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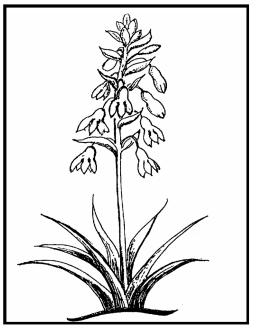

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From Eugenics to Epigenetics: Exploring the Decoupling of Human Sexual and Reproductive Behaviours

by

John Hobcraft

(This is the text of a lecture delivered at The Galton Institute Centenary Symposium *What Makes us Human?* in 2007)

Introduction

In 1907, when the Eugenics Education Society (now The Galton Institute) was founded, the United Kingdom was in the middle of the First Demographic Transition. Fertility levels had already fallen significantly as a result of increased abstinence (and perhaps contraception) being used, largely within marriage (only four per cent of births occurred outside marriage). Thus the decoupling of sex from reproduction had apparently begun, although we shall argue that the importance of abstinence for fertility control probably inhibited recreational sex as never before. One hundred years later, as we celebrate the Centenary of The Galton Institute, we are in the throes of the Second Demographic Transition. Sexual partnerships are more fluid, many couples cohabit rather than marry and there is much more partnership breakdown. Childbearing is much more likely to take place outside marriage with 43 per cent of all births in England and Wales in 2005 occurring outside marriage. Among these births out of wedlock in 2005 two-thirds were registered by cohabiting couples, one-fifth by couples living apart and the remaining sixteen per cent were 'sole registrations' by the mother.

This paper will trace the evolution of partnership and reproductive behaviour over this hundred year period (see also Cook 2005; McLaren 1999; and Szreter 1996) and interweave the account with some of the concerns of and developments from the eugenics movement in England and Wales. The story will come up to date with a consideration of recent and prospective developments, including issues of embryology, reproductive epigenetics and the possible emergence of a new eugenics through 'designer babies'.

The early years

A central concern of the eugenic approach was with differential reproduction, without which the concerns about the genetic pool and especially heritability of 'ability' would have been much less salient at the beginning of the 20th Century. These concerns helped to shape the inclusion of fertility questions in the 1911 Population Census and were informed by the development of the social class measures used in their detailed analysis by Stephenson which emerged in the early 1920s (see Szreter 1996). Around this time the Eugenics Laboratory at UCL under Karl Pearson was established and one of its early major projects was the monumental analysis of birth rates in northern England (Elderton 1914). During this period Leonard Darwin's leadership of the Eugenics Society (as it became)

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We are sorry to announce that **Dr Milo Keynes** died on the 18 February, 2009 in Cambridge. There will be an obituary for Dr Keynes in the June Newsletter.

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emphasised the need to reduce fertility differentials by reducing the reproductivity of the poor or lower social classes or effectively the 'feeble minded' (Searle 1998 and Soloway 1998).

As Szreter (1996) has shown there was considerable variation in fertility and nuptiality behaviour among occupations within Stevenson's social classes. For example, a major fertility decline was already under way for cotton workers by 1911, probably largely through spacing births achieved to a considerable extent through sexual abstinence or withdrawal. Nevertheless, England was distinguished by far less geographic variability in the timing of the onset of fertility decline than many other European countries (Teitelbaum 1984 and Coale and Watkins 1986).

Soloway (1982 and especially 1990) has also discussed the gradual emergence of birth control in England, including its acceptability, and the links to the eugenics movement. The earliest active promoters of the need for fertility control were the Malthusian League, who were radical and secularist, and concerned with helping the poor to escape from the consequences of high fertility. This movement perhaps had its origins in the work of Drysdale (1850), but can be linked more explicitly to the notorious Bradlaugh-Besant trial of the late 1870s. Victorian England was not ready for open discussion of birth control, which was actively opposed by the church: their real offence was to publish this advice cheaply and actively proselytise to the working classes.

In contrast the eugenicists were generally much more elitist and concerned more with protecting their own interests and 'society' from the fecklessness of the poor: they believed that heredity made it unlikely that the lot of the poor could be improved a great deal. Thus differential reproduction would result in 'race suicide' and especially be dysgenic: hence the advocacy of 'negative eugenics'. The massive losses through death of healthy young men during the Great War of 1914-18 were also seen as dysgenic.

