Ergot usage and contamination of foodstuffs in the seventeenth and eighteenth centuries and its possible implication in the population changes in England

Jeanette Swaffield

PhD

University of Edinburgh

2009

Source: Adam Neale (1828), opposite title page

Declaration

I declare that this thesis has been composed by myself and is my own work.

This thesis has not been submitted for any other degree or professional qualification.

Abstract

The English population question in the long eighteenth century is explored and investigated further by using the results from the demography available from the 30 year study by the Cambridge Group for the History of Population and Social Structure, together with an understanding of the impact of ergot contamination of diet on female fertility.

The hypothesis presented is that the staple rye diet at the end of the seventeenth century was contaminated with ergot which acted as a contraceptive and abortive agent and in addition could have had an influence on both the survival of women and children if given accidentally or deliberately during labour. Within this thesis it is argued that when the ingestion of ergot on rye was reduced within the diet from around the third decade of eighteenth century onwards this would have removed or released these fertility constraints and therefore it would have allowed women to become more fertile, while improved midwifery practice curtailed the negative effects of ergot ingestion during childbirth. These findings and their timing closely parallel the demographic changes reported by the Cambridge Research Group. Sufficient accumulated circumstantial evidence was found to support the hypothesis to suggest that ergot could have been a factor in both the fertility changes during the long eighteenth century and the perinatal mortality rate. The conclusions of this thesis need to be taken forward in additional local parish research by others to further substantiate these findings.

Ergot usage and contamination of foodstuffs in the seventeenth and eighteenth century and its possible implication in the population changes in England

Contents

List of Figures

List of Tables

Abbreviations

GIP	Generalized inverse projections
GRR	Gross reproductive rate
FAS	Foetal alcohol syndrome
IGR	Intrinsic growth rate
MFR	Marital fertility rate
TMFR	Total marital fertility rate
w-y l	Woman-years lived

Glossary

Endogenous infant mortality – infant deaths due to pre-maturity, birth trauma or inherited genetic defects

Ergonovine maleate (USA) is ergometrine in UK

Exogenous infant mortality – infant deaths caused by the invasion of the body by external agents e.g. infections

Fecundity - capacity of individual or couple to reproduce

Fertility - the scale of reproduction which actually takes place

Perinatal mortality – late foetal and early postnatal mortality

Infant mortality – the number of children per 1,000 live births in a specific area who die during the first year of life

Intrinsic growth rate – Growth rate without migration figures

Maternal mortality - the death of a woman while pregnant or within 42 days of termination of pregnancy irrespective of duration and site of pregnancy

Menarche – the first menstrual period

Menopause – the permanent cessation of menstruation

Nuptiality - state of marriage

Polynomial trend line – Excel 'best fit' line to data expressed as an equation of the form $y = a_1 + a_2x + a_3x^2 + a_4x^3 + ...a_nx^{n-1}$

Stillbirth rate - number of stillbirths per 1,000 live births and stillbirths

Acknowledgements

My sincere thanks are due to Professor Michael Anderson, my supervisor, for sharing a wealth of lifetime academic experience with me, challenging my arguments to ensure that I produced my best work and also supporting me past his retirement to the completion of this thesis.

My thanks are also due to Dr Malcolm Nicolson at the University of Glasgow and the Wellcome Institute who provided a small travel grant in 1994 so I could discuss my ideas with specialist academics and professionals.

Professor John Burnett, now deceased, would have been thrilled to see the completion of this thesis as he initially inspired me to carry out the research.
I have particularly enjoyed using the library and special collections provided by both the University of Edinburgh and the National Library of Scotland and I would like to thank the staff at both these institutions for all their help, support and guidance.

My special thanks go to my husband John for all his support, especially for his practical help in taking the dog for a walk each morning so I could be at my computer by 8 a.m. each day.

Preface

In October 1977, at the start of a four year degree in Government, Politics and Modern History at Brunel University, I attended, as a mature student, Professor John Burnett's lecture on '*Questions in history*'. During his presentation he spoke about the population question in England, raising the issues of when exactly the population suddenly increased and why.

As my background was in nursing I was aware of the history of pharmacology and the use of natural drugs as medication. It occurred to me immediately that if, as he suggested, one of the reasons for the increase in population was diet change, in particular towards a wheat diet, there could be a link with the reduced intake of ergot, a fungus growing on rye which caused abortions, and the introduction of other foods which improved the diet of the people. I knew ergot grew mostly on rye but did not know if this was the staple diet, but vaguely knew that potatoes were introduced at some stage and would have improved the vitamin contents of diets.

