outside the Land (…)" (Sarason, 1986, 119). Indeed, in the

3: Palestine can be defined roughly as the territorial entity between the Mediterranean Ocean and the Jordan river. Alternatively, as the area between the Mediterranean Ocean and the Euphrates (Gen 15:18).

4: It is common to date the Mishna to the beginning of the third century CE and to assume that the Babylonian Talmud contains material from a wide period which probably reached its final form some time between the fifth and the seventh century. The various parts of these text collections are, however, notoriously difficult to date.

5: All abbreviations are according to the standard of *The SBL Handbook of Style: For Ancient Near Eastern, Biblical, and Early Christian Studies.* Edited by P.H. Alexander *et al. ii*. 4th reprint. Peabody, Ma., Hendrickson Publ., 2004, 79–81.

context of extensive discussions concerning laws of agriculture, produce and harvest in the Land, Syria is given particular attention in the Mishna. It is sometimes presented as a part of the Land (*m. Ḥal.* 4:11f; *m. Demai* 6:10) and sometimes not (*m.* ʻ*Or.* 3:9; *m. Maʻas.* 5:5; *m. Ḥal.* 4:7–8). Other passages seem to ascribe a both-and identity to Syria (*m. Šeb.* 6:2–6), or put it in a special position both vis-à-vis the Land *"proper"* and other lands of the world (*m. Šeb.* 6:6). In effect, Syria seems to be partly inside and partly outside the Land.

How should we understand this phenomenon? We must, of course, take into consideration that there may have been no clear distinction between the areas I have referred to as Palestine and the larger geographical entity of Syria. Since some tractates distinguish between Syria and Palestine, however, that explanation is not sufficient in itself. Another factor may have been that Syria was considered contingent with Palestine, on the fringe area of biblical mappings of the Land. The debates about the role of Syria may display a certain elasticity to the Land in order to include areas in the north. A third factor, however, may have been that the Jewish settlements in Syria were already large and therefore important to define at the time when the Mishna was written and redacted. As *m. Ḥal.* 4:11 says: "One who acquires [land] in Syria is like one who acquires [land] in the outskirts of Jerusalem". Thus, it is possible that an effort was made, at least in some tractates, to ascribe the status of Land to the localized action of Jewish settlements in Syria.

My second example is Babylonia. As I. Gafni points out in his book *Land, Center and Diaspora: Jewish Constructs in Late Antiquity,* the Jewish communities that dwelled in Babylonia came to ascribe a wide range of attributes commonly reserved for the Land to their own environment in Babylonia, but without denying the historical and eschatological status of Palestine as the Land (Gafni, 1997, 116). According to Gafni, Babylonian institutions were thought to equal and continue the legacy of institutions formerly in Jerusalem (*b. Giṭ* 6a). Babylonian Jews ascribed Davidic roots to their leadership. They claimed to have material remains from the Jerusalem temple. They understood Babylonia to be the 'real' homeland of Abraham (*b. Pesaḥ.* 87b), and they ascribed notions of sacred soil and boundaries to it (*b. Sanh.* 38a–b; *b. Giṭ* 6a; *b. B. Qam.* 80a). They also explicitly equated cities in Palestine with cities in Babylonia (*b. Yoma* 10a) and claimed that the Shekinah, God's presence, went with the exiles to Babylon, only to linger there in Babylonian synagogues (*b. Meg.* 29a).[6] In other words, there is reason to believe that an attempt was made in these tractates to redefine the Babylonian settlement in vital matters as the Land.

In the Land while abroad

This very brief discussion of the examples Syria and Babylonia suggests that differing versions and interpretations of the Land may have coexisted in the extensive rabbinic material. Coupled with continuing concern for Palestine as the historical and eschatological Land of Israel, we find a willingness to redefine Jewish settlements outside Palestine as local Lands. By adjusting the biblical laws of the Land to Syria, the Jewish communities of Syria may have lived "as in the Land". Moreover, by applying names and

6: Cf. Gafni, 1997, 116. Cf. further *b. Qidd.* 71b; *b. Ketub.* 111a.

notions, and by transferring the customs and the authority of the institutions of Jerusalem to Babylonia, the tractates of the Babylonian Talmud mentioned here attempt to construct Jewish Babylonia into a parallel and perhaps equally real, Land. In this manner, these texts would allow diaspora settlements to commemorate the history of the Land in Palestine as well as a hope for returning to that Land, but at the same time continue their life abroad as if they were dwelling in the Land. This means that in a period when relatively few Jews in fact lived in Palestine, these texts could present other ways of defining ones life as living in the Land.

A spatial epistemology that highlights localized action has several advantages. Firstly, it displays sameness where an interpretation based on a territorial epistemology would show the differences between Palestine, Syria and Babylonia. Secondly, where a territorial epistemology would focus on the concern for the territory of Palestine, an epistemology stressing localized action would pinpoint the continuing fruitfulness of the Land-concept. Thirdly, this epistemology would make sense out of passages that are busy mapping people and their practices rather than precisely delimiting territories. It makes it easier to understand why texts let the extent of the Land vary so much, why texts sometimes include Syria, for instance, and why some tractates would allow the areas on the eastern side of the Euphrates to be described as the Land. In this manner, the spatial epistemology of Lefebvre and Soja equips scholars of ancient texts to deal with more meaningful interpretations of descriptions which would otherwise seem strangely "out of place".

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ARNSTEIN AASSVE and MARIA IACOVOU

Youth Poverty in Europe[1]

Young adulthood is a stage of life characterised by dramatically changing circumstances for many individuals. Around the middle of the 20th century, the transition to adulthood was typically a rather brief and well-structured phase of the life cycle, but in recent decades it has become considerably more complex, and in many countries more protracted. Among the population as a whole, many events which figure prominently in the transition to adulthood have been shown to be importantly related to the risk of poverty: finding (or failing to find) employment, child-bearing, union formation and changes in living arrangements (Aassve *et al.* 2006; Fahmy 2006). However, very few studies have been made of the impact of these events among the group in which they are arguably most common: young adults. The very fact that European countries differ widely in these demographic behaviours, suggest that also youth poverty will differ significantly. Taking the median age when young individuals gain residential independence in different European countries as an example (Figure 1) proves the point.

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The rectangular points indicate the median age at which young adults start to live alone. Early home-leaving is much more common in the Scandinavian countries and the UK, while leaving home occurs much later in the Southern European countries and Ireland. There are significant country differences in other demographic behaviours as well, but the age of leaving home is particularly noticeable. Next, consider the poverty rates among the age group of 20 – 24 year olds[2] that live with parents from those who do not. The former is given by the left hand side bar, the latter by the right hand side bar. It is clear that everywhere, young people who have left home are more likely to be poor than those who remain living with their parents. But again we see some very interesting differences across countries. For those living at home, young people in the Scandinavian countries are least likely to be poor, while those in the southern countries are most likely to

1: This note is a shortened version of a previously published paper in the Journal of European Population 2007, (Springer). The work forms part of the project "Poverty among Youth: International Lessons for the UK", funded by the Joseph Rowntree Foundation Grant no. 803554 under the Ladders Out Of Poverty programme. The ECHP data used in the analysis were produced and made available by Eurostat. All errors and inconsistencies in the paper are our own.

2: For simplicity, we consider here the age group of 20 – 24 year olds only. The patterns for older age groups are similar, though by age 30, not many Scandinavians are recorded as living at home any longer. Aassve *et al.* 2007b provides further details of these patterns.

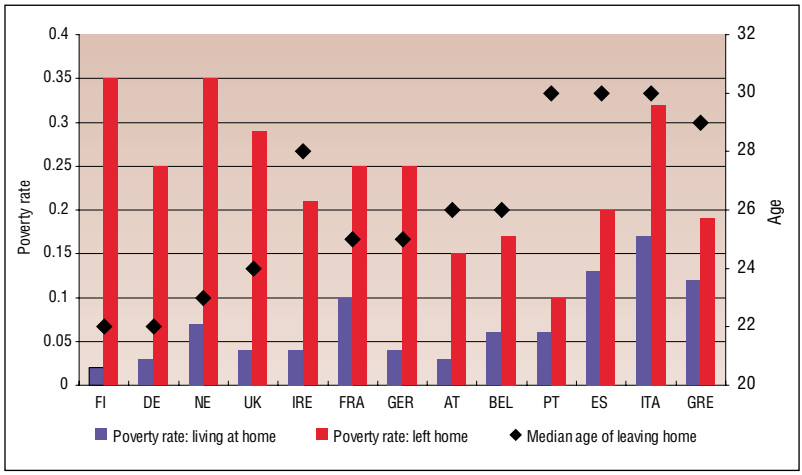

Figure 1. Poverty rates by residential status and median age of leaving home
Source: Iacovou (2002) using ECHP for 1994.

be poor. Among those *living away* from home, the pattern is reversed, with young Scandinavians more likely to be poor than those in the southern countries. Figure 1 shows that the increased probability of being poor associated with having left home is highest in those countries where leaving home occurs earlier and lowest in those countries where it typically occurs later. The data used to produce these figures is derived from the European Community Household Panel (ECHP), a set of comparable large-scale longitudinal studies set up and funded by the European Union. The data has a number of advantages, among them, that it provides probably the best opportunity to date for meaningful cross-country comparisons using micro-level information.

As is clear from these data sources, there is a strong relationship between independent living and youth poverty. In order to understand why this is so, it is necessary to understand how poverty is normally defined. The standard way is to take the sum of all household members' net income and divide this by an equivalence scale, the purpose being to account for economies of scale in the household (that is, two people can live more cheaply sharing a household dwelling than one person living on her own)[3]. Next, the poverty threshold is defined as the median of the net equivalised household income for a given country in a given year. If then, the income of a given household falls below this threshold, the household and all the individuals living in it, are deemed poor. Despite many drawbacks, this remains the standard way of measuring poverty in Europe. This way of constructing a poverty status variable warrants a few comments. First, it is clear that with this definition, eradicating poverty *totally* is pretty much impossible. Second, poverty measured in this way also reflects income inequality in the country of interest. The most important implication for the relationship between independent living and youth poverty is that as young individuals leave the parental home, their household income will in most cases fall, often dramatically so, simply because

3: Whereas the equivalence scale matters for the poverty level, it does not impact the poverty ranking of countries. In our application, the equivalence scale will affect the estimate of leaving home on entering poverty in a particular country, but it will not affect the comparative perspective. We use the modified OECD equivalence scale which is a common choice in poverty studies.

their parents' income do not longer count in the household income of the young individual. The parental home acts therefore as an important shelter against poverty. This raises the very interesting question: why are there such strong differences in leaving home and youth poverty across European nations? Why do young individuals in Scandinavian countries decide to leave home at such an early age when it clearly increases the risk entering poverty, at least for a short time? Why not stay at home longer, as their Mediterranean counterparts do, and thereby avoid poverty?

To answer these questions, let us introduce a statistical tool for assessing the different effects of leaving home on entering poverty, again using our ECHP data. We are interested in estimating the effect of leaving home on poverty entry, *net* of other observed factors which influence the likelihood of entering poverty. Ideally, we would like to compare the risk of poverty for individuals leaving home, with the risk for the *same* individuals if they did *not* leave home (the 'counterfactual' situation). The problem is, of course, that for any given individual the two scenarios are mutually exclusive (a person cannot leave home and stay at home at the same time), preventing a direct comparison between the two. Instead, we use a simple matching technique where we compare individuals leaving home with others who stay at home, but are similar in all available characteristics (Rosenbaum and Rubin 1983). The method can be explained as follows: youths who are observed living in the parental home in time period t are divided into two groups: 1) $D_i = 1$ those who left home by time $t+1$ (the 'treatment'), and 2) $D_i = 0$, a 'control' group (those who were still living at home at $t+1$). Each youth in the 'treatment' group is then paired with one or more youths in the 'control' group, who are as similar as possible in terms of a range of observable characteristics *measured prior to the event*, and the difference between groups in the outcome variable (in this case poverty in year $t+1$) is measured. If the differences in characteristics between the 'treatment' and 'control' groups are captured by the observable covariates, then matching methods yield an unbiased estimate of the average impact of leaving home on the treated individuals, i.e. those who actually left home (see Aassve *et al.* 2007a and 2007b for further details). There are several different algorithms by which individuals may be matched: these are explained in Becker and Ichino (2002), Smith and Todd (2005) and Caliendo and Kopeinig (2005).