It was only in the 1920s, when sexuality became more openly discussed, that birth control clinics were established. Marie Stopes was by far the most visible face of this movement and her *Married Love* (1918) had the explicit sub-title 'a new contribution to the solution of sex difficulties'. Stopes' concerns with advocacy of the most reliable methods of contraception were explicitly bound up with her views on women being able to have a rewarding sex-life without the fear of unwanted conceptions (e.g. Peel 1997). However, it is important to recall that fertility levels had already halved by the 1920s from their peak in the 1870s: most fertility control had occurred without the availability of clinics or appliance methods and despite church, medical and societal opposition. Szreter (1996) emphasises the key importance of prolonged periods of sexual abstinence, although there is some evidence for the role of withdrawal and abortion, with condoms and other 'appliance' methods really only becoming viable on a wide scale in the 20th Century (although there is disagreement on the importance of condoms and appliance methods in the early decades).

Thus, the first fifty years or so of fertility decline in England can be seen as having a major effect of repressing sexuality for men and particularly women, since the main means of fertility limitation or birth spacing was through abstinence; withdrawal was hardly compatible with relaxed sexual behaviour either. Mason (1994 and 1994a) suggests that sexual control within marriage, at least for the better off, was established early in the 19th century (see also Cook 2005 and Weeks 1989) and Szreter and Garrett (2000) argue that 1816 was a key watershed, marking the beginning of a crossover in fertility behaviour, such that the better off began reducing their fertility, but the poor did not. Hobcraft (1996, pp 509-14) discusses the fact that observed fertility behaviour implies quite substantial proportions of couples trying to limit their fertility very early in marriage, probably largely by spacing measures, and continuing to implement this behaviour at all parities, thus often but unreliably achieving quite small family sizes. For example 81 per cent of women married in the 1870s had a third birth; this had reduced to only 55 per cent for women marrying in the first decade of the 20th Century; and only 40 per cent of those marrying in 1915 had a third birth (and only 64 percent of them had a second birth).

Stopes' emphasis on married love also reflects the views of the time that saw marriage as the only acceptable context for childbearing and to a considerable degree for sexual activity. In 1845 some seven per cent of births occurred outside marriage; this proportion gradually declined to about four per cent at the dawn of the 20th Century and hardly increased until the 1960s, with the exception of brief rises during the later years of the two World Wars; by 1960 5.4 per cent of births occurred outside marriage. Of course, many marriages were precipitated by conceptions, although we cannot document this statistically at the national level until the changes in registration of 1938.

Fertility declined inexorably through into the 1930s. By 1927 Blacker had helped to cajole the Eugenics Society into sponsoring birth control through the quaintly titled Birth Control Investigation Committee (he also served as its Secretary until it closed in 1939). He was also extremely influential in shifting emphasis towards 'positive eugenics' and trying to distance the Eugenics Society from its 'racial suicide' proponents by making it more concerned with scientific analysis. He played an important role in persuading the Eugenics Society to fund several other key population related organisations: the British Social Hygiene Council, the Marriage Guidance Council, the Joint Committee on Voluntary Sterilization, the Society for the Promotion of Birth

Control, Clinics, the National Birth Control Association and the Family Planning Association (Soloway 1998).

The PIC and the LSE

Another key development led by the Eugenics Society was the establishment in 1936 of the Population Investigation Committee (PIC), which played a hugely influential role in the study of demography and related issues (Langford 1998). Langford points out that this was effectively a reconstitution of the Eugenics Society's Positive Eugenics Committee (established in 1934) out of which came Glass' *The Struggle for Population* (1936); the PIC was established as a more independent, distanced entity. Sir Alexander Carr-Saunders chaired the PIC until 1958; C.P. Blacker was Honorary Secretary until 1975; L.J. Cadbury was Treasurer from 1939 to 1976; and David Glass essentially dominated its research activity until his death in 1978.

Virtually throughout its existence the PIC was linked to the LSE and bound up with developments in demography there. These had their beginnings with Edwin Cannan's famous population projection of 1895, suggesting the onset of population decline; Arthur Lyon Bowley, Sydney Webb and Harold Laski all published early papers on the birth rate. Sir William Beveridge, who was LSE's Director from 1919-37 also published a paper in *Economica* (1925) on the fall of fertility among European races. Beveridge wanted to establish a Chair of Social Biology (with T.H. Huxley as an 'academic hero') and began negotiations for funding with Rockefeller in the mid-1920s. Eventually the shortlist comprised J.B.S. Haldane and Lancelot Hogben (with Solly Zuckerman being deemed unsuitable!). Hogben was appointed in 1930 and remained at the LSE until 1937: the brief was to cover variation and heredity in man; selective immunity; relative importance of environmental factors in social structure; questions of race and class in relation to hereditary endowment; and economic and biological tests of fitness. This brief certainly overlapped heavily with the Galtonian agenda, although Hogben was an active critic of the Eugenics Society.