When I discussed this with Professor Burnett at the end of the class he was very excited by the idea and encouraged me to read Ashley's book *The bread of our forefathers* (1928) on the diet of the English throughout history and Eden's work on the *State of the poor* (1794) to see if these would inform me further. These documents set off an enthusiastic interest in ergot which should have been completed in the early 1980s but has taken me until retirement to fully investigate, although all through the period from 1977 until now I have collected and documented material in readiness for an in depth study.

I applied, with the support of Professor Burnett, for an ESRC scholarship in 1980 which I obtained in 1981. Initially, as I had been told I was not successful, I obtained alternative employment. I was not told that I was fourth in line for three awards, and when one of the three failed to take up a scholarship I was offered it. As I had taken up a very high profile and public employment I did not feel I could just terminate my new post and very reluctantly turned down the award. An attempt to undertake a

PhD on the subject was also thwarted in the 1990s while a senior lecturer at the University of Glasgow, as this could not be pursued on moving to a post at the Scottish Executive.

The resulting failure to investigate the subject in the 1980s has been advantageous but has also had its disappointments. On the one hand undertaking research in the twenty-first century has given me a wealth of information and sources which would not have been available thirty years ago and the technology to produce so much more using computers and search facilities and the magnificent special collections libraries in Edinburgh. Also so much has been researched and published on the long eighteenth century in England that offers a useful background context to this thesis. On the other hand, it subsequently offered another researcher an opportunity to take a broad look at the topic. Matossian's work on mycotoxins and her publications on witchcraft, led her to develop an interest in the role of poisons in the history of the diet of populations, mostly across Russia and Europe.

Matossian (1985 and 1989) attempted to address the population question in England, but she headlined ideas rather than fully exploring the evidence and any relevant research. The consequential lack of referenced statements was highlighted by a number of reviewers of her publications who were critical of her approach to historical research (Hardy, 1988, 1991 and Wilkinson, 1990). Hardy (1991, p. 510) stated that, superficially Matossian's arguments seemed not implausible, but she considered her work insubstantial and deeply unscholarly. Hardy argued that Matossian did not define her claim that ergot acted as a fertility suppressant and that she variously implied that it was due to infant mortality, miscarriage, or temporary female infertility.

Therefore, one of the important areas to explore in further research is an explanation of how exactly ergot could have acted on women's fertility during the long eighteenth century, by retrospectively applying modern knowledge of its action to this period.

Having retired, I decided that I now had the time and enthusiasm to complete my own research to evaluate the role of ergot in the diet of the poor in England and to determine, through an in depth academic PhD, whether ergot on rye was a factor in English agriculture and in turn could have affected fertility in England in the long eighteenth century. In particular I wanted to understand exactly how the action of ergot affected fertility and under what circumstances. I felt that modern knowledge and understanding of the fungus could help me understand its possible impact in the context of contemporary agriculture, food and drinks preparation practices.

Through my interest in the consequences for fertility of both low level and concentrated ergot ingestion, as presented in this thesis, and drawing upon both my extensive original research, aided by the facilities now available, and the linkages I have established to historical social customs, modern pharmacological studies and production standards in growing and processing food from rye, I believe that I have made an original contribution to the body of knowledge in this area. In particular I was able to demonstrate specifically how ergot could have potentially affected women's fertility throughout their reproductive life, as well as finding other valuable insights to its contemporary use in pregnancy and labour.

I therefore recognize that while my PhD in 1980 would have included some of the basic background information later published by Matossian, I believe that the research I completed from 2004-2009 contains so much more original information and includes knowledge that would have been unattainable or unavailable in the 1980s and will therefore be much more valuable to historians. My original hypothesis has therefore developed and benefited from its thirty-one year gestation - this thesis is the result of that undertaking.

Chapter 1

The English population question and the points arising from the Cambridge Group's research findings

The English population question in the seventeenth and eighteenth centuries continues to be an area which warrants further investigation, interpretation and discussion. Demographic studies of the population of England, both in terms of description and analysis, have conventionally been divided under three headings: fertility, mortality and nuptiality, with a fourth heading of migration sometimes added.

Until 40 years ago almost all historians of population thought that population growth in early modern England was low because of high mortality coupled with periodic crisis and that the recorded rise was due to a longer expectation of life and decrease in mortality. Flinn (1970) and McKeown (1976), for example, were strong supporters of this view while John Habakkuk (1971) heralded the view that there was a sharp increase in marriages with a significant increase in fertility.