To understand this better, we may think of an outcome Y, defined under two observed or hypothetical scenarios: Y^0, which is the outcome in the case that the young person receives the treatment, and Y^1, which is the outcome in the case that he or she does not receive the treatment.

	Outcome if leaves home	Outcome if stays at home
Treatment group (leavers)	$Y^1 \mid D=1$ (observed)	$Y^0 \mid D=1$ (unobserved)
Control group (stayers)	$Y^1 \mid D=0$ (unobserved)	$Y^0 \mid D=0$ (observed)

We are interested in the effect of the 'treatment' on both the treatment and the control groups. For the treatment group, this effect is termed *ATT* (Average Treatment Effect on the Treated) and measures the differ-

ence between the average outcome measure for those who leave home, and the average outcome measure for the same group under the hypothetical scenario that they had not left home. Another useful statistic is the Average Treatment Effect on the Controls (*ATC*), which measures the effect of leaving home on entering poverty for those staying at home – if they had instead left home. This measure refers to the group who does not leave home, and estimates the difference between the average outcome measure in (a) the hypothetical case that they did leave home, and (b) the actual case in which they did not leave home.

Under the assumption of homogeneous treatment effect, *ATT* and *ATC* should give the same results. However, this is rarely the case. Heckman et al. (1997) have shown that treatment effects are rarely homogeneous. In our setting, it was not clear a priori which way the selection effect would go. It may be that young adults who would face a higher risk of poverty if they left home are more likely to stay home for longer because they are aware of this higher risk. This would imply that the 'true', 'causal' effect of leaving home was actually higher than that suggested by the unadjusted relationship between home-leaving and poverty rates. On the other hand, it may be that certain characteristics are associated with *both* a higher propensity to leave the parental home *and* a higher risk of poverty on leaving home. In this case, the raw figures would exaggerate the extra risk of poverty experienced by home-leavers, and the effect attributable to the home-leaving event would be lower.

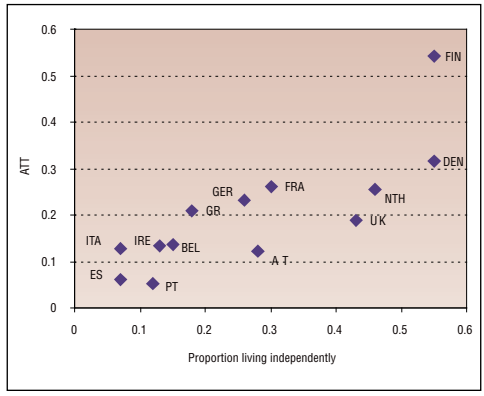

Figure 2. Percentage living independently vs ATT 20–24
Source: Aassve *et al.* (2007b)

Figure 2 plots *ATT*s for each country against the proportion of young people living independently in each country. There is a clear correlation: in those countries where home-leaving occurs early, the extra risk of poverty associated with the home-leaving event is higher, whereas in those countries where home-leaving occurs later, the associated extra risk of poverty is lower. Thus age is likely to be an important driver behind the observed patterns. Since in Finland (and other Scandinavian countries), young individuals leave home at such young age, they are also more likely to experience poverty.

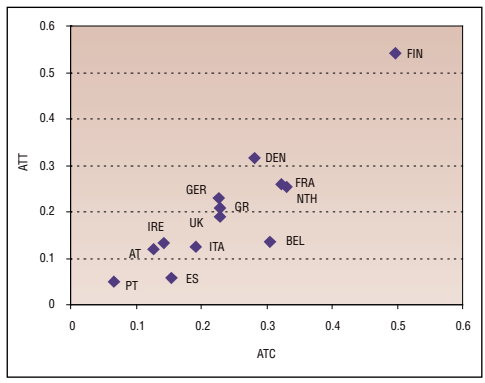

Figure 3. ATC against ATT 20–24

Figure 3 plots the two sets of estimates for each country. In Finland and Denmark, the *ATT* is higher than the *ATC*, implying that young people who remain living at home would actually face a *lower* risk of falling into

poverty if they left home, than those who actually leave home. This is highly counter-intuitive, since if young adults as a group were behaving as rational economic agents, one would expect those with a lower risk of poverty to leave home. In all other countries, this is in fact the case: either by a small margin (Portugal, Austria, Ireland and Germany) or by a more substantial margin (all other countries: the margin is greatest in Belgium and Spain, but is also sizeable in Italy).

The results therefore leave us with two puzzles to explain. First, why do we observe the earliest home-leaving in precisely those countries where young people lose the most, financially speaking, by leaving home? And second, how do we explain the highly counter-intuitive result that in some countries home-leavers have a *higher* risk of poverty than stayers? By comparing estimates of *ATT* and *ATC*, we find that in most cases the former is smaller than the latter, which is the result we would expect: young adults tend to stay at home if leaving home increases the poverty risk. As a result, our analysis shows that young individuals do take into account perceived poverty risk (or their financial circumstances) when making decisions about leaving home. In other words, young individuals opt to stay at home longer as a means to avoid economic hardship. Interestingly, this is not the case for Finland and Denmark. In these two cases, *ATT* is slightly larger than the *ATC*, implying that young adults choose to leave home, despite the fact that the likelihood of experiencing poverty would have been lower if they had stayed at home. In essence, this means that in those countries where young adults have the most to lose, they also leave home earlier. Moreover, in these very same countries, poverty would have been lower, had they not chosen to leave home. Whereas past studies have focussed on explaining why young individuals in Mediterranean countries leave home so *late*, perhaps the more relevant question in this setting is why do young adults in Scandinavian countries leave home so *early*? Certainly, leaving home in Scandinavian countries implies dramatically higher poverty rates, and it would be of interest to know why young individuals indeed choose to leave home under such circumstances. There are several plausible explanations. One can be found in the age profile for poverty in Scandinavian countries. Whereas poverty rates in Finland and Denmark peak around age 23 to 25, mainly as a result of leaving home, they drop dramatically from then onwards, and by the early thirties, young Scandinavian adults have by far the lowest poverty rates of all countries included in our analysis (Aassve *et al.* 2006). Thus, young adults in Scandinavian countries who leave home at an early age might very well be aware that this increases their poverty risk, but they might be equally aware that if they indeed do face economic hardship, it will in most cases be of a temporary nature. Important factors are, of course, the well functioning labour markets in Scandinavian countries together with generous welfare benefits and high wages (Breen and Buchmann, 2002). From a statistical point of view, this implies that there is low 'state dependence'. In other words, experiencing poverty during one's young adult years does not have serious scarring effects for adult life. The situation is different in Mediterranean countries. We know that youth unemployment rates are high (except in Portugal) and very often young individuals find it difficult to obtain stable employment. Moreover, youth wages in Mediterranean countries are low. As a result, the parental home provides for many young adults an important shelter against

economic hardship, as is clearly indicated by our estimates of the *ATT* and *ATC*. Another issue concerns educational infrastructure. Whereas the Scandinavian norm (and also in many conservative countries and the UK) is for young individuals to move away from home to undertake university studies, the picture is different in Italy and Spain, for instance. In Italy, an essential part of education policy has been to ensure geographic spread in the location of universities, with the aim of helping young adults stay at home whilst attending higher education (Billari *et al.* 2007). Social norms play an important part in this picture. Clearly, living in the parental home until one's early thirties in a Scandinavian country would be very much against the norm, whereas it would be widely accepted as normal behaviour in a Mediterranean country. In the long run, social norms are of course not exogenous, but depend on the institutional setting in which young individuals reside. Such differences in social norms are reflected by the fact that the destinations from leaving the parental home differ widely across countries. Leaving home in Mediterranean countries frequently coincides with marriage, whereas the majority of those leaving home in northern countries do so to live alone.

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Social Factors, Mortality and the Spanish Influenza in Kristiania 1918–19

Introduction[1]

Studies of historical epidemiology have shown that poor populations suffer more from the burden of disease and death from epidemics, with cholera and tuberculosis being two good examples. However, much of the literature since 1918 has favored the view that the Spanish influenza pandemic of 1918–19 struck victims independent of class or other social indices. This view has prevailed although contemporary household surveys after the 1918 pandemic showed that there were indeed clear differences between the classes in disease incidence and that case fatality rates from influenza and pneumonia also varied according to socioeconomic status (Hanssen 1923, Sydenstricker 1931). This paper is the first to combine multivariate event history analysis with unique individual and household-level data to test the conservative hypothesis that Spanish influenza was a socially neutral disease with respect to mortality.

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Data and methods

The data have been taken from nominal censuses and death registers for two parishes in the Norwegian capital Kristiania in 1918–19 (renamed Oslo in 1924): the affluent parish of Frogner on the west side and the poor parish of Grønland-Wexels on the east side. The two parishes cover 16 percent of a total population of 260 000 in 1918. The data are superior for three reasons. First, influenza was a reportable disease in Norway in 1918, but that was not the case in many other countries. Second, there are no gaps or errors in the censuses or registration of vital events confounded by the First World War. Finally, in contrast to belligerent countries, there are few or no problems distinguishing flu deaths from war deaths in neutral Norway.

The analysis includes 250 deaths from influenza and pneumonia, 81 in Frogner and 169 in Grønland-Wexels. Four independent variables at the individual-level (age, sex, marital status, and occupation-based social class), one independent variable at the household-level (size of apartments), and one independent variable at the parish-level (Grønland-Wexels, Frogner) are included in the analysis. The analysis is carried out

1: This paper is an abridged version of a study previously published in *Social Science & Medicine* (Mamelund 2006).

using Cox proportional hazard models. To simplify the presentation of the results, estimates (with 95 percent CI) are only shown for social class, size of apartments and place of residence.

Results

Figure 1 shows that there is a 19–25 percent lower mortality in the two upper classes vs. the lowest class, but the estimates are not statistically significant. The results also show that there is a partly linear decline in mortality by size of apartment. Households residing in apartments with 2, 3 and 4 rooms, for example, have 34, 41, and 56 percent lower mortality rates, respectively, than those residing in 1-room apartments. Finally, we see from Figure 1 that there is a 49 percent higher mortality rate for those residing in the poor parish of Grønland-Wexels compared with the affluent parish of Frogner, all other factors being the same.