By then major scares of population decline were emerging: fertility had continued to fall and was below replacement level. Hogben's wife was Enid Charles, who played an important part in raising awareness (or panic) about the fertility decline in her *Twilight of Parenthood* (1934), which included one projection of the population of the UK falling to only five million by 2000. Carr-Saunders, who was the leading British demographer, became Director of the LSE from 1937 to 1957. He established the first academic post in demography (a readership initially held by Kuczynski from 1938-41, then by Glass from 1945-48, Grebenik from 1949-54 and Norman Carrier from 1954 to 1979).

The PIC brought together representatives of a wide range of scientific societies and played a crucial role in bringing about the changes in registration of births in the Population (Statistics) Act of 1938, which began collection of mother's age, birth order and duration of marriage for birth statistics and enabled much better analysis of fertility behaviour. The PIC, especially its key players, also played a significant part in lobbying for the Royal Commission on Population, which was set up with the explicit aim of understanding and altering the low fertility levels. The work of the Royal Commission, eventually established in 1944, was heavily shaped by the PIC. Carr-Saunders was a member of the Commission and much of the scientific work was effectively carried out by the PIC. This included the *Family Census*, which collected and analysed the fertility histories of a million women (Glass and Grebenik 1954) and the first ever major national survey of birth control practice in Britain (Lewis-Faning 1949).

The PIC, under Glass' intellectual leadership but with critical support from Carr-Saunders and Blacker, began a dizzying series of other major pioneering studies during the late 1940s. In 1946, the birth cohort study that was to become the National Survey of Health and Development was begun under Glass' leadership – it continues to this day and, along with the subsequent birth cohort studies it inspired (the 1958 National Survey of Health and Development, the 1970 British Cohort Study, the Avon Longitudinal Study of Parents and Children, and the Millennium Cohort), is part of a widely envied British tradition.

The PIC also played a key role in establishing and funding the important Maxwell study of trends in Scottish intelligence, which aimed to explore the explicit eugenic concerns about the decline of national intelligence due to differential reproduction. This study repeated the 1932 Scottish study of intelligence for all school children born in 1921; the same test was administered in 1947 to all Scottish school children born in 1936. Contrary to the standard eugenic claims the evidence showed an improvement over time (see also Deary 2005).

More recently, systematic improvements in IQ scores over time have received attention as the 'Flynn' effect (e.g. Flynn 1987 and 2007) Such systematic changes over time can only be environmentally induced, since genes are unlikely to have changed and a compelling, but not undisputed, explanation for the paradox of high heritability measures along with big environmentally-induced changes has been put forward by Dickens and Flynn (2001; see also the comments by Loehlin 2002 and Rowe and Rodgers 2002, and the riposte by Dickens and Flynn 2002; also Flynn 2007). One of the (many) problems of partitioning variance into genetic and environmental components is that any estimates are dependent on the amounts of environmental (and genetic) variation in the population under study at the time they are studied. Moreover most gene-environment correlation or interaction is swept into the 'genetic' component. In this context there are a few interesting recent studies that document

differing heritability of IQ by socioeconomic status (Guo and Stearns 2002, Rowe et al 1999, Turkheimer et al 2003 and Harden et al 2007). These studies show lower genetic heritability and thus higher environmental influences among the more disadvantaged than for the advantaged, perhaps suggesting that the scope for raising IQ scores among the disadvantaged is much greater than presupposed by the eugenicists.

Lastly the first ever national study of social mobility anywhere was carried out by Glass in 1949 (Glass 1954). This built upon work carried out in the 1930s under the auspices of Hogben (1938): measuring the extent of social mobility is also of great relevance to exploring and perhaps challenging the fundamental tenets of eugenicists.