The publication of the 30 year work of the Cambridge Group for the History of the Population and Social Structure (Wrigley and Schofield, 1981 and Wrigley, Davies, Oeppen et al., 1997, from now on to be referred to as the Cambridge Group) has now offered a rise of fertility in England in the '*long eighteenth century*'[1] as the principal reason for the population increase, and not mortality.

These findings have been generally accepted by most academics in the field, although there have been a few vociferous critiques from some, such as Razzell (1998, p.469-500 and 2007), who has a deep '*scepticism about mathematical models in historical research, and a belief that theoretical thinking is most fruitfully developed through detailed empirical research based on local sources* (p. xvii)' while others, such as Outhwaite (1991, p. 26), have suggested that they are to be used

[1] The long eighteenth century is argued to extend from 1688-1832, from the 'Glorious Revolution' to the legislative reforms starting with the Reform Act of 1832 (O'Gorman, 1997, p. xi).

with caution as students *'can derive conflicting and misleading conclusions, and it has consequently to be mined with care.'*

The Cambridge Group used family reconstitution plus aggregative data from generalized inverse projections (GIP) (superseding the use of back projection) to calculate their results.[2] For the GIP, records of baptisms, marriages and burials from monthly totals of events taken from the registers of up to 404 parishes were used to reconstruct the data. These records began to be kept from 1538, with the establishment of the Church of England, and were superseded in 1837 when the state assumed responsibility for vital registration. The family reconstitutions were finally based on 26 parishes. In both methods the geographical spread of parishes did not wholly match that of England as a whole.

While the major issue arising from the Cambridge Study was that fertility rather than mortality appeared to be the main reason for the rise in the population from around the middle of the eighteenth century, they also concluded that there was little variation in the results from parishes across England (1997, pp. 41 and 554).

However, eight parishes had been rejected: five due to under-registration or late starting or early finishing registration problems, and in three others this was due to the level of childlessness among married women being suspiciously high[3], even though the Cambridge Group considered that this could mean that genuine *'outliers'* would be excluded pp. 29-30). Also, Smith (1999, p.19), one of the members of the Cambridge Group, later suggested that in neither of the approaches was it possible to deal effectively with regional patterns, even though the research helped to inform demographic trends and patterns in certain types of communities and further suggested that this handicap must always be kept in mind.

---

[2] Wrigley et al. (1997), explained that the reason for the change from back projection to GIP was because it is a *'more refined and flexible method, which employs statistical techniques whose properties are better understood* (p. 515)'.

[3] This included the Parish of Hawkshead, see Chapter 10 below.

The Cambridge Group results and interpretation

Smith (1999) has nicely summarized the results from the above reconstructions: after a period of stagnation in the second half of the seventeenth century and first half of the eighteenth century, the population began to grow rapidly. From 1541 to 1871, the pattern of English fertility was high up to the mid-sixteenth century with a gross reproductive rate (GRR) of about 2.8, followed by a fall to 2.4 and thereafter the GRR tended to fall further, but only slowly and slightly, until it sagged to a nadir of about 1.8 to 1.9 in the last third of the seventeenth century. There was then an irregular and slight recovery, until the mid-eighteenth century. After 1756, the rise of fertility accelerated noticeably, with GRR reaching a peak value of 3.1 in 1816. In Figure 1.1 the data are presented in 50 year mid-point estimates (Wrigley et al., 1997, p.538). The full data used are presented together in Table 1.1a and 1.1b at the end of this chapter. To enhance the figures, the data from Smith (1999, p.20) have been redrawn and superimposed upon the Wrigley GRR data to show 5 year changes. While there appears to be an anomaly between the two sets of data between 1800 and 1850, the rise in fertility from the middle of the eighteenth century is clearly shown.

The mortality series, as represented by expectation of life at birth, (Figure 1.2) also suggested a cycle, which, while less regular than that displayed by GRR, revealed a lengthy deterioration through the seventeenth century followed by a recovery to late sixteenth century levels by the end of the eighteenth century (Table 1.1a Section B and Figure 1.2), with a noticeable rise in the middle of the eighteenth century.