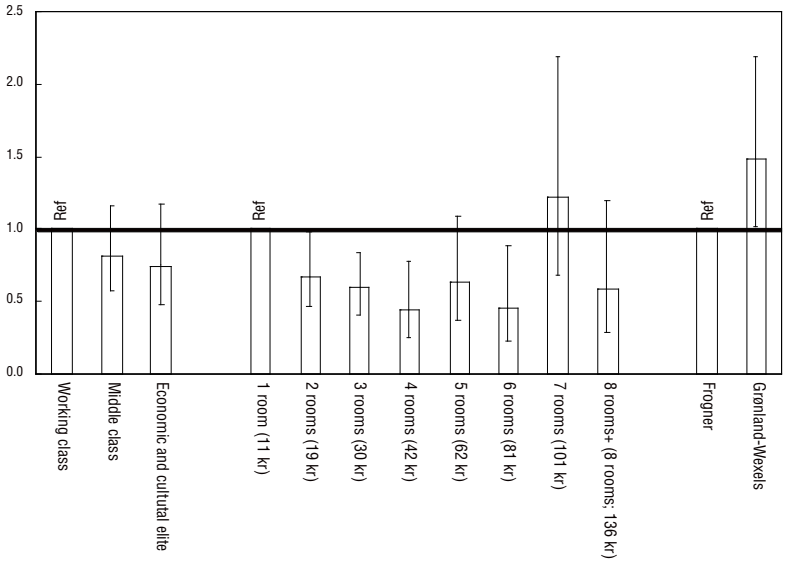

Figure 1. Results from Cox regressions for mortality from Spanish influenza in Kristiania in 1918–19 (with 95 percent CI), controlled for age, gender and marital status. The average monthly rent (in 1918 NOK) by apartment size is shown in parentheses.

Discussion

Previous studies of the possible role of socioeconomic status in explaining mortality during the 1918 pandemic have generally argued that death victims were picked randomly among the different social strata. One reason why the 'socially neutral view' has survived in the literature as well as in people's collective memory might be that the contemporary world mass media as well as subsequent academic and popular accounts of the 1918 influenza pandemic emphasized that not even royals, world political leaders, or members of the economic or cultural elites escaped. For instance, King Alfonso XIII (1886–1941) of Spain was early reported to be laid low by influenza, Prince Erik of Sweden (1889–1918) died 29 years old, and the famous Norwegian painter Edvard Munch (1863–1944) was severely ill and barely survived.

This study is the first to show that there are indeed independent effects of social factors on 1918 flu mortality. The results for the capital of Norway may be of international relevance as few other countries have

similar data available. The study finds indications of a class gradient in individual-level mortality, but the relationship was not statistically significant. However, size of apartment, which is a perfect proxy for rent ($r=0.98$)[2] and therefore probably also for income, is negatively and significantly associated with mortality.

The wealthy and highly educated probably had lower mortality from influenza and pneumonia than the poor and less educated because the former benefited from earlier (self) diagnosis, bed rest and quiet nursing (thanks to saved capital and health insurance, which enabled them to be away from work), fewer pre-existing lung (tuberculosis) or heart diseases, and few or no nutritional problems. Further, a low intake of nitrogen weakens the immune response which is known to increase susceptibility to bacterial and viral diseases. The study also finds that living in a 'poor area' (Grønland-Wexels) increases mortality above and beyond characteristics at the individual and household level. There might be two reasons for this seemingly contextual effect. First, the analysis may not capture unaccounted characteristics of material deprivation in the 'poor area'. For example, the analysis does not account for why housing conditions were much poorer in Grønland-Wexels than in Frogner: poor housing conditions are in turn known to be associated with respiratory symptoms and reduced lung function. Second, the variables included may not fully capture the variation in mortality. Furthermore, several variables have been omitted from the analysis. For example, the database used in this study does not include information about pre-existing diseases, in particular tuberculosis, and the working environment and experience (work load, type, hours worked per day, overtime, shift work, etc.), all of which are factors that may have a bearing on individual mortality levels.

Important today?

This study contests the conservative view that the 1918 flu was socially neutral with respect to mortality. In this respect, the 1918 flu was no different from other historical epidemics when it comes to the role of poverty and wealth in explaining mortality. The topic of this paper is timely since the world now awaits the rise of a new pandemic. Many elements of importance for mortality outcomes are different today from in 1918. For example, the global monitoring of influenza is much better than before. Contingency plans have also been developed by the World Health Organization and at national levels. However, the world remains vulnerable. Poor countries will probably suffer the most once again due to co-morbidity (tuberculosis, HIV/AIDS, malaria, etc.) and poor nutrition. Furthermore, poor countries cannot afford to stockpile vaccines, antiviral drugs and antibiotics to the same extent as the rich ones. Murray *et al.* (2006) predicts 62 million deaths world-wide should a 1918-like virus reappear today, with 96 per cent of the deaths occurring in poor countries. Although most deaths might occur in the poor countries, there is reason to believe that there will be significant social variation in mortality within rich countries. Our recent past has shown that social differences in mortality and longevity are widening dramatically in Western welfare states (Marmot 2004).

2: This correlation was estimated using aggregate-level data for 19 parishes covering the whole city of Kristiania.

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EINAR THOMASSEN

The Gospel of Judas, or, Is Philology a Science?

The announcement of the rediscovered *Gospel of Judas* at a press conference in Washington on 6 April 2006 created a worldwide sensation. Here was an ancient Christian 'gospel' portraying Judas as Jesus' intimate friend and superior to the other disciples. Or at least that was the claim made at the press conference and in the book published at the same time (Kasser, Meyer and Wurst 2006). In the intervening year, however, some scholars have questioned this interpretation. The publication of this document and the subsequent debate are prime examples of how knowledge is produced and tested in the philological-historical disciplines.

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The work of reconstruction

The Gospel of Judas is one of several texts inscribed in a 4th century Coptic papyrus codex, i.e. a manuscript in the format of a book rather than a scroll. The codex was in a deplorable state when scholars obtained access to it in July 2001, after it had been incompetently handled by manuscript dealers and others over the years, following its discovery in the late 1970s. Painstaking work was done in Geneva, piecing together each broken page and determining the sequence of the pages. Such work is based partly on the physical properties of the fragments (fibre patterns and shapes of the fragments) and partly on the linguistic and interpretive understanding of how the text itself hangs together. The logic of this procedure is not unlike laying a puzzle, only in this case, a number of the pieces are missing.

The physical reconstruction of the manuscript forms the basis for the subsequent operations of transcribing the text, translating it, interpreting its meaning and, finally, assessing its historical significance. These are not, however, tasks that can be carried out in isolation from one another. The translation of individual phrases on the one hand and the interpretation of the 'plot' and the ideas contained in the text on the other are obviously to a large extent interdependent. Even the identification of each letter and the correct placement of the fragments are affected by issues relating to the interpretation of the essential message of the document. This inevitable 'hermeneutical circle' does not imply, however, that theories about the overall sense of the text absolutely govern the interpretation of the individual data. The 'softer' operation of forming a general theory of the meaning of the text is constantly challenged by the fact that the 'harder' data of the physical properties of the manuscript and the grammatical and lexical rules of the Coptic language, as well as by the demand that the overall interpretation itself must be reasonably consistent. Hence, there are ways in which the interpretation of a text can be tested empirically.

What is the *Gospel of Judas* about?

Scholars already knew that a *Gospel of Judas* had existed, since the title is mentioned by Bishop Irenaeus of Lyons in his work against heretics written in around 180–190 A.D. The text that has now become available is thus the sensational recovery of a writing believed to have been lost for good. Briefly, the 'gospel' is a revelation dialogue, where Jesus speaks with his disciples and teaches them religious truths. The teaching is of a 'Gnostic' nature, reflecting an understanding of Christianity that was condemned as heretical in antiquity, but which has become much better known again recently because of discoveries such as the Nag Hammadi documents. Gnostic Christians considered the material world to be evil as it had been created by malicious or ignorant powers. They believed that Jesus was to teach humankind about the unknown true God beyond this world and to redeem the divine spirit trapped in human bodies. In the *Gospel of Judas,* Jesus tells the disciples that they do not worship the true God, and that they are slaves under the powers that reside in the stars, from whence they rule the world.

It is a peculiarity of the *Gospel of Judas* that all the disciples are condemned as ignorant and apparently beyond redemption. Instead, the document speaks about a 'holy immortal race' that will be saved, but we never meet that group of people in the text. Judas, however, is less ignorant than the other disciples, and Jesus gives him special instruction about how the world came to be created, among other things. The gospel ends with Jesus predicting that Judas will 'sacrifice' him, or, as he puts it, "the man that carries me". Then Judas hands Jesus over to the Jewish leaders.

The claims

The team responsible for the first edition, translation and analysis of the *Gospel of Judas* (Kasser, Meyer and Wurst 2006) made a series of claims about the document. In this gospel, they say, Judas alone of the disciples receives the knowledge necessary for salvation. Moreover, Jesus instructed Judas to hand him over to be 'sacrificed,' and this act is a service to Jesus since it delivers him from his imprisonment in a material body. Finally, this shows that some early Christians had a positive view of Judas and his act of 'betrayal.'

Testing the claims

The claims made by the first editors take the shape of a hypothesis about the general meaning of the document. It is a hypothesis that can be tested and, since the publication of the text, several scholars have indeed challenged it. This is because several crucial passages do not seem to be consistent with the editors' assumptions. The following is an alternative translation of one passage in particular (pp. 46–57):

Editors' translation	*Alternative translation*
Judas said, 'Master, **could it be that my seed is** under the control of the rulers?'	Judas said, 'Master, **may my seed never be** under the control of the rulers!'
Jesus answered and said to him, 'Come, that I [. . . . .], but that you will grieve much when you see the kingdom and all its generation.'	Jesus answered and said to him, 'Come, and I'll [[. . . . .], but that you will grieve much when you see the kingdom and all its generation.'
When he heard this, Judas said to him, '**What good is it that I have received it? For you have set me apart for that generation.**'	When he heard this, Judas said to him, '**What good have I then received if you have cut me off from that generation?** '
Jesus answered and said, 'You will become the thirteenth, and you will be cursed by the other generations—and you will come to rule over them. **In the last days they will curse your ascent to the holy [generation].**	Jesus answered and said, "You will become the thirteenth, and you will be cursed by the other generations, and you will come to rule over them **in the last days. They will < . . . > you and you shall not ascend to the holy [generation].**'

The alternative translation is based on the fact that the Coptic expression the editors have translated as 'set apart for' is translated as 'set apart from' everywhere else in Coptic literature. Thus, rather than promising Judas membership in the holy generation, Jesus has in fact told him that he will not be joining the saintly race. This interpretation is also borne out by the last phrase: although some of the letters are imperfectly preserved, the text must be restored differently from what the editors have done in order to respect normal Coptic syntax.

In fact, Judas is destined to become 'the thirteenth.' Other Gnostic texts that display the same kind of cosmology as the one outlined in the *Gospel of Judas* indicate that the earth is surrounded by thirteen spheres, where the topmost is occupied by the world-ruler himself. That is apparently where Judas will go, to sit next to the evil lord of the cosmos. For that reason, the text also calls Judas the 'thirteenth *daimon*,' where *daimon* is surely to be translated as 'demon' and not as 'spirit', as the editors do. Judas is thus an evil character – not Jesus' 'bosom friend'. If Jesus foretells his act of betrayal, it is simply because he knows in advance what will happen, and not because he is asking Judas to perform the act.

Is philology a science?

Space constraints do not permit a discussion of several other passages which, correctly interpreted, confirm these conclusions. The main point here, however, is to demonstrate that the most common criteria for what constitutes 'science,' such as falsifiability, corroborability, empirical testability, etc., also apply to work in the historical-philological fields of knowledge. The procedure of formulating hypotheses and testing them empirically also operates with the interpretation of texts, and, by extension, with the reconstruction of historical processes, which is always based on textual interpretation. It is not the case, as is sometimes asserted, that theory – in this case an interpretive framework – simply shapes the

data. Data have a resilience of their own. Fortunately, they can overturn a proposed theory. In philology, such data take the form of the physical properties of manuscripts, linguistic rules and textual and ideological coherence.