Early marriage and the baby boom: 1950-64

By the time the Royal Commission reported in 1949 the problem of below replacement fertility had receded. From 1950 to the mid-1960s there was a steady upward trend in fertility. As mentioned earlier, childbearing outside marriage was still rare and unacceptable: women who became pregnant outside marriage were under pressure to marry before the birth, to seek an illegal abortion or to have the child adopted whereupon the mother was all too often institutionalised or deemed mentally unfit. There is evidence that sexual activity was beginning to occur more frequently at younger ages during the 1950s (Johnson et al 1994), perhaps partly related to conscription removing young men from parental control; another factor may have been the post-war availability of penicillin to enable confidence in treating sexually transmitted infections. However, the major change in partnership behaviour during this period was a shift towards ever younger marriage. In part this increase in marriage can be linked to greater sexual activity: in 1951 14 per cent of first marriages of women under age 45 and 23 per cent of teenage marriages resulted in a birth that was a premarital conception; by 1964 these proportions had reached 22 and 37 per cent respectively; the numbers of such teenage female 'shotgun' marriages rose from 12 to 40 thousands over this 13 year period. Thus, a consequence of the beginnings of the 'sexual revolution', combined with unreliable contraception and illegal abortion, was to contribute to increasing young marriage during this period. The separation of recreational from procreational sex was still very incomplete.

The period from 1950 to 1964 was not only the heyday of early marriage and related premarital conceptions, but also covered the 'baby boom': total fertility rose from 2.18 in 1950 to its peak level of 2.93 births per woman in 1964. However, it is important to realise that most of this increase (probably 80 per cent) actually occurred through changes in propensities to have the first two births; almost half of this 80 per cent is attributable to increased propensities to go on to a second birth after having the first (Ní Bhrolchaín 1987). Just ten percent of the overall change was attributable to increased propensity to go on to the third birth and the chances of going on to fourth or higher order births reduced. Because substantially higher proportions of women achieved a second birth, greater numbers were at risk of having further births, although the propensities to do so did not change. Moreover, earlier childbearing meant that women were at risk of having third and subsequent births for longer. Thus the actual proportions with more than two births rose significantly, but with very little indication of any change in underlying fertility control behaviour after the second birth had occurred.

However, from 1960 on there is also some evidence of changes in the proportions of births occurring outside marriage: throughout the 1950s this proportion was about five per cent; by 1964, when fertility peaked this had risen to seven percent; by 1970 it had reached eight per cent and even by 1977, when total fertility had dropped to a low of 1.77 was still just below ten per cent. Alternatively we can consider all births conceived outside marriage (i.e. including premaritally conceived births): in 1950 these comprised 12 per cent of all births; by 1964, at the fertility peak, this proportion had risen to 15 per cent, peaked at around 18 per cent in the late 1960s and was back down to 16 per cent by the fertility low in 1977 (Hobcraft 1996). Thus we see the beginnings of behaviour change, with small but fluctuating increases in births conceived outside marriage and a slightly clearer indication of early shifts towards greater acceptability of having the birth outside marriage.

The baby bust: 1964 to 1977

This is a critical period for understanding subsequent developments in sexual and fertility behaviour. It is indeed the period when recreational sex began to be almost completely separable from procreation if so desired. During the 1960s there was a major transformation in contraceptive reliability, with the gradual and eventually widespread introduction of the contraceptive pill and the IUD and easier access to (and simpler procedures for) sterilization. Hobcraft (1996) uses Cartwright's (1987) results on wantedness of births to estimate the role of the 'contraceptive revolution' in reducing fertility. For 1967/8 (when 20 per cent of the sampled mothers were already using the contraceptive pill) the total fertility of 2.61 can be partitioned into a 'wanted' fertility of 1.77 and an excess fertility of 0.83 through mistimed or unwanted births; by 1975, the total fertility was 1.78, with wanted fertility at 1.41 and excess fertility of 0.38. Thus over half of the fertility decline from 1967/8 to 1975 (0.45/ 0.83) can perhaps be attributed to improved contraception, a profound change; and this estimate understates any role of sterilization. If such information had been available for 1964 and 1977, the impact of improved contraceptive technology and availability would probably have been greater in the overall baby bust. By 1984, when total fertility was 1.75, wanted fertility had risen slightly to 1.49 and excess fertility

fallen further to 0.26; especially noteworthy was the reduction in proportions of births not wanted at all from 11 per cent in 1975 to 3 per cent.

The 1967 Abortion Act also played an important role in altering the ability to make choices concerning unwanted conceptions, whether in or out of marriage. The impact of this Act took a few years to be realised, as services were gradually extended by region and to single women, but by 1972 there were 160,000 abortions performed (compared with the current 200K), amounting to 14 per cent of all conceptions. It is hard to judge the impact of legalised abortion on total fertility, since estimates of around 100,000 illegal abortions per year before the Act have been proposed. Total fertility would have been 0.35 higher if all legal abortions had resulted in live births.