Wrigley et al. (1997, p. 197) and Wrigley (1998, p. 460) stated that the most striking feature of the population of England in the long eighteenth century lay in the fact that, during the seventeenth century, the intrinsic growth rate[4] (IGR) was very close to zero, whereas by the early decades of the nineteenth century it had reached the highest level up to then in national history, at about 1.75 per cent per annum, (Wrigley, 1998, stated 1.71). The reconstruction suggested that the total population

[4] Intrinsic growth rate – Growth rate without migration figures

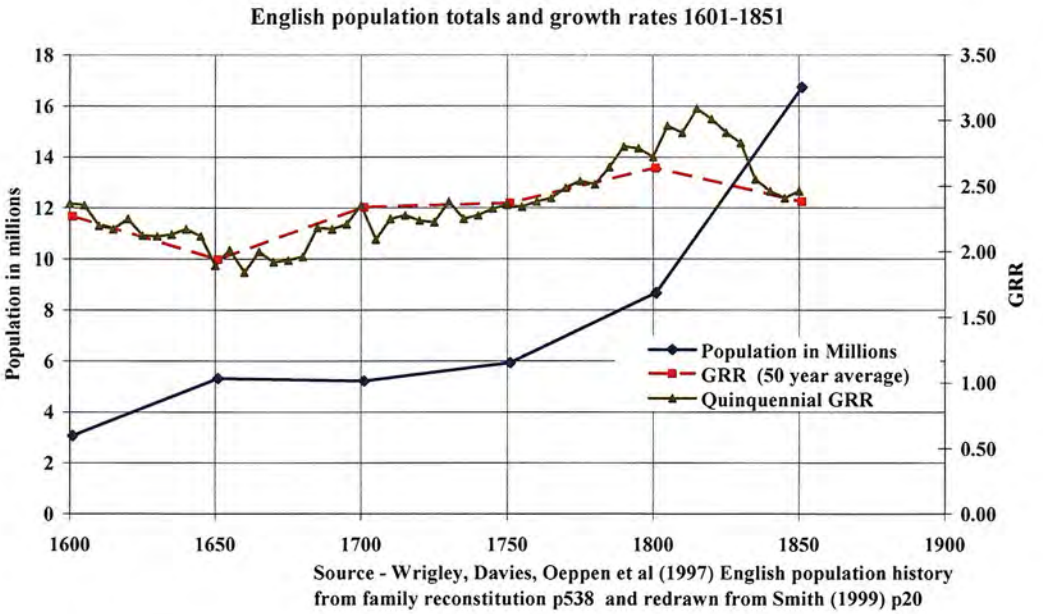


Figure 1.1 Graphical representation of the English population total and growth rate 1651 to 1851 (Table 1a Column A)

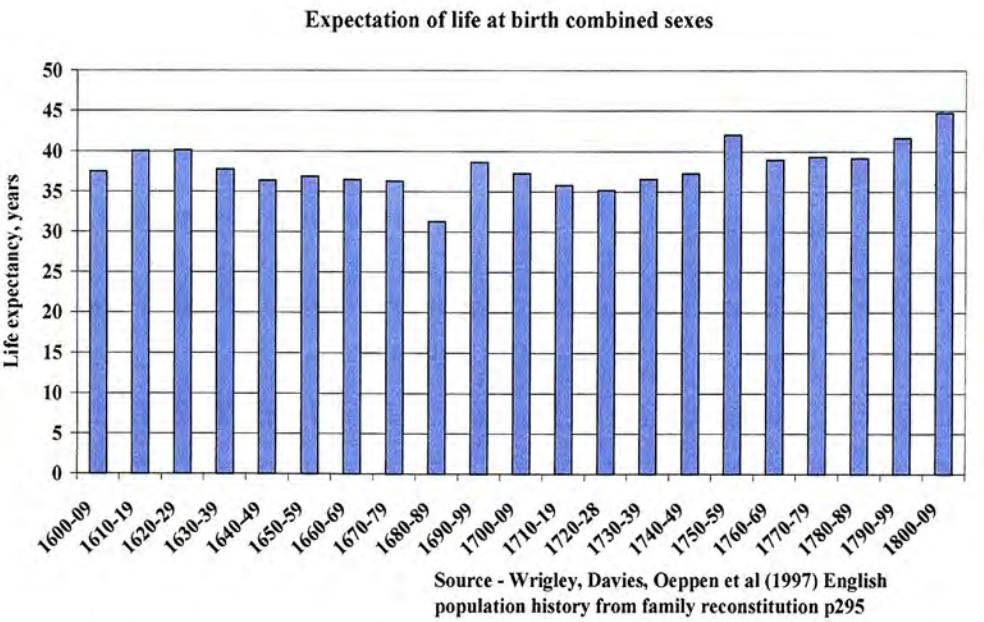


Figure 1.2 Expectation of life at birth, combined sexes, 10 year average values (Table 1a Column B)

(Figure 1.1) grew from a low point of about 5 million in 1686 to about 11 million in 1821, an increase of about 130% (p.461). Expectation of life at birth rose from the third decade of the eighteenth century (Figure 1.2).