It is easily understandable that faced with a text entitled 'The Gospel of Judas,' where Judas is accorded a privileged role, scholars' first impression should be that Judas was the hero in this case, in a blatant reversal of his traditional image in orthodox Christianity. The media exposure and the commercial potential of a 'sensational discovery' apparently also served to generate prejudice towards a certain general interpretation of the document. Against this background, it is reassuring to conclude that scholarship nonetheless seems to possess an intrinsic self-regulatory ability, allowing truth to prevail over sensation in the long run.

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ANNE RENEFLOT

Combining Qualitative and Quantitative Methods:

A Case from Family Demography

Introduction

Over the past four decades, we have witnessed massive changes in Western family patterns, characterised by a decline in marriage and an increase in divorce and out-of-wedlock fertility. Aside from representing quantitative changes, these changes also represent qualitative changes, i.e. changes in the meaning of family life to children and adults. While marriage some decades ago signaled the start of living together and having children, today, many couples live together and have children long before they eventually formalize their relationship. Cohabitation represents a new form of union, and family demographers are struggling with the place of cohabitation in the family formation process.

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While quantification is a major strength of demography, it may also contribute to a theoretical weakness within the discipline by imposing constraints on the demographic imagination (Knodel, 1997). This might be the case in particular in the face of the changes mentioned above. The point I am trying to make in this brief paper is that that by complementing traditional demographic research activity with more qualitatively oriented research, we might be able to give richer and better explanations of the phenomena we are studying, e.g. union formation. The structure of this paper is two-fold. In the first part, I address the use of qualitative research in family demography more generally and, in the second part, I refer to a multi-method study I conducted on cohabiters' marriage preferences (Reneflot, 2006).

Barriers to the use of qualitative research

Aside from the very nature of demography, which suggests a strong quantitative focus, two elements may serve as barriers to the use of qualitative research: What counts as valid knowledge and what resources are available? Some argue that quantitative research and qualitative research represent distinctive epistemological positions, that is, different approaches to what should count as valid knowledge (Bryman, 1988). This conception implies that quantitative research and qualitative research are irreconcilable. Another and, to my view, more productive position, is that quantitative and qualitative research represent distinctive approaches to social research (Bryman, 1994). This means that we acknowledge that they are distinctive and that they are appropriate to different kinds of research

problems. Furthermore, quantitative research and qualitative research hold different strengths and weaknesses. According to this position, the decision to use quantitative research, qualitative research or to combine the two is based on technical considerations.

There might also be more trivial barriers to the use of qualitative research. Given the strong quantitative dominance, most demographers do not have adequate training to perform qualitative studies. The lack of training might also lead demographers to overlook the option of conducting a qualitative study. They are simply not used to posing qualitative research questions or to considering a qualitative research strategy. Finally, most researchers are constrained by time and money. The decision regarding research strategy is often a trade-off between what one ideally would like to do and what is possible within available time and money parameters. Given limited resources, choosing an unfamiliar research strategy might be perceived as both too costly and uncertain.

The rationale underlying more use of qualitative research in family demography

In general, qualitative research is characterized by focus on process and meaning, close contact between researcher and subject, a more unstructured and flexible research design, and by the production of rich data. Qualitative research is considered to be particularly useful in studies of unexplored or new social phenomena. Hence qualitative research may prove a useful supplement to family demographers in their studies of modern family patterns, e.g. cohabitation. Qualitative studies may shed light on people's expectations when they enter a cohabiting union. They may also reveal information about the process of moving in together and agreeing on the more practical aspects of their union, such as the organization of a couple's finances and housework, etc. This applies to everything which can provide important feedback on the understanding of cohabitation as a union form and which can give direction to further research.

Qualitative research includes a wide range of research designs, data collection methods, and methods for analyzing data. In-depth interviews can be a useful supplement to survey and register data (the main data sources in demography). In-depth interviews are characterized by a focus on biography, personal experiences and subsequent outcomes. They are usually undertaken in private, providing an opportunity to explore sensitive or personal topics that people might not want to speak about publicly or have recorded on a questionnaire. In-depth interviews are usually based on an interview guide delineating the topics to be dealt with in the interview. The aim is to follow the interest and experiences of the subject and to allow them much more control over the interview than is possible in a questionnaire. The idea is that such an approach will allow for new ideas to emerge that may not even have been considered by the researcher in advance.

Knodel (1997) suggests three benefits of in-depth interviews. First, they confirm or disconfirm the findings of surveys. Answers to closed-ended question are not always easy to interpret. Although perhaps trivial, qualitative research can confirm or disconfirm whether questions did actually tap what they were intended to tap and hence add credibility to surveys. Second, in-depth interviews can help researchers gain a fuller

understanding of the meaning of survey findings. In-depth interviews encourage respondents to express more elaborate opinions or accounts on behavior addressed in a survey and to place it in a context. Third, qualitative research can help provide explanations for relationships being studied. The more elaborated answers from in-depth interviews can provide more insight into the phenomena being studied and contribute significantly to explaining them, at least intuitively, giving direction to the collection of more appropriate quantitative data.

A multi-method study of cohabiters' marriage preferences

Little is know about what cohabiters expect to gain by formalizing their relationship. The objective of this multi-method study (studies combining qualitative and quantitative methods) was to contribute to the understanding of the factors behind the transition from consensual unions to marriage, employing a gender perspective. The assumption was that a marriage will only be formed if both partners consider it an advantage. Of course, the man and the woman do not necessarily draw the same advantages from marriage, and the overall advantages for each of them may not be equally strong.

The quantitative part of the study was based on the Omnibus survey 1996, where 617 cohabiters, among others, were asked about their plans to marry. They were given 12 different reasons for hesitating to marry. These reasons were derived from a theoretical framework consisting of the following four arguments that are likely to be involved in the decision-making process: Quality of the existing relationship, quality of the relationship if formalized, expenses and work associated with a wedding, and normative pressure (this latter argument was not addressed in the Omnibus survey). The quantitative analysis found that men are more hesitant to marry than women (both among childless cohabitants and cohabiting parents), and that men and women give different reasons for hesitating to marry. For example, childless men worried about the quality of the relationship, and that a marriage would be economically disadvantageous. Men may fear that a more traditional provider role is expected in marriage than in consensual unions. Among those who were parents, women hesitated because they feared the work and expenses associated with a wedding.

The qualitative part of the study consisted of in-depth interviews with four cohabiting couples. The idea with the qualitative interviews was to delve deeper into cohabitants' views on the differences between marriage and cohabitation (e.g. organization of economy, division of labor, and whether this organization could be an incentive to favor cohabitation over marriage), and to address the normative pressure argument. The in-depth interviews confirmed, gave nuance to and expanded the result of the quantitative analysis.

For one, they provided support for the idea that people expect the value of marriage to be different from that of a consensual union with the same partner. For example, men's possible fear of a more traditional provider role, to which reference was made, was confirmed. Some informants felt that, as cohabiters, they could divide the household expenses equally and keep what was left of their income to themselves, while in marriage they

would be expected to pool their incomes. Thus, a change from cohabitation to marriage may be expected to be a disadvantage, especially for men.

Second, the fact that more women than men attach more weight to the wedding argument does not necessarily mean that they appreciate the ceremony and the festivities less. At least, our in-depth interviews revealed very positive attitudes among the women to being a bride, and to gathering family and friends for a big wedding celebration. However, it may well be that a woman has a more realistic view about how much it takes, perhaps for her in particular, to give such a party.

Finally, the in-depth interviews provided information on whether cohabiters experience normative pressure towards marriage (an aspect not covered by the Omnibus survey). The impression from the in-depth interviews was that this pressure indeed was a reality, although it was rather mild, and largely restricted to the period after the birth of the first child. Women in particular reported that they were exposed to some mild persuasion to marry and that they were uncomfortable with it. Men, on the other hand, voiced very strong resistance against being prevailed upon to marry, like this man:

> *I notice that my brothers and sisters are getting married one by one and I see the photos on the wall at my parents' house. In a way I get the hint in the open space left there….then I think "what the hell!" as I'm really obstinate about things like that…..can't I have a first-class family without all that glitter and finery?*

Conclusion

In this brief paper, I have argued that even though family demography is mainly a quantitative discipline, it could benefit from more use of qualitative research. This could prove especially useful in the face of the dramatic changes in western family patterns over the past four decades. By including qualitative research, we can improve our demographic imagination and be able to give richer, better explanations for these changes.

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EGOR BABAEV

Superfluids, Superconductors and Supersolids:

Macroscopic Manifestations of the Microworld Laws

A superconductor is a state of matter in which electrons flow without resistance. A superfluid is a fluid devoid of viscosity. Superfluidity was first discovered in experiments on helium conducted by Petr Kapitsa in 1937. The lack of viscosity is a phenomenon which is highly counterintuitive from the point of view of the classical physics on which our intuition is based. This phenomenon has a quantum nature, i.e. it is related to the physics of the microworld, where particles are divided into two classes: bosons and fermions. One of the fundamental properties of bosons is that at a sufficiently low temperature, multiple boson particles can occupy the same quantum mechanical state, which results in a large number of them behaving in a coherent manner. Having a large number of particles 'conspire' to behave coherently is a prerequisite for superfluidity. It is precisely this type of collective behavior that makes it difficult for the system to dissipate energy. As a result, once you make such a liquid flow, the flow will essentially persist indefinitely, as opposed to the flow in a cup of tea which eventually stops some time after you stop stirring.

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My most important point is that particles in a superfluid or superconductor behave coherently, according to microworld laws. These systems involve very large numbers of particles. This essentially 'amplifies' the behavior of a single particle which obeys microworld laws, making its behavior manifest in the collective behavior of a liquid. The quantum mechanics aspect then manifests itself in the fact that the abovementioned dissipationless flows are not arbitrary but are subject to quantization. To illustrate this point, if you stir a cup of tea, you create an arbitrary vortex, be it large or small. However, you cannot create an arbitrarily small or an arbitrarily large vortex, and you cannot circulate a quantum fluid arbitrarily. Quantum fluids allow only a discrete number of vortices, and the discreteness is controlled by fundamental constants. Accordingly, superconductivity and superfluidity are *macroscopic* manifestations of microworld laws, i.e. they allow us to observe the laws of the microworld by watching flows in systems consisting of a large number of particles.

Experimental discoveries of new quantum fluids have therefore often had ramifications far beyond the physics of condensed matter. Notable examples are:

1) superconductivity in metals (1911);
2) superfluidity in 4He (1937);
3) superfluidity in 3He (1972);
4) high-Tc d-wave superconductivity in copper oxides (1986);
5) Bose-Einstein condensation of ultracold atomic vapors confined in traps (1995);
6) I should also mention recent experiments on *supersolidity* in 4He, which might add crystalline, poly-crystalline or glassy solids to the list of systems with superfluid properties, along with liquids, vapors and electrons in metals. The term 'supersolid' refers to a solid state of matter in which interior a fraction of particle density can move without friction, resulting in counterintuitive behavior. For example, some of the particles in a rotating supersolid do not rotate, but remain irrotational by slipping through the rotating crystalline lattice.

Because the 'super' state of matter is a macroscopic manifestation of microworld laws, most of these experimental discoveries required novel theoretical ideas for their interpretations. They have subsequently also inspired a number of correspondingly novel notions in other branches of physics. For example, the seminal work of Bardeen, Cooper, and Schrieffer provided a theory of conventional phonon-mediated superconductivity and influenced the appearance of the Nambu-Jona-Lasinio model which describes dynamical symmetry breaking in particle physics. The phase and spin degrees of freedom in neutral superfluids are naturally related to Goldstone bosons. The Higgs effect is a counterpart to the Meissner effect in superconductors, while the Nielsen-Olesen cosmic strings form counterparts to the Abrikosov vortices in superconductors. There are also numerous other examples of deep connections between physical phenomena which take place on macro- and micro-scales. This illustrates rather strikingly how Nature appears to employ similar principles on vastly different energy and length scales, and especially how experimental advances in condensed matter physics indirectly influence and inspire ideas relevant to other branches of physics.