A further legislative change of profound importance for demographic behaviour was the Divorce Reform Act of 1969 enacted in 1971. This enabled a couple to divorce on the grounds of adultery, cruelty, desertion for at least 2 years, mutual consent (after 2 years), or if one person only wanted a divorce after 5 years. By 1976, when the early trends had settled there were 127K divorces in England and Wales (by the 1990s this had increased to 150-160K per year).

Thus, by the mid 1970s contraception and abortion provided reliable means to avoid unwanted births, although acceptability and accessibility were and remain an issue, especially for teenagers and the unmarried. There were the beginnings of increased childbearing outside marriage and it became easier to end an unsatisfactory marriage. It was perhaps during this period that the true initial sexual revolution came to pass. The ability to have a satisfying sex life, especially for women, without unwanted consequent pregnancy or birth became a reality for the first time. As we have argued above, the first demographic transition (from the latter part of the 19th Century to the 1930s served to make sex increasingly difficult and the need to abstain or 'be careful' to avoid unwanted births was undoubtedly challenging and perhaps even played a part in the emergence of Victorian prudery. Arguably, at least within marriage, sexual activity was less inhibited by concerns about procreation (although childbearing was still hazardous for the woman's health) before conscious birth control (e.g. pre 1850 or perhaps pre 1816 – see Szreter and Garrett 2000 and Mason 1994 and 1994a). It was not until the 1970s that such tensions could be largely overcome.

The partnership revolution: 1980 on

Total fertility remained low throughout the last 20 years of the 20th Century. In 1980 total fertility was slightly elevated, partly as the result of a pill scare (Murphy 1993), at 1.88; for the remainder of the 1980s total fertility fluctuated between a high of 1.82 and a low of 1.76; during the 1990s there was a very slow decline, reaching a minimum in 2001 of 1.63, with a subsequent steeper rise to 1.87 for 2006.

However, partnership behaviour and the partnership context of childbearing changed radically during this period. In 1979 some 11 per cent of non-married women aged 18-49 were cohabiting, comprising only three percent of all women in the age group. By 1991 these proportions had risen to 23 per cent of non-married women and nine per cent overall; the latest figures for 2001/2 show 30 per cent of non-married and 15 per cent of all women aged 18-49 to be cohabiting.

In 1980 the proportion of births occurring outside marriage had risen to 12 per cent; by 1990 this proportion had more than doubled to 28 per cent and the seemingly inexorable rise continues, with the proportion for 2005 being 43 per cent. The national figure hides considerable geographic variability. Over 60 per cent of all births occur out of marriage in several northern cities: Kingston-upon-Hull and Knowsley (both 66%), Blackpool, Hartlepool, Redcar and Cleveland, Liverpool, and NE Lincs, as well as in Blaenau Gwent and Merthyr Tydfil in Wales; fewer than 30 per cent of births are outside marriage in Wokingham (24%), Bucks, Surrey and several London Boroughs (Camden, Kensington and Chelsea, Tower Hamlets, Wandsworth, Westminster, Brent, Ealing, Harrow, Kingston, Merton, Redbridge, and Richmond). Incidence of unmarried fertility is generally highest in the North East region of England (55%) and in Wales (52%) and lowest in London (35%) and the South East (38%).

There is also substantial variation in the proportions of births outside marriage by country of birth, compared with the national average of 42 per cent in 2005: UK-born 49%, Caribbean born 59%, Irish 32%, African 24 to 36%, Indian sub-continent 2%, Far East 15%, rest of New Commonwealth 7% and rest of world 26%. So, with the expected exception of those of Caribbean origin, all other immigrant groups are *more* likely to have births within the context of marriage.

There have been remarkable changes in the partnership contexts of births outside marriage. We can only infer this from registration information. Since 1986 it is possible to distinguish among out of wedlock births those registered jointly by parents living at the same address (assumed cohabiting) those registered jointly by parents living at a different address (assumed in a stable visiting union or 'living apart together' - LAT), and those registered solely by the mother (assumed to be 'solo' births). Under these definitions, in 1986 ten percent of all births were to cohabiting couples, four per cent to LATs and seven per cent to solo mothers; by 2006 28 per cent were to cohabiting couples, nine per cent to LATs and seven per cent to solos. This twenty year period has seen a doubling of the proportion of out of wedlock births, from 21 to 44 per cent; a near tripling of births to cohabitees, from ten to 28 per cent; a doubling of births to LATs, from four to nine percent; and a

relatively stable proportion of solo births at around seven per cent. This last figure shows that there has been a consistent level of acknowledgement of paternity, at around 93 per cent, over the past 20 years.