While the two methods (GIP and family reconstitution) yielded the same *'big picture'*, Wrigley (1998) stated that the two methods together brought to light many previously unknown or obscure features of English population history, some of which are simultaneously illuminating and puzzling.

Those aspects which could be seen as illuminating referred to aspects of fertility and to the sudden rise in the population related to a decrease in the age at marriage (Figure 1.3), an increase in the percentage of women marrying (Figure 1.4) and greater fertility throughout marriage (Figure 1.5), especially in women towards the end of their fertility span. A decrease in legitimate infant mortality (Figure 1.6), especially endogenous[5] rather than exogenous[6] infant mortality, a decrease in the death of women during childbirth (Figure 1.7), a slight decrease in the spacing between babies by 3 months for all ages of married woman (Figure 1.8), and an increase in prenuptial conception and births outside of marriage were also significant. These issues are to be examined further below.

Marital changes and resulting births

The change in the age at marriage, between the late seventeenth century and the early nineteenth century, (Figure 1.3, Table1.1b Section G) is estimated to have increased the intrinsic growth rates from zero to about 1.26 per cent per annum. In times of dearth, when it was expensive to set up a new home, it appeared that late marriage occurred and the numbers of women never marrying also rose (Smith, 1999 and Wrigley et al., 1997). Hinde (2003, p. 188) argued that the percentage never marrying was as high as 20.6 per cent in 1700-09, while in the period 1770-79 it was

[5] Endogenous mortality- infant deaths due to maternity, birth trauma or inherited genetic defects
[6] Exogenous mortality-caused by the invasion of the body by external agents e.g. infections

as low as 4.3 per cent, using data from Wrigley and Schofield (1981) and Wrigley et al. (1997).

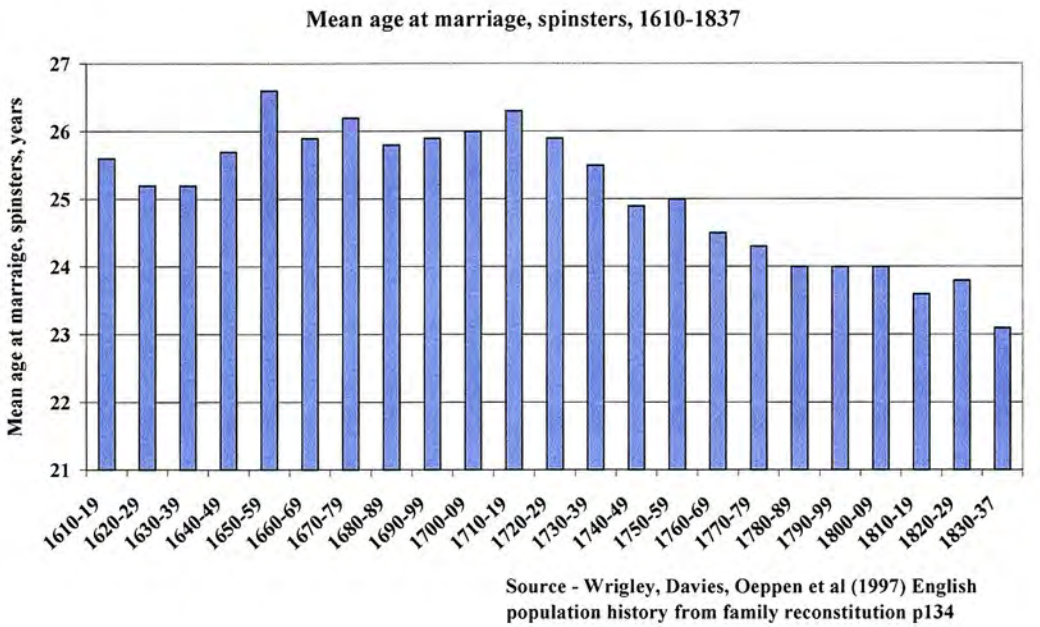


Figure 1.3 Mean age at marriage of spinsters 1610 to 1837 (Table 1b Column G)