The experimental discovery of Bose-Einstein condensation in atomic gases and recent reports of the possible experimental discovery of supersolidity (more than 40 years after its prediction) may have a special impact on theoretical condensed matter physics. In a sense, it will mark the first time that all the classes of predicted 'aggregate' super states of matter have been proven by experiment. It is therefore crucially important to raise the question of where we can expect further experimental advances in the field of quantum fluids to be made.

One possible candidate for a novel quantum fluid is hydrogen under extreme compression. Wigner, Ashcroft and others have predicted that under sufficient compression hydrogen should become a metal (i.e. the ultrahigh pressure can strip the protons in a hydrogen molecule from their accompanying electrons). Ashcroft also predicted that it might become a liquid metal at extremely low temperatures.

It is currently held that the interiors of Jupiter and Saturn are largely composed of liquid metallic hydrogen, which makes it the most abundant substance in our planetary system. In a terrestrial laboratory, hydrogen was metallized only at high compression and high temperatures [1], but current experiments aim at metallizing hydrogen at extremely low temperatures which is prerequisite for a state to form a quantum fluid.

Could liquid hydrogen be a novel quantum fluid?

To answer this question, we have to examine the quintessential state-defining properties of superfluids and superconductors, i.e. at their reactions to rotation or stirring or to the application of a magnetic field. If we (slowly) rotate a superfluid, a fraction of the system which is superfluid will not follow the rotation. At rotations exceeding a certain critical velocity, a superfluid forms vortices (tiny quantum tornadoes) with quantized circulation. Superconductors do not form vortices in response to rotation, but rather a dissipationless quantum fluid of electrons manifests itself as a property of the superconductor to expel the magnetic field. The reaction of the projected liquid metallic state of hydrogen to the application of a magnetic field was studied in [2,3,4]. Its reaction to a magnetic field was quite unexpected: it can drive the system from states with superconductivity (where charge flows have no resistance) and superfluidity (i.e. dissipationless mass transfer) to exclusively superconducting or exclusively superfluid states. Moreover, these states can be experimentally probed at extreme pressures [5].

As mentioned above, one hallmark of the quantum-ordered states is their non-classical response to rotation (i.e. when the reaction to the rotation or stirring of a solid or a liquid contradicts the behavior expected by classical physics). The rotational responses of all currently known 'super' states of matter (superconductors, superfluids and supersolids) are largely described by two fundamental principles that are more than half-century old, and they fall into two categories according to whether the systems are composed of charged or neutral particles. A superconductor (i.e. a system composed of electrically charged particles) obeys the London law, which relates the angular velocity to a subsequently established magnetic field that depends on fundamental constants alone and does not depend on any details of the microscopic physics of a superconductor. Superfluids obey the Onsager–Feynman quantization of superfluid velocity, i.e. that a superfluid can only react to stirring by creating quantum vortices with quantized circulation. A recent publication [6] states that these laws will be violated in the projected liquid metallic states of hydrogen and deuterium. The predicted rotational response of the quantum state of liquid metallic hydrogen will be highly complex, involving a counterintuitive situation in response to stirring a fraction of the particle density to flow in the direction opposite to that of the stirring. Imagine, if you would, a cup of tea that you stir with a spoon. Classical physics would expect the tea to flow in the same direction as that of the stirring. However, quantum effects cause the opposite to be the case in projected liquid metallic hydrogen: stirring in one direction will make protons flow in the direction *opposite* to that of stirring. Since the reaction to a magnetic field and the rotational response are quintessentially state-defining properties of quantum fluids, the above results suggest a classification of the projected

liquid state of metallic hydrogen as a new class of quantum fluids, which can be a projected new state of matter awaiting an experimental discovery.

Experimental discoveries of superfluids and superconductors teach us about more than just the physics of the microworld. In medicine, most of today's MRI scanners are based on superconducting magnets. Many exciting applications for quantum fluids were suggested recently, including precision instruments such as highly accurate navigation, superfluid gyroscopes and accelerometers. It may also be possible to use quantum fluids for radically new computational devices, e.g. quantum computers. Moreover, it has been discussed whether it might be possible to perform quantum computations with quantum vortices, similar to the above-mentioned vortices which form in a quantum fluids in response to rotation.

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ASLE SUDBØ

From Stonehenge to Nanohinge

Functional materials are materials that have physical and/or chemical properties that can be exploited to perform specific functions. The prime modern example of such a functional material is the semiconductor, which is put to use in every conceivable electronic device in use today. It is a type of material that has completely reshaped today's world as we know it. However, it is far from the only type of functional material we have. Magnetic, ferroelectric, optically active, metallic, insulating, superconducting, and thermally insulating materials are some important examples. Materials have always played an important role in the history of modern man, from the Stone Age via the Iron and Bronze ages, up to the Semiconductor Age in which we may say we live today. Changes in the way materials have been used, and in which materials have been used, have historically given rise to changes in technology and thus in civilizations.

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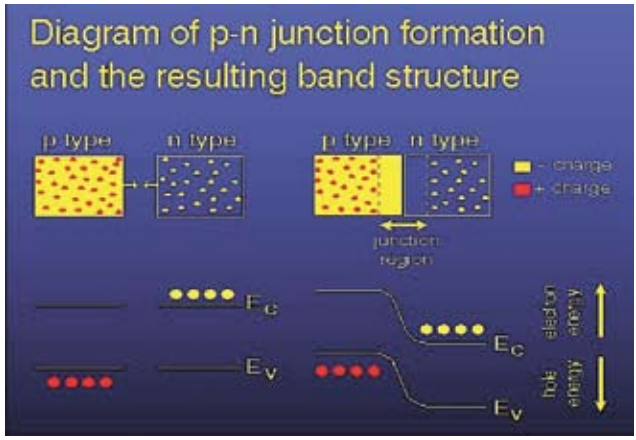
Agriculture and hence stable non-nomadic societies developed in the Younger Stone Age about 4000 years ago on the basis of three materials: stone, wood and animal bones. The making of clothes and shelters, the keeping of livestock and the cultivation of the soil were largely contingent on these three materials for several thousand years. About 4000 years ago, man discovered how to extract minerals and make metals and metal alloys, such as iron, bronze and brass, in areas such as Egypt. However, it took another 2000 years before this knowledge spread to northern Europe, for example. The Stone Age was followed by the Bronze Age (1800–500 B.C.), which in turn was followed by the Iron Age (500 B.C.–1000 A.D.). Compared with stone, wood and bones, metals have the novel property of being ductile, i.e. one can make them in practically any shape without breaking them. This makes them suitable for manufacturing tools and weapons, which was their original novel functionality. In addition, many of them are excellent conductors of electrical current. As such, they are extremely important modern functional materials. Functional materials have been of such importance in the history of human beings that entire eras have been named after them. Among the most prominent and lasting, not to mention pleasing uses of materials are in art and architecture. Without a doubt, the most famous structure remaining from the Stone Age is the

enigmatic Stonehenge on the Salisbury plain in the UK. It is made of huge vertically positioned blocks of solid rock in a regular pattern of concentric circles, topped by even larger horizontally positioned blocks of rock. The fact that Stonehenge has remained largely intact for more than 4000 years bears witness to its expert construction.

By far the most important single functional material of the 20th century is silicon, designated by the chemical symbol Si. One might quite reasonably assert that we are currently living in the Silicon Age. Si is the cornerstone and workhorse of most semiconductor devices, although GaAs (gallium arsenide) is often used also. A semiconductor is only able to conduct electrical current with great difficulty, and only if sufficiently large voltages are applied. The reason for this is that crystalline materials only allow certain bands of energy for the electronic states of the material. A semiconductor is a material where all such bands up to a certain energy level are precisely filled, while the next available energy band is entirely void of charge carriers. A metal, on the other hand, is a material where the next available band is only partially filled. For a semiconductor to be able to carry an electrical current, an electron in the uppermost entirely filled band must be transferred up to the next available band where it can enter a state in which it can conduct electrical current without the associated current being compensated for by the motion of an electron in the opposite direction. This requires an energy transfer across the energy band gap of the semiconductor, and this in turn requires a minimum bias voltage to produce a measurably large current.

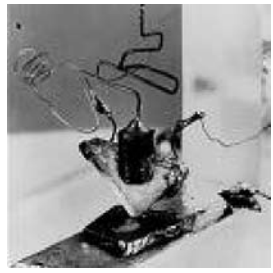


One may, however, improve the conducting properties of such semiconductors either by removing electrons from the top of the uppermost filled band or by adding electrons to the bottom of the next available energy band using atomic substitutions. The former is called hole-doping (giving a p-type semiconductor), the latter electron doping (giving an n-type semiconductor). Making a sandwich of a p-type and an n-type semiconductor will result in the principal structure of the transistor, which is nothing but a current valve. This principal is illustrated in the figure above.

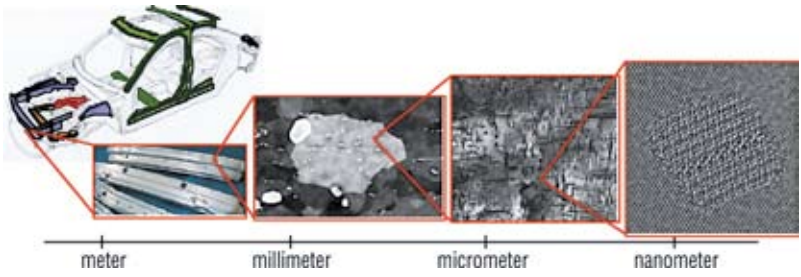
The world's first operational transistor was made by John Bardeen, William Shockley and Walter Brattain at AT&T Bell Laboratories on 23 December 1947 (see illustration below). It was originally intended as a solid state amplifier, but today its role is almost exclusively as a current valve in Very Large Scale Integrated Circuits, where tens millions of transistors are etched by photolithography onto a few square millimetres on

the Central Processing Unit of any personal computer. This is a very far cry from the current valves which were used in the first generation of electronic numerical integrators right after WWII (the number crunchers of that era). These early computers used bulky radio tubes as current valves.

The ENIAC at Princeton had a punching power many orders of magnitude less than any relatively ordinary PC today. It took up three full stories in an entire building, and consumed so much electrical power during the runs that the electrical power to households in the greater Princeton area had to be temporarily suspended. No wonder the market analysts at IBM estimated the worldwide need for such computers to be about five (5) at that time. *In short, the transistor is without a doubt the single most important invention of the 20th century.*



Among the metals, we must mention iron, copper and aluminium. From iron one obtained, perhaps entirely by accident, steel. Steel is an alloy of iron and carbon. Its carbon content ranges from a fraction of a per cent to a few per cent, depending on the grade of the steel. It has a history of 3000 years of development, and is the main material used in structures where tensile strength is of prime importance. Due to its low electrical resistivity and relatively low price, copper has been the mainstay material in current-carrying wires for years. In contrast to iron and copper, aluminium is a light metal and has become the material of choice in the automotive industry. The material has been refined to an extreme degree, an effort where Norway has been a pioneering country due to cheap hydroelectric power. As the picture below illustrates, material defects and impurities on a vast range of length scales ultimately determine the usefulness and strength of the material.



A novel class of materials currently emerging on the scene, and which will be of great importance in the future are the so-called bio-compatible functional materials. These can be a sort of substitute artificial body parts, as illustrated in the picture of the 'Bionic Man' to the left. He moves artificial limbs simply by thinking about moving them. In this context, bio-compatible nano-structures are also envisaged used in replacement or regrowth of teeth, ligaments, blood vessels, replacement heart valves and artificial kidneys, to mention a few examples.