Again there are substantial geographic differences in the partnership contexts of births outside of marriage. In England and Wales 63.5 per cent of extramarital births are jointly registered with both partners at the same address (to 'cohabiting couples'). Just over 70 per cent are to cohabiting couples in the East, South East and South West regions; but in Inner London only 45.5 per cent of births outside marriage are to cohabitees and 55 per cent in Outer London; outside London the proportion is lowest, at around 60 per cent, for the North East, North West, and West Midlands. This contrasts with around two-thirds of extramarital births being jointly registered at the same address in Wales and Scotland, but only 37 per cent in Northern Ireland. At the more local level over three-quarters of all births outside marriage are to cohabitees in the East Riding of Yorkshire, Leicestershire, Devon, Richmond-on-Thames, Wokingham, and West Berkshire, and Powys in Wales. In contrast, fewer than half of such births are to cohabitees in Inner London as whole (lowest at around 40 per cent in Newham and Southwark); in Barking and Dagenham, Brent, Croydon, and Enfield in outer London; and in Birmingham, Manchester, Liverpool, Knowsley, and Middlesbrough.

Juxtaposing the estimates provided for proportions of women cohabiting (among those aged 18-49) with the proportions of births that are jointly registered at the same address (putatively cohabiting parents) raises intriguing questions: in 1991 nine per cent of women were cohabiting, but 17 percent of births were to cohabiting women; by 2001/2 15 per cent of women were cohabiting, but 25 per cent of births were jointly registered at the same address. Some of this discrepancy undoubtedly arises from the turnover in cohabitation, especially the tendency to marry following a birth: cohabitation is a prevalence measure whilst births are an incidence measure.

One other feature of recent fertility change is noteworthy. In 1995 total fertility was 1.72 and had fallen to 1.65 in 2000; by 2005 this had risen again to 1.80 for 2005 and the most recent figure for 2006 is at 1.87. As shown in the table below, there was a reduction of 44 thousand births from 1995 to 2000 followed by an increase of 66 thousand from 2000 to 2006. Over this entire period there has been a reduction in the number of births to UK-born women of 43 thousand births accompanied by a rise in births to foreign born women of 65 thousand. Some of this increase will have derived from foreign born women ageing into the reproductive years rather than new migrants, but this rise is substantial.

More recently there are indications of some quite dramatic shifts in sexual behaviour among young people, although studies of this are usually small-scale. Oral sex, both fellatio and cunnilingus, have become much more acceptable behaviours and are often precursors to or separate from penetrative vaginal heterosexual sex (see England et al 2008; Halpern-Fisher et al 2005; Prinstein et al 2003; and Stone et al 2006). Among US college students (England et al, 2008) there are emerging nomenclatures for the often casual sexual relationships: 'hooking up' covers one-off oral or vaginal sex and 'friends with benefits' refers to longer lasting friendships where sex occasionally occurs. In addition a much wider range of sexualities are becoming widely accepted in many of today's developed societies, including lesbian, gay, bisexual and transvestite cultures and groups (Aapola et al 2005 on changing identities for young women and Adkins 2002). The prevalence of newer sexual identities and the incidence of changed one-off sexual encounters and the interplays among oral and vaginal sex are still poorly documented for the UK.

Emerging issues: embryology, epigenetics and the new eugenics?

Procreation has become even more separable from sexual behaviour with the advances in assisted reproduction. Concerns about delayed reproduction, combining career development with eventual parenthood, and the increased ability to enable couples and individuals to overcome infertility problems have combined to alter attitudes to reproductive behaviour. Freezing of eggs, initially for cancer patients, but now extended more widely on grounds of equity, has permitted far more women to be moderately confident about their ability to have a child, even if they or their partners prove to have primary or secondary sterility by the time they wish to become parents. More generally the regular advances in wider assisted reproductive

	1995	2000	2005	2006	Change 1995-2000	Change 2000-2006
Total births (K)	648	604	646	670	-44	+66
Births to UK-born women (K)	566	511	512	523	-55	+12
Births to non-UK born women (K)	82	94	134	147	+12	+53
Percent to non-UK	12.6	15.5	20.8	21.9		

technologies (ART) both pose ever more testing ethical debates and enable more women or couples to enact their reproductive choice options despite difficulties in conceiving or often in bringing a conception to successful parturition, since there is considerable evidence that implantation problems and foetal wastage are among the key factors in inhibiting fertility with increasing age of the mother (e.g. Valeggia 2007).