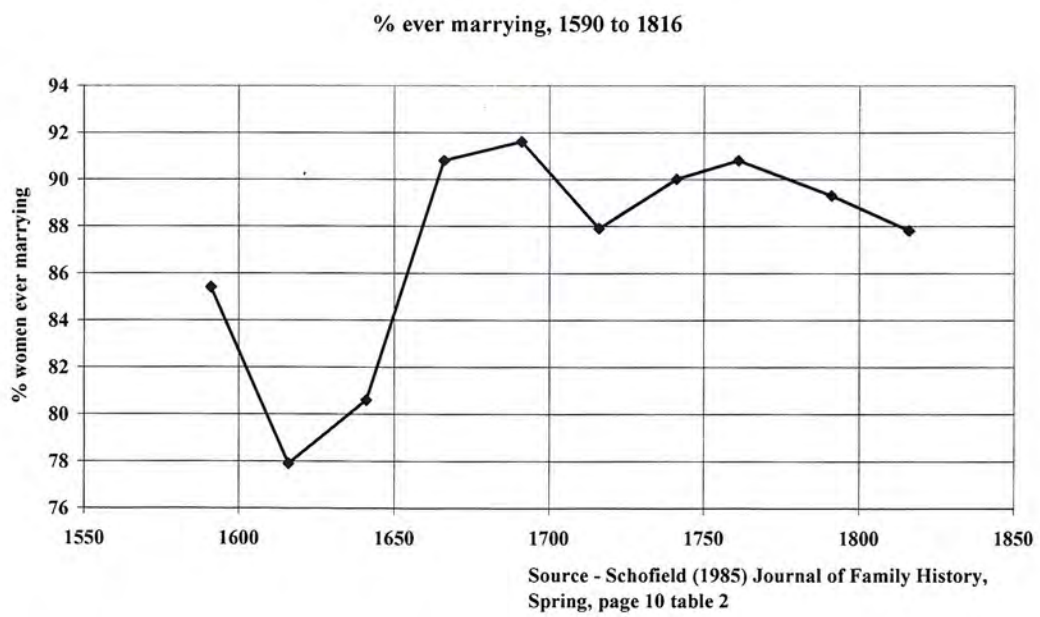


Figure 1.4 Percentage women ever marrying 1590 to 1816 (Table 1b Column H)

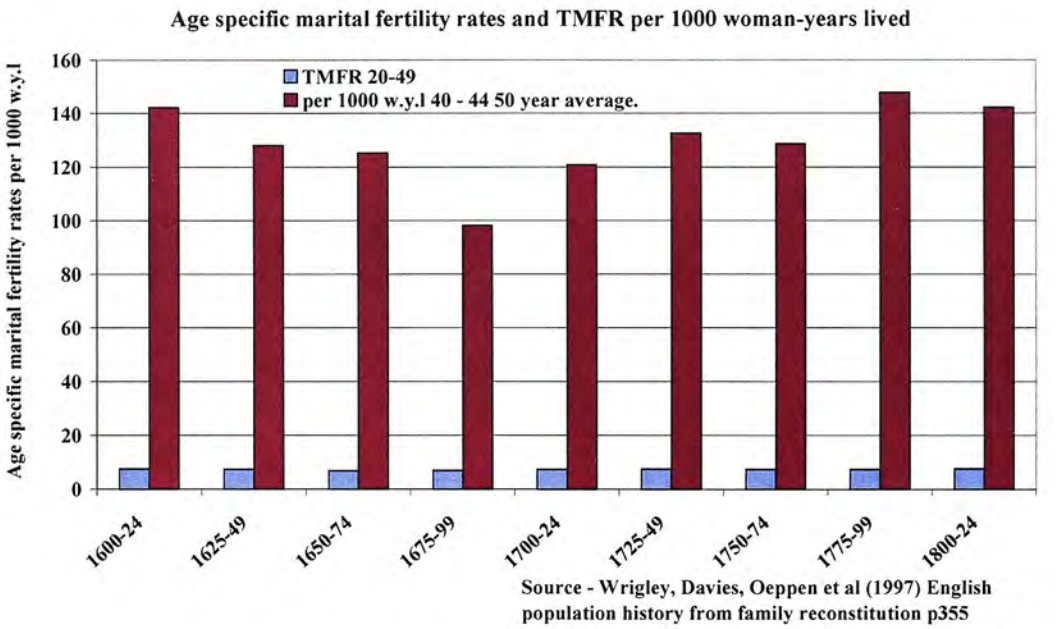


Figure 1.5 Age specific marital fertility rates and TMFR per 1000 woman-years lived (Table 1.1b Column E)