Finally, to close the circle on our journey through time from

Stonehenge to present-day material technology, reference is made to Nanoelectromechanical Systems (NEMS). They can potentially improve our ability to measure small displacements and forces at the molecular scale, and of being used in intelligent nanoscale mechanical devices, such as nanoscale door hinges (nanohinges) that have actually been manufactured in Japan. The ability to make virtually any sort of moving mechanical device almost on the molecular scale, clearly opens new vistas in the human endeavour of making good use of Mother Nature.

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JOHN J. COLLINS

The Life Angelic, according to the Dead Sea Scrolls

Sixty years have passed since the first Dead Sea Scrolls were discovered in a cave near Qumran on the shore of the Dead Sea, south of Jericho. Eventually, fragments of more than 800 manuscripts were pieced together. These texts date from the centuries before and after the turn of the era, i.e. the period that saw the conquest of Judea by the Romans and the birth of Christianity. Prior to the discovery of the Scrolls, we had scarcely any literature in Hebrew and Aramaic from this period, although we had a small corpus of literature that had been preserved in translation.

The finds included copies of nearly every book in the Hebrew Bible. (The book of Esther is the exception). These manuscripts are a thousand years older than the manuscripts on which printed editions of the Bible are based. On the whole, they testify to remarkable accuracy in the transmission of the text, but there are some notable variations. In some cases, the scrolls are closer to the ancient Greek translations (the Septuagint) than to the traditional Hebrew (Masoretic) text.

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The Scrolls have shed light on numerous aspects of ancient Judaism. The interest in religious law (*halacha*) that is typical of rabbinic Judaism is now seen to be well developed before the rise of Christianity. The scrolls provide material for the early history of Jewish liturgy, and of biblical interpretation. A series of commentaries on the prophetic books, called *pesharim*, are the oldest known biblical commentaries. The style of interpretation in these books has significant similarity to the way in which scripture is interpreted in the New Testament. In both cases, it is assumed that the prophets wrote about the end of history, which was now at hand. Other important similarities to early Christianity concern the expectation of messiahs or savior figures. One Aramaic text (4Q246) speaks of a figure who will be called 'Son of God' and 'Son of the Most High' in terms very similar to those used with reference to Jesus in the Gospel of Luke.

A sectarian movement

The Scrolls, however, are not simply a cross-section of Judaism around the turn of the era. They are the library of a sectarian movement which is usually identified as the Essene sect, also known from ancient Greek and Latin authors (VanderKam, 1994, Vermes, 2004). One of the first texts found at Qumran is a Community Rule, dubbed "the Manual of Discipline" because it provides the regulations for a community that lived a quasi-monastic life. Another rule book, called the Damascus Document because it mentions Damascus several times, seems to describe an earlier stage of this movement. (Part of this Rule had already been discovered at

the end of the 19th century in a Cairo synagogue). At some time in the second century BCE, a group of Jews were dissatisfied with the way the religious law (the Torah) was being observed, and formed a new covenant, with its own provisions for admission and expulsion. Points of disagreement included various matters relating to purity, which were thought to defile the temple cult, and the religious calendar. The latter point was crucially important since it determined the days on which the festivals were celebrated. The movement described in the Damascus Document had not completely withdrawn from the rest of Jewish society. We are told that they lived in camps according to the order of the land, and married and had children. Parents were expected to enroll their sons in the new covenant. Members contributed two days' salary a month to the common fund. There was strict community discipline, however. Permission was required for marriage or divorce, and a penalty is prescribed for "fornicating with one's wife" (perhaps for having intercourse during her menstrual period).

The Community Rule is clearly related to the Damascus Document, and repeats many of its regulations, but it envisions a stricter form of community. Members must now merge all their possessions with the common fund, and there is no mention of women or children. They still had many settlements, but they had more intense community life. Most scholars believe that one settlement of this community was located at Qumran, near the caves where the scrolls were found. The ruins admit of explanation as a community settlement (Magness, 2002). They had several large cisterns, presumably to provide water for ritual washing, and some large assembly rooms. There is a cemetery with approximately 1100 graves adjacent to the site. The caves where most of the scrolls were found could only be reached by going through this settlement. A vocal minority of scholars (Golb, 1995, Hirschfeld, 2004) deny that the site was a sectarian settlement, and suppose that the scrolls were brought from Jerusalem. However, this is a difficult supposition in view of the proximity of the caves to the site.

The community described in the Community Rule seems to prescribe a holier kind of life than was required in the Damascus Rule, although the latter continued to be copied and preserved. The reason for the stricter form of life was that the community took it upon itself to atone for the land, in place of the temple cult, which was rejected. They did not make animal sacrifices, but their whole lives were to be an offering to God. They were to enter into communion with the angels, who were constantly engaged in praising God. Fellowship with the angels required a high degree of purity. This also explains why there is no mention of women in the Community Rule.

According to the ancient Greek and Latin accounts, the Essenes were celibate, although the Jewish historian Josephus allows that one branch of the movement accepted marriage. The scrolls never make celibacy an explicit requirement. Consequently, there is ongoing controversy as to whether the sect should really be identified as the Essenes. A few female skeletons were found in the cemetery, but mostly in peripheral areas. Not enough of the cemetery has been excavated to clarify the extent to which women were present in the community. Moreover, while the ancient accounts describe a process of admission and community life very similar to what we find in the Community Rule, they show no awareness of the

concern for religious law or the messianic and apocalyptic expectation that characterize the community. Yet the absence of women from the Community Rule is striking, and it is highly compatible with the emphasis in the Scrolls on fellowship with the angels. The existence of another rule book (the Damascus Rule), which provides for marriage, is quite compatible with Josephus' report of two branches of the Essenes.

The strict community life described in the Community Rule is an anomaly in ancient Judaism. The accounts of the Essenes provide by far the closest parallels. (The Jewish philosopher Philo describes a somewhat similar group called the Therapeutae in Egypt, who practiced celibacy but included women as well as men). A few hundred years later, Christian religious communities would arise in the deserts of the Near East. They also practiced celibacy and pursued an angelic life. It is not possible, however, to establish any connection between the community of the Scrolls and Christian monasticism. We know that the settlement at Qumran was destroyed by the Romans in 68 CE. The movement described in the Scrolls, whether or not it should be identified with the Essenes, also disappeared from history at that time, only to re-emerge from the caves more than 1900 years later.

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ADELA YARBRO COLLINS

The Historical Jesus:
Then and Now

In the ancient and medieval periods, there was no problem of the historical Jesus since no distinction was made between the historical Jesus and the Christ of faith. Since the late 19th century, a central issue has been whether Jesus was primarily a teacher or an apocalyptic prophet.

The Enlightenment

Some Enlightenment thinkers were materialists and atheists. Others, especially those belonging to a closely related movement which historians called 'Deism', attempted to reconcile faith and science. Contrary to traditional 'theism', the Deists argued that God was the first cause of all things and the originator of the immutable laws of nature, but that these laws exclude the possibility of miracles or direct divine intervention.

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Reimarus

The Deist who had the greatest influence on research on the historical Jesus was Hermann Reimarus (1972). He believed that only a rational religion could benefit humanity. He argued that Jesus did not intend to found a new religion, but to present himself as a political Messiah who would liberate the Jewish people from the power of Rome and re-establish an independent, earthly, kingdom of Israel.

Strauss

The next scholar to have an enormous influence on research on the historical Jesus was David Friedrich Strauss. The purpose of his book was to present the mythical approach to the life of Jesus in order to replace the antiquated systems of supernaturalism and naturalism. With the exception of the exorcisms, the miracles attributed to Jesus did not actually happen, according to Strauss. The miracle stories are expressions and illustrations of the conviction that Jesus is the Messiah.

Schweitzer

Albert Schweitzer (1901; 1906) was familiar with apocalyptic works first discovered in the 19th century, as well as with those which were already well known. He argued that when Jesus spoke about the Kingdom of God, he was not speaking about a just and moral society to be established by human beings, but about the new age described by the apocalypses that God would bring about.

Bultmann

Rudolf Bultmann (1926) accepted Schweitzer's historical argument that Jesus was an apocalyptic prophet. He agreed that Jesus' point of view was mythical, and he used existentialist philosophy to 'demythologize' the teachings of Jesus. He reinterpreted Jesus' understanding of the Kingdom of God in terms of an entirely future power that wholly determines the present. Although people today no longer expect God to intervene in history and establish a new age, each of us must face our own deaths, and this expectation is analogous to that of Jesus. Since we face an inevitable death, we ought to focus on the necessity and significance of decision.

The renewed quest

Under the influence of neo-orthodox theology, the quest for the historical Jesus was relegated to the sidelines as irrelevant for Christian theology, which, it was argued, is based on the apostolic witness, not on the teaching of Jesus. However, in the 1950s, scholars reopened the question of the historical Jesus, arguing that it was necessary for the Christian faith that continuity between the historical Jesus and the Christ of faith be established. Günther Bornkamm published a consensus portrait of Jesus under the title *Jesus of Nazareth* in 1956. The standard portrait, however, was rather bland and failed to take the Jewishness of Jesus seriously enough. Some scholars even doubted the Jewish nature of Galilee, but recent archaeological studies have established that Galilee was virtually as Jewish as Judea at the time of Jesus. Mark A. Chancey (2002) has given an excellent summary of the evidence.

Sanders

E. P. Sanders (1985) argued that it is difficult to move from "Jesus the teacher" to "Jesus, a Jew who was crucified, who was the leader of a group that survived his death, which in turn was persecuted, and which formed a messianic sect that was finally successful." He concluded that Jesus should be interpreted as a prophet of the restoration of Israel. He expected God to intervene soon to establish a new and glorious age, but one that is distinctly more secular than the apocalyptic vision reconstructed by Schweitzer.

Crossan

The work of John Dominic Crossan (1991) contrasts sharply with Sanders' work. Crossan attempts to eliminate the apocalyptic aspect of the activities and teachings of Jesus. He discredits apocalypticism by associating the ancient apocalypses with the militant activists in the late Second Temple period. In other words, he links the apocalyptic perspective with violence and assassination. He also claims that the sources that portray Jesus as a wisdom teacher or sage are older than those that present him and his message in prophetic and apocalyptic terms. Crossan concludes that Jesus proclaimed and founded an egalitarian kingdom of nobodies whom Jesus sent out to exchange a miracle for a meal, i.e. healing for hospitality. Although Crossan portrays Jesus and his followers as rural and thus as 'peasants', he also claims that they were similar to Cynic philosophers. The Cynic movement, however, was an urban phenomenon.

Criticism of the quest

In the 1990s, some scholars criticized the whole enterprise of research into the historical Jesus. One of these, Dieter Georgi (1992), argued that the aim of Reimarus and others who took up the quest for the historical Jesus after him was not neutral, but had a clear theological purpose: to gain a verifiable reconstruction of the public career of Jesus of Nazareth and to put this reconstruction into the center of reflection on theology and faith, turning this 'true' Jesus into the center of theological discourse. He argued further that "The contemporaneity of the New Quest with the end of the New Deal and the restoration of the bourgeoisie in the United States and Germany after World War II and within the confines of a burgeoning market-oriented Atlantic community is not accidental."

Elisabeth Schüssler Fiorenza (1997) argued that the two dominant hermeneutical approaches in Jesus research are historical positivism (represented by Crossan) and canonical, theological positivism (the approach taken by Luke Timothy Johnson). She claimed that the flood of allegedly new scholarly and popular books on Jesus does nothing to undermine fundamentalist desires for a reliable account of the historical Jesus or religious certainty about the meaning of his life. At best, one can glimpse the historical shadow of Jesus, but how 'his picture' develops will always depend on the lens through which one looks, that is, on the re-constructive model adopted.