I have for some time found it puzzling as to why reproductive function among women declines after age 30 at an ever increasing rate up to the menopause: there is considerable heterogeneity in the onset of infecundity, and much more than in the occurrence of menopause (e.g. Hobcraft 2003). There are quite strong grounds for believing that the menopause around age 50 has evolutionary origins: a recent synthesis suggests the necessity of both protection of mothers from rising maternal mortality risks and providing post-reproductive grandmothers who enhance inclusive fitness by caring and providing for their own and their daughters' children (Shanley et al 2007). But why is it so common for subfecundity or infecundity to occur during the thirties and early forties? Why did natural selection not eliminate such variability in a fitness characteristic? Research at the MRC Reproductive Biology Centre (http://www.hrsu.mrc.ac.uk/programmes/pg_2/programme2.php) has shown important linkages to the rates of proliferation of germ cells and oocyte losses for the neurotrophin NT4, Brain Derived Neurotrophin Factor (BDNF) and the neurotrophin receptor TrkB, and to activin. These may in turn link to allelic variation DNA markers for the relevant genes.

Equally, there is now evidence of huge variation among men in the numbers of Sertoli cells in the testis and consequent sperm counts, determined during foetal, perinatal and peripubertal life. The causes of these variations are not yet well known (Sharpe et al 2003), although maternal smoking during pregnancy plays a significant role (Jensen et al 2004, Storgaard et al 2003).

Modern minimally-invasive approaches that collect urine, saliva, or dried blood spots make it much easier to monitor reproductive performance, fecundability and foetal loss (Valeggia 2007) and to extract and genotype DNA and other biomarkers (McDade et al forthcoming, Lindau and McDade 2007). In combination these approaches should soon begin to give us insights into the interplays of genes with reproductive capacity; but more emphasis is required on whether and how these linkages change over the lifecourse. Some glimpses of the potential for such studies with animal and human populations are beginning to emerge (e.g. for congenital male infertility Rockett et al 2004).

However, there are likely to be important epigenetic mechanisms at work in altering reproductive function of males and females throughout foetal and lifecourse development – the possible linkages for maternal smoking as an environmental stimulus for changing relevant gene expression or linkages to viruses or other environmental insults remain to be explored. The reference to epigenetics in the title of this paper reflects the growing importance of understanding gene-environment interplays in reproductive biology and behaviours. Genetic research on fertility related behaviours is still in its infancy (or possibly gestation period). Useful reviews of some of the issues are given in several chapters of Wachter and Bulatao (2003) and in Hobcraft (2006). Both Rutter (2003) and Hobcraft (2003) illustrated their concerns about the interplays of genes with partnership and reproductive behaviours by linking these to likely 'risk taking' markers (possibly in the dopamine pathways), which could be associated with early sexual behaviour, partnership breakdown, non-normative childbearing contexts, and lower contraceptive use. Hobcraft (2006) elaborates the animal and human evidence for a possible association between bonding or attachment, partnership formation and breakdown and parent-child relations, and the genetic markers for oxytocin and vasopressin receptors in the brain (see also Young 2003). Exciting developments in these gene-environment interplays are to be expected in the next few years.

There is also a tendency towards a new eugenics in the shape of 'designer babies": selective abortion of female foetuses is common in China, India and Korea; selective abortion of foetuses with genetic markers known to be linked to serious disability or disease is also increasingly common. As our knowledge of linkages for genetic markers to a wide variety of factors improves there is considerable concern that eugenic selection will occur. It is perhaps beneficial that the search for genes related to intelligence has not found a limited number of key markers that are critical to intelligence; on the contrary it seems increasingly apparent the IQ or 'g' is linked to a large number of genetic markers, each with small effects. This makes it much more difficult to implement selective abortion of the less intelligent, which would most closely link designer babies to the early Galtonian concerns. More speculatively, the future may see possibilities for genetic manipulation, making possible an even wider range of concerns about the ethics and desirability of such designer babies.