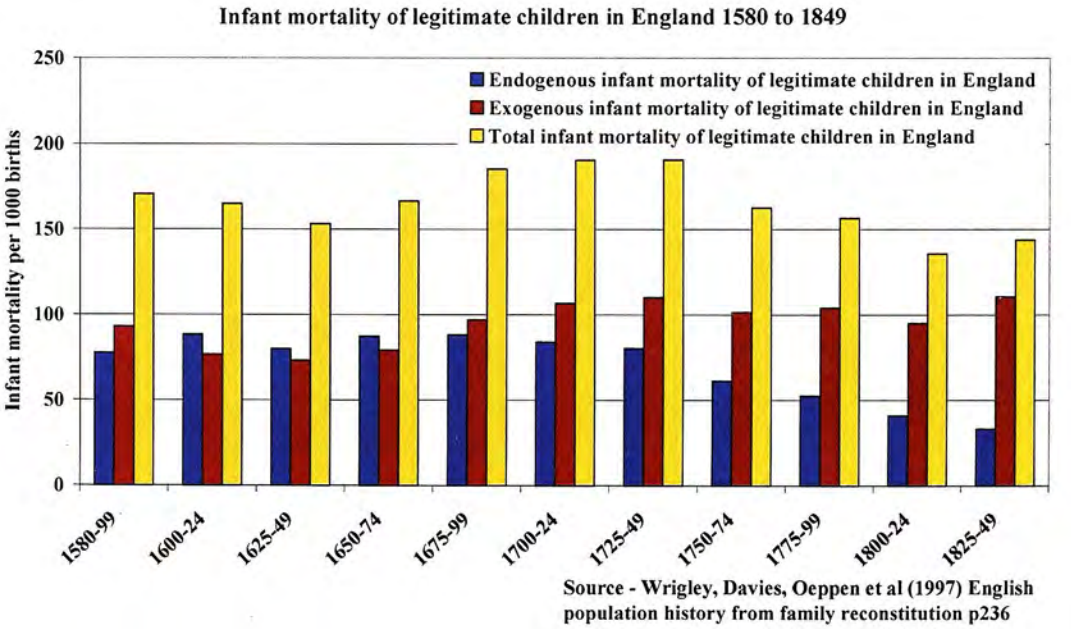


Figure 1.6 Infant mortality of legitimate children in England from 1580 to 1849 (Table 1a Column D)

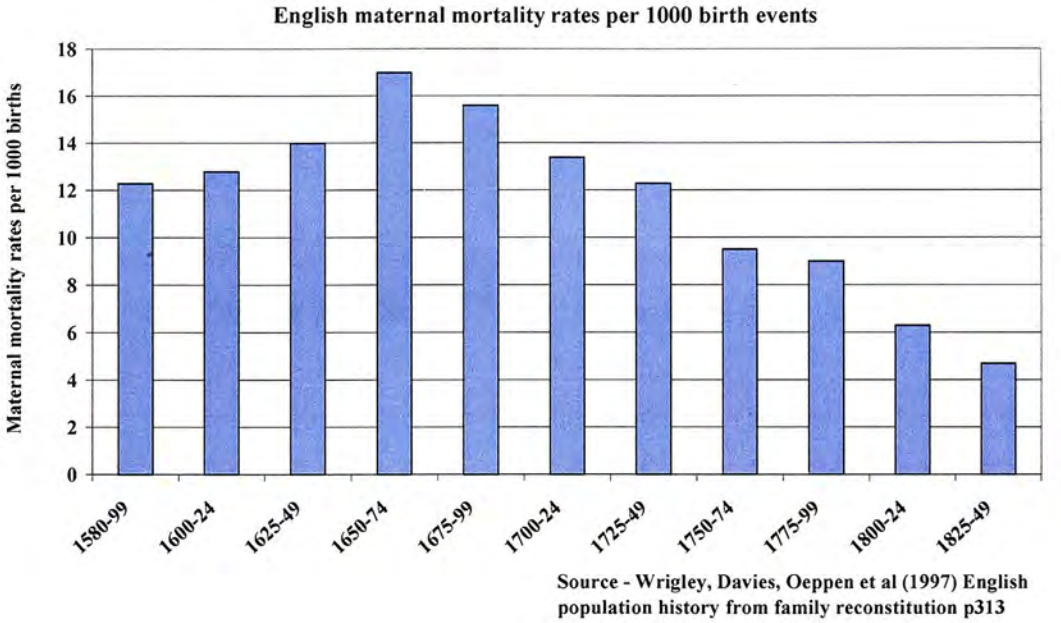


Figure 1.7 English maternal mortality rates per 1000 birth events from 1580 to 1850 (Table 1a Column C)