Meier

John P. Meier published three volumes on the historical Jesus under the overarching title: *A Marginal Jew*. A fourth volume is projected. This work is a model of secular, skeptical historiography, but no doubt post-modernists, such as Georgi and Schüssler Fiorenza, would call it 'positivist'.

The historical Jesus now

During his lifetime, Jesus attracted some followers as an authoritative teacher. Others followed him as a prophet proclaiming the Kingdom of God, while yet others followed him as an exorcist who had the power to overcome evil spirits. It is likely that some drew the conclusion that Jesus was the Messiah even during his lifetime. This response was due in part to his authoritative and charismatic actions and in part to the readiness of a segment of the people to look for an alternative to the rule of the Romans and their client-kings, the Herodians. The crowds that Jesus drew no doubt attracted the attention of the authorities. Not long after they heard some people proclaim him as king and saw him overturn tables in the Temple, they arrested him and executed him. This event must have been a devastating shock to his followers. Some of them interpreted his execution as the typical fate of a prophet.

It is much more surprising that other followers of Jesus interpreted his death as the pre-ordained death of the Messiah. Rather than giving up the idea that Jesus was the Messiah of Israel because he suffered and died, instead of leading the people to victory over the Romans, this group of followers reinterpreted the concept of the Messiah. They looked to scripture for guidance and became convinced that the psalms of individual lament, such as Psalm 22 and 69, and the passage about the suffering servant in Isaiah 53 showed that the suffering and death of the Messiah was part of the divine plan. They concluded that it was the risen Jesus,

not the earthly one, who would rule over all creation as God's agent. Jesus, they believed, was already exalted to heaven and had begun to rule. His reign would be fully manifest in the future when he would be revealed as the Son of Man, in fulfillment of the prophecy of Daniel 7:13.

It is impossible to know whether Jesus considered himself to be the Messiah. He presented himself as a prophet, perhaps at least implicitly as the final and most authoritative prophet. He was a teacher with extraordinary authority, and he was believed to have performed at least one type of mighty deed. These qualities made him stand out as a leader and a focal point for the hopes and expectations of those who were dissatisfied with the current order. Although Jesus showed no interest in leading a revolt, his talk about the Kingdom of God and his extraordinary qualities were apparently enough to lead those with high hopes for a new order to fix those hopes on him.

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ANTTI MARJANEN

What Does It Mean When a Woman Is Called or Portrayed as a Man?

The Idea of Gender Transformation in Early Christian Texts and in Modern Times

The *Gospel of Thomas*, the most important non-canonical early Christian source containing teachings attributed to Jesus, ends with a brief, but dramatic dialogue between Jesus and his disciples, for whom Peter is the spokesperson. The topic of their conversation is the position of Mary Magdalene within the circle of disciples:

> Simon Peter said to them, "Let Mary leave us, for women are not worthy of life." Jesus said: "I myself shall lead her in order to make her male, so that she too may become a living spirit resembling you males. For every woman who will make herself male will enter the kingdom of heaven" (*Gospel of Thomas* 114).

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It becomes clear in the text that Jesus does not agree with Peter's claim about women's worthlessness, but sides rather with Mary Magdalene and other women in the argument. According to Jesus, women are worthy of life and they too may enter the kingdom of heaven. By implication, he also insists that Mary Magdalene, and thus presumably also other women, can belong to the circle of disciples on one condition. They must be transformed and make themselves male. What on earth does this mean? What kind of transformation is the text talking about? To be sure, this ancient text cannot speak about sex-change in the modern sense, but what can then be meant with this 'making oneself male?'

A few weeks ago, I received a letter from a female reader of the *Gospel of Thomas* who was so puzzled by the ending of the text as it now stands that she was convinced that the original text must have been reshaped in some way. Even the scholars who have worked extensively with the *Gospel of Thomas* are fairly unsure about the possible meaning of what Jesus said. This is illustrated by the variety of interpretations which have been advanced (Marjanen 1996: 48–55). At this point, we cannot go into these interpretations but we look at other early Christian texts in which similar gender transformation language is used and in which that language and its

function seem to be more easily construed. Those texts will introduce us more thoroughly to the notion of 'females becoming male' and will shed some light on the last lines of the *Gospel of Thomas* as well.

Becoming male: means of protection and demonstration of decency

There are texts in which a woman is said to put on a male appearance, either by cutting her hair or donning male dress to hide her gender. This kind of disguise is understandable in a culture, such as the ancient Mediterranean culture, in which women were not, for example, expected to travel alone or together with men who were not part of their family or at least part of their closest circle of acquaintances. The male impersonation of women could thus serve as a means of protection from violations and as a demonstration of decency. To give one example, in a Syrian hagiographical story, Pelagia, a wealthy, beautiful prostitute of Antioch, hears a moving sermon delivered by a visiting Egyptian bishop, Nonnos, and is converted and baptized by him (Brock and Ashbrook Harvey 1997: 40–62). After her baptism, she renounces her wealth and decides to retire to the life of a recluse on the Mount of Olives. Putting on a male dress, she is able to leave Antioch secretly. After arriving at the Mount of Olives, she continues to hide her real identity and becomes known as the eunuch Pelagios. She has lost her earlier beauty but now she becomes famous because of her virtuous life and performance of miracles. It is only when she dies that people become aware of her real biological sex.

Becoming male: a metaphor for spiritual advancement

Even in the example of Pelagia, a means of protection and a demonstration of decency are not the only and probably not even the primary reasons for male impersonation. The story ends with a somewhat amusing, but rather revealing, reference to people's reaction when they find the dead body of Pelagia: "Praise to you, Lord; how many hidden saints you have on earth – and not just men, but women as well!" Between the lines, the people's surprise suggests that women were not expected to exhibit as much sanctity and spiritual advancement as men. Hence, the woman Pelagia must have undergone her 'gender transformation' and become the man Pelagios to be allowed to assume a higher spiritual existence.

A similar example is offered by Thecla, a female companion of Paul in the 2nd century *Acts of Paul and Thecla* (Schneemelcher 1992). Attracted by the teachings of Paul to the extent that her interest in his company was almost akin to that of an admirer (19–20), Thecla deserts her fiancé and commits herself to chastity which is the central theme of Paul's proclamation (10). Being temporarily separated from Paul, Thecla is seized and tortured because of her faith, but then released. After that she baptizes herself and puts on a male cloak (40). Together with some young men and women, she then goes to look for Paul and meets him in a town called Myra. After Paul was informed of all that had happened to her, he authorized her to "go and teach the word of God" (41). The fact that she travels together with her male and female companions indicates that her male impersonation does not serve to disguise her sex and thus to protect her from violations. It is, however, seen as a concrete sign of her spiritual advancement in terms of devotion to the ascetic life.

Male impersonation also had a subversive dimension. The Hellenistic-Jewish philosopher Philo presents the women members of a Jewish religious community near Alexandria, the so-called Therapeutae, as having attained a kind of relative equality with men (*De vita contemplativa*; Colson *et al.* 9:112–168). In his description of ordinary women, however, he insists that they are by no means allowed to consider themselves on a par with men or to transgress their normal gender roles. They are explicitly not supposed to assume a male appearance (*De virtutibus* 21; Colson *et al.* 8:174–75). Attitudes like Philo's may to some extent explain why gender transformation language did not always result in concrete actions in the texts. 'Being male' represented spiritual advancement also in those cases where women did not undergo an external male impersonation, but where their real or assumed spiritual power and influence elevated them in a higher spiritual hierarchy and they were called men.

In his *Homiliae in Josue* (Sources chrétiennes 71: 267), the early 3rd century theologian Origen states: "It is the difference between hearts which decides whether somebody is a man or a woman. How many women are there who before God belong to strong men, and how many men must be counted among weak and sluggish women." Wanting to emphasize the great significance of his sister as his instructor, the 4th century theologian Gregory of Nyssa calls Macrina a man (*Vita Macrinae* 1; Sources chrétiennes 178: 140). In turn, another 4th century theologian, John Chrysostom, praises his woman disciple Olympias as follows: "Don't say a 'woman' but 'what a man!' because this is a man, despite her physical appearance" (*Life of Olympias* 3; cf. Torjesen 1993: 211). To be sure, these 'compliments' did not prevent these male theologians from denigrating women in general (Clark 2004: 177). In fact, the whole idea of 'female becoming male' was based on the culturally conditioned fact that all that had to do with the feminine represented that which was conceived as weak, irrational, unstable, and spiritually inferior. Masculine terminology, on the other hand, symbolized all that which was valiant, rational, courageous, immovable, and spiritually perfect (Meyer 1985).

As femaleness functioned as a negative religious symbol, its opposite, i.e., maleness, thus became a metaphor for spiritual progress, even for salvation. Although the metaphorical speech about maleness and femaleness was supposed to affect all people's lives, there was also a tendency to start limiting this kind of symbolic use of gendered terminology to women only. In other words, spiritually ordinary women are 'females', whereas spiritually extraordinary women can 'become male' or 'like males', whatever this meant in each particular case. The last lines of the *Gospel of Thomas* are likely to be seen against this backdrop as well. The opportunity for Mary Magdalene and other women to belong to the circle of disciples depends on their willingness and capacity to become male, i.e. spiritually advanced. In the context of the *Gospel of Thomas,* this most probably meant some kind of ascetic state. According to Jesus, through this, women reached the same spiritual level as their male counterparts: women might thus become living spirits "resembling…males".

Becoming male: obtaining male qualities for the successful endurance of hardships

When early Christian texts discuss the idea of gender transformation in terms of 'females becoming male', they do not necessarily make an

explicit reference to a concrete or metaphorical male impersonation. For example, although the expression 'becoming male' occurs very rarely in texts which portray martyred scenes of women, the idea of gender transformation is often present in them. It may take place by assuming qualities ordinarily attributed to masculinity. It is very common that women martyrs are described as Christian gladiators, athletes or soldiers. To give just one example, in a Syrian martyrdom account *Febronia*, in which the women of a convent face the challenge of being seized by Roman soldiers and taken to court, the abbess of the convent, Bryene, encourages the title character of the text, Febronia, saying: "Remember the wrestlers who went before you, who underwent a glorious martyrdom, receiving a crown of victory from the heavenly ringmaster of the light. These people were not just men, but they include women and children as well" (Brock and Ashbrook Harvey 1997: 150–176).

In the gladiatorial context, two significant male characteristics, courage and strength, were needed. In addition, Christian martyrdom accounts refer to the endurance (Lat. *patientia*, Gr. *hypomonē*) of the martyrs, male and female alike. Although *patientia* (*hypomonē*) was normally seen as a female virtue associated with passivity and more precisely with giving birth, in the context of athletic contests and political fights, it took on a special nuance. This is illustrated by Seneca, the 1st century Roman philosopher and politician, who emphasized that the endurance requested of the athletes and those who were politically tortured was 'courageous endurance', as distinct from womanish *patientia* (Shaw 1996). Thus, in that context it became a male quality. When female martyrs were also described as exhibiting this male *patientia*, it, in fact, signified a kind of transformation from femaleness to maleness.