Conclusion

Given the nature of this volume, marking the Centenary of the Galton Institute, we have ranged over experiences covering the last hundred years. Nearly all of the documentation and illustrations have covered experiences in the UK or often England and Wales. However, many of the issues raised in this paper are of equal salience for other developed countries: the availability of modern reliable contraception, access to safe abortion, increasing prevalence of childbearing outside marriage, access to ART and the consequent separation of recreational sex and procreation. One of the most important factors inhibiting such occurrence of the second demo-

graphic transition is the role of religion (and concomitant cultural and institutional constraints), although the rapid transition to non-marital childbearing in Ireland indicates that such behaviours and constraints can change surprisingly quickly.

The widespread nature of the second demographic transition makes it difficult to build theories which are too narrowly based on context. Thus, for example, it would be tempting to try to explain the rise in cohabitation in the UK by some of the short-term tax structure changes that enabled couples who were cohabiting to obtain dual mortgage tax-relief (which married couples did not get) for a short period. Such context-specific factors may of course play an important part in variations in timing or prevalence of new behaviours, but cannot be adequate as fuller explanations. However, there are some huge variations in the timing and possibly long-term levels of the separation of sex from procreation or the shifts in partnership behaviour and partnership contexts for childbearing and childrearing (for a broad account and interpretation see Hobcraft and Kiernan 1995).

We have not dwelt upon some other key underlying factors as fully as would be ideal. For example, the role of the feminist movement throughout the century considered here needs emphasis, from early birth control movements to changing attitudes to female sexuality, reproductive choice and the gender inequities all too often institutionalised in marriage. The linked tensions between ever increasing female employment and the traditional domestic division of labour may have played a part in increasing partnership breakdown, most commonly initiated by the female partner.

Neither has the influence of the HIV/AIDS epidemic been considered in the accounts presented here. One possible consequence has been a shift towards condom use, rather than more reliable contraceptive methods. However, all of the circumstantial evidence concerning young people's sexual behaviour does not suggest this as having inhibited recreational sex; possibly the modest rise in numbers of induced abortions (and the less well documented use of emergency contraception, such as mifeprostone) has offset the increased risk of conception.

It is not difficult to understand the way in which modern fertility control, enabling recreational sex without procreation, played a part in the widespread adoption of cohabitation and greater sexual freedom for casual and longer-term non-cohabitational sexual partnerships. But the shift in the normative context for childbearing does not flow so inevitably from the ability to separate recreational sex and reproduction. Perhaps the growth in acceptability of cohabitation and other weaker forms of sexual partnership did in itself contribute to changing the normative context for childbearing.

It is to be hoped that major gains in understanding partnership and reproductive behaviour at the population level will accrue from the launch of two major prospective studies, the UK Household Longitudinal Study and a new Birth Cohort Study, both with larger samples than hitherto and both likely to bridge behavioural and biological domains. The potential for informing work on genetics and epigenetics of these emerging studies in combination with existing birth cohort and household panel studies is enormous, with long runs of 'environmental' information which can be combined with genetic and other biomarker information to enrich our understanding of human sexual and reproductive behaviours.

The societal challenges posed by current childbearing and childrearing behaviours and the varied and fragile partnership contexts for this are considerable, but we have deliberately eschewed taking a modern eugenicist perspective and prefer a perspective that sees enabling choice and development within such contexts as deserving emphasis. Moreover, this paper has been aimed at the traditions of science and understanding encapsulated in the shifts of name from the avowedly political Eugenics Education Society, through the more neutral Eugenics Society to the modern Galton Institute.

Scientific concerns about reproduction have, in some real sense, moved from eugenics a hundred years ago to an increasing emphasis on genetics and epigenetics, along with embryology, today. However, there are some suggestions that eugenic selective abortion may be emerging to bring us full circle.

John Hobcraft is Professor of Social Policy and Demography at York and Co-Director of the Centre for Research on Child Development and Well-being.

References for this piece can be obtained on request from the General Secretary.

EDITOR'S NOTE:

I am the new editor of the Newsletter. The main thing that potential contributors need to know is that I have a horror of verbosity. Before I retired from my career post, I spent much time pruning the contributions of my junior colleagues into something manageable in terms of signal/noise ratio – occasionally, there was nothing left at all! Relevance of contributions to the interests of the Institute is, of course, paramount.

Robert Cohen

GALTON INSTITUTE WEBSITE

We are in the process of updating and re-designing our website and the webmaster would like to hear from any of our members with web skills who would be willing to assist her with this.

Her email address is:-

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