The discussion about the use and function of the early Christian gender transformation language can be summarized as follows: (1) If gendered language is used to describe spirituality or a Christian way of living more generally, feminine terminology stands for a less successful performance, if not for a failure; (2) 'becoming male' is a symbol of spiritual progress; (3) femaleness can be transformed into maleness through a religious conversion, spiritual growth, or the endurance of hardships; (4) the transformation may be a mental or spiritual process (conversion, spiritual growth) or a change in lifestyle (e.g. acceptance of sexual asceticism or martyrdom). In those cases, it may apply to both sexes, but it may also take place through concrete actions by which one alters appearance (e.g. a woman putting on male dress or cutting her hair); (5) although 'becoming male' language is chauvinistic, at least from our modern perspective, in early Christianity it was not necessarily consciously employed to denigrate women who were called or portrayed as men. In the *Gospel of Thomas* 114, for example, the Jesus of the text, by indicating his willingness to make Mary and other women 'male', elevates her to the same level as her male companions both in the circle of disciples and the kingdom of heaven.

Women made 'male' in modern times

The use of gender transformation language is not only a phenomenon of bygone days. Even in our modern days, women are called and portrayed as men although the function of gender transformation language is not necessarily the same. For the sake of comparison, let me give three examples. The first comes from the same cultural area as our ancient examples

but it is much more recent. Anton Blok, an anthropologist who investigated the male and female roles in a Mediterranean society of the 1970s, interviewed a male informant who described a woman living in his village who was forced by circumstances to take care of many things which were considered men's affairs as follows: "… she is a woman who only lacks testicles to make her a man" (Gilmore 1987: 9). Since the informant clearly regarded his characterization of the woman as favorable, it actually resembles pretty much some of our ancient examples. Without understanding the chauvinistic implications of his statement, the informant thought that presenting the woman as 'nearly a man' is a compliment in the same way as the Jesus of the *Gospel of Thomas* saw his own statement about the 'male' Mary Magdalene.

In even a more sophisticated modern setting, characterized in principle by non-chauvinistic attitudes and equality between the sexes, gender transformation language is used to reinforce the stereotypical notions of gender roles. Let me give you two examples. The first relates to the hostage drama in the Persian Gulf last spring when some British Royal Marines were captured by Iranian soldiers without offering any resistance. In order to be freed from the awkward situation, the British Marines agreed to collaborate with their captors to the extent that they both apologized for their actions and criticized the politics of their own country. The American military historian Ralph Peters was highly annoyed about the sheepish behavior of the British soldiers in his article in the New York Post (April 3, 2007). His criticism reached its climax in the rhetorical question: "Was Margaret Thatcher the last real man in Britain?" Here, gender transformation language takes on a function somewhat different from that in the ancient texts. (I have found only one example of similar use in the ancient texts I have studied.) Although the rhetorical question certainly says something about Mr. Peters' perception of Mrs. Thatcher's character, its primary function is not to speak about her. In this context, a woman is called a man because somebody wants to disparage real men by implying that their behavior in this particular situation was womanish.

The second example relates to the coming presidential elections in the USA, and I found it by 'googling'. I wanted to see what happens when I search for information by combining two entries, one being the phrase "what a man", and the other being the name of a prominent woman politician. Madeleine Albright did not give interesting results, but Hillary Clinton did. I found a website entitled "Hillary Clinton is the Right Man for the Job." Under the title, there is a picture in which Hillary Clinton is viewed from behind with her face turned toward the camera. She is standing in front of a urinal and the picture wants to give the impression that she is urinating in a manly fashion. This tasteless picture makes it clear that, unlike the ancient versions of gender transformation language, the use of the term 'man' on the title of the page is not a benign attempt to say something positive about a woman who is called a man. The text and the picture serve not only to undermine the credibility of a candidate for the highest political office in the world, they go even further. In an extremely chauvinistic manner, the website subscribes to a conservative notion that a real woman should not even aspire to enter an arena traditionally belonging to men. Gender transformation language is thus used for the denigration of the entire female sex.

This last modern example does not actually have any correspondence in ancient sources. In antiquity, masculine terminology and masculine qualities were so clearly linked with positive values and human characteristics that their use in connection with complimenting women was somehow understandable, despite the chauvinistic connotations these kinds of compliments inevitably have from a modern perspective. The last modern example, in turn, exhibits a use of gender transformation language which cannot be justified in any situation.

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KAREN L. KING

Difference and Diversity:
Writing the History of Ancient Christianity

What is the nature of religious tradition? Is it something fixed and unchanging that one can only accept or reject? If so, it is difficult to see any hope for change or even any place to discuss constructively problematic, religiously-based views, for example, on human rights, women's roles or religious warrants for violence. However, historical study, as it has been practiced since the Enlightenment, paints a very different picture of the history of religions. We can easily show, for example, that Christianity has always been made up of diverse and often conflicting voices. The earliest surviving evidence, i.e. the letters of Paul in the New Testament, raises numerous issues that were under discussion at the time, ranging from controversies over leadership and sexuality to practical matters such as how to divide up the food at community meals (I Corinthians; Galatians).

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Subsequent centuries witnessed an enormous array of literary production, theological speculation, and ritual improvisation, much of which was subject to considerable controversy. There was no 'celebration of difference' here. Instead, by the 4th century, Christian discussions of variety and difference had more or less settled into the tidy bifurcating discourse of orthodoxy and heresy, right and wrong, true and false. Leaders sought to solidify Christian unity by attempting to institute uniformity in creed, canon and hierarchical male leadership. Any deviation or disobedience was considered heresy, and said to have been introduced by Satan to corrupt the truth and divide the church (Bauer 1971: xxi–xxv; Le Boulluec 1985; King 2003, p. xx).

Modern historical critics have found much to criticize in this theological portrayal of the causes and character of early Christian diversity and its rhetorical claims to uniformity and unity. They no longer understand history as the ground upon which Satan futilely opposed the inexorable, teleological movement of God's will, but rather as a place of human struggle, conflict and constructive negotiation. Starting perhaps with the work of Ferdinand Christian Baur, historians now commonly talk about the 'varieties of early Christianity' and understand that attempts at uniformity have always been partial and contested (for further discussion, see King, forthcoming).

I believe we are now on the brink of another watershed in the representation of early Christian diversity, building on recent approaches to historical criticism, social history, cultural anthropology, feminism, post-structuralism and post-modern criticism, and aided as well by work which integrates archeological materials, including sensational manuscript discoveries from Qumran, Nag Hammadi, Oxyrhynchus, and elsewhere,

into early Christian historiography. Such approaches let us see that religious tradition, even sacred texts, are not static givens, but are always in ongoing processes of formation. Early Christian writings are in one sense examples of ancient Christians largely doing what people generally do, i.e. struggling to understand the meaning of tradition in the face of contemporary events, and to greater and lesser degrees in conversation and controversy with each other. Because such practice is selective, i.e. people choose which traditions to follow, they need to take responsibility for the effects of religious practice.

This methodological approach yields a very different portrayal of early Christianity than what is provided by the master story. Rather than anachronistically dividing the new manuscripts into 'orthodox' and 'heretica' based on hindsight, we can try to read them in their ancient historical contexts, at a time before it was entirely clear who would win the battle for Christianity. By placing texts from rejected 'heretics' side-by-side with their 'orthodox' opponents, we can better see where the differences lay and what was at stake. Let me offer two very brief examples from the second century CE: *The Gospel of Mary* and *The Gospel of Judas*. The first challenges the view that all Christians agreed that women should not be leaders in the church, while the second challenges the view that all Christians saw the martyrs as heroes of the faith who died as sacrifices due to the will of God.

The Gospel of Mary

Mary Magdalene is best known in the West as a repentant prostitute, the image of female sexuality redeemed. Yet there is not a shred of evidence to support this portrayal, and it was never held by the Eastern churches. All the sources, including the New Testament gospels, portray her as a faithful disciple of Jesus. Why, then, did such an erroneous portrayal arise?

Several early Christian writings were recovered in the past century. They portray Mary Magdalene as a leading disciple of Jesus after his death (Marjanen 1996). Chief among these is the *Gospel of Mary* (see King 2003). In it, the Savior gives special teaching to Mary about the nature of the soul. When she relates this instruction to the other disciples, Peter and Andrew react strongly, charging her with inventing lies. The problem for Peter is clearly depicted as jealousy: "Did (the Savior), then, speak with a woman in private without our knowing about it? Are we to turn around and listen to her? Did he choose her over us?" he asks. Levi assures Peter that the Savior did indeed favor her, and he admonishes the disciples to quit fighting among themselves and instead go forth and preach the gospel, as they were commanded.

The issue with which the *Gospel of Mary* struggles is the question of who has understood the teachings of the Savior. Who, then, is able to go forth and preach the gospel? Mary's stability of character and advanced teaching present her as the model disciple. Peter, on the other hand, has not understood. He cannot get past the distinctions of the material body to see Mary's spiritual nature. He fails to grasp that because the self is viewed as the spiritual soul, and because at death the body will dissolve back into matter, distinctions written on the body are therefore bound to pass away, as will sexual distinctions. What ultimately matters is the state

of one's soul. Hence, leadership should be based upon spiritual maturity, the capacity to understand Jesus' teachings, to meet the needs of others, and to preach the gospel – for both men and women.

The close association of Mary's name with a kind of theological reflection that was later rejected provides a new clue as to why the portrayal of Mary as prostitute was invented. Discrediting her may have been in part a strategy of the church fathers to counter the interpretation of Jesus' teaching and the arguments for women's leadership which were being spread under her name in works like the *Gospel of Mary*. Because it argues so forcefully for the legitimacy of women's leadership, the *Gospel of Mary* lets us hear a voice other than the one dominant in works like *I Timothy*, which silences women and insists that their salvation lies in bearing children. We can now hear the other side of the controversy over women's leadership and see what arguments were given in its favor.

The Gospel of Judas

The second example is the *Gospel of Judas*. What does it tell us about the larger issues that were debated in the earliest centuries of Christianity? Elaine Pagels and I have argued that the context for reading the *Gospel of Judas* is Christian persecution, and that its main point is to oppose the glorification of violence in God's name. The author is distressed because at the same time as Christians were dying for refusing to sacrifice to the Gods of Rome (an act of treason), some Christian leaders were bringing sacrifice right back into the center of Christian theology and practice by understanding Jesus' death as sacrifice, by practicing the Eucharist as a sacrificial meal, and worse, by encouraging fellow believers to offer themselves as sacrifices to please God (Pagels and King 2007, 59–75). For example, the 3rd century church father Tertullian, insisted that God uses the martyrs' suffering like a physician's tonic, painful when administered, but it improves one's condition. Indeed, it is "by means of fires and swords, and all that is painful" that God heals and grants everlasting life (*Scorpiace* V). Martyrs, he says, are "conquerors who fight with their blood to win victories," and whose patience assures "hope of revenge" (*Scorpiace* XII). For the *Gospel of Judas*, such leaders have missed the whole truth of Jesus' teaching about the true God and Father, and are instead worshipping the false angels that God had set to rule over the heavens. Jesus teaches that a person's most intimate identity with God is spiritual – and immortal, untouchable by the powers that temporarily hold sway in the world below (Pagels and King 2007, 77–98).

Certainly, the *Gospel of Judas* is no moderate voice, but rather a passionate expression of anger and condemnation, bitterness and revenge. It lets us see more clearly how violence aimed at Christians from the outside took full root within the community itself, where we hear Christians raging against each other and see communities torn apart. If such polarization created a sense of unity and cohesion for some, it tore others apart. When Constantine converted, the persecutions came to an end and we heard no more of the heretics who told other stories. The opposition was all but silenced, not because remnants of their voices did not survive, but because narratives of glorious triumph flooded into any places where such views might have taken root.

Examining ancient Christian controversies brings historians into an arena fraught with complexities and ambiguities, contested stories, theo-

logical controversies, loud voices, and even louder, deafening silences. But perhaps it is precisely such a complex history that we need in order to address the complex issues of our own day in a critical and constructive manner.

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KAREN L. KING

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