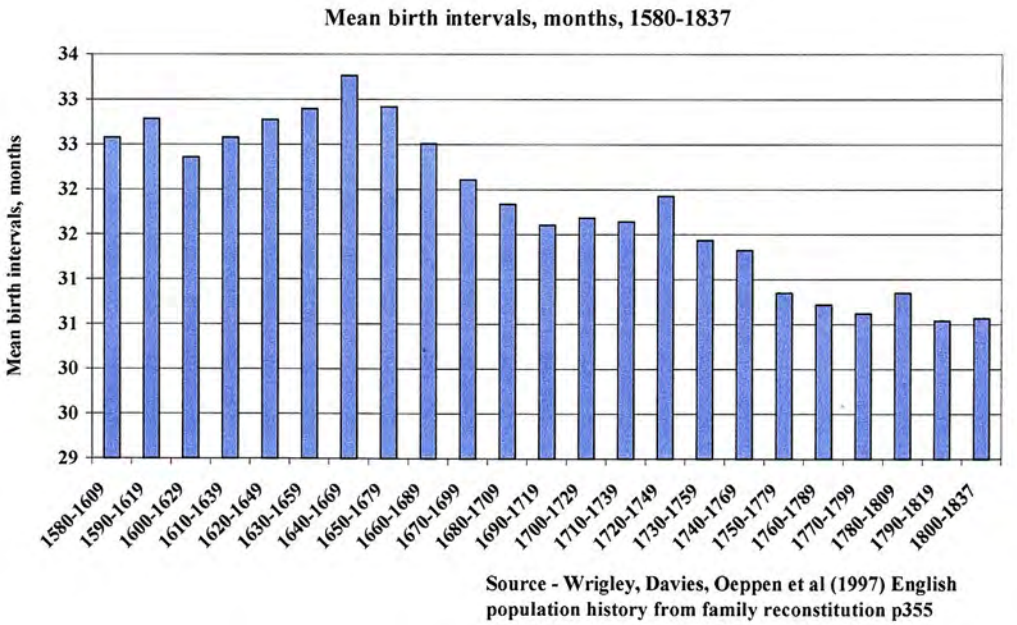


Figure 1.8 Mean birth intervals measured in months from 1580 to 1837 (Table 1b Column F)

The figures used in Figure 1.3, Table 1.1b Section H arise from the Weir (1984) and Schofield (1985) debate between 1984/5.

Mean birth interval

Another variable which affected fertility was the mean birth intervals which Wrigley (1998) set out for 30 year periods (See Table 1.1b section F and Figure 1.8).

Working in 30 year periods from 1640-69, when birth intervals were at their longest, and the period 1790-1819, when they were at their shortest, the mean interval fell by more than 8% from 33.3 to 30.5 months. The more 'volatile' decennial series fell from a maximum of 33.6 months in 1660-9 to 29.9 months in 1810-9, or by about 11%. Where an infant death occurred, birth intervals tended to be about 8 months shorter on average than when an earlier child survived the first year, because breastfeeding was reduced.

In early modern England the mean birth intervals were long - up to 33.3 months. Some historians were convinced this was due to extended lengths of breastfeeding, leading to lactational amenorrhoea. Knodel (1988) thought this was particularly so in parts of Germany in the same period.

Wrigley assessed the evidence of the impact of the average length of breastfeeding on the birth intervals, but dismissed a possible change in breastfeeding practice as an explanation for any change in birth intervals. He concluded that *'it appears probable, however, that it is unnecessary to involve breastfeeding practice to account for the change'* (1998, p.438). However, Wrigley et al. in the Cambridge Study (1997, p.207), recognized that breastfeeding did have a protective effect on babies. They stated that where breastfeeding was universal and prolonged, infant mortality was normally quite low; where it was brief, and especially where children were weaned at birth, it was much higher.

Maternal and infant mortality

Wrigley (1998) further suggested that earlier marriages and a decrease in mean birth intervals, combined with the increase in the growth rate attributable to the fall in the perinatal mortality rate of 0.38 per cent per annum, broadly match the increase in the intrinsic growth rate of about 1.71 per cent per annum (p.462). He suggests that the combined contribution of the fall in late foetal and early postnatal mortality (perinatal mortality rate) to the overall acceleration in the intrinsic growth rate, which took place between c.1680 and c.1820, was substantial.

Table 1.1a section C and D and Figure 1.9, show that there was a trend towards a decrease in endogenous infant mortality, which was mirrored by a decreasing trend in maternal deaths (Figure 1.7), against a rise in each age-specific rate of maternal fertility, especially in later life (Table.1b section E and Figure 1.5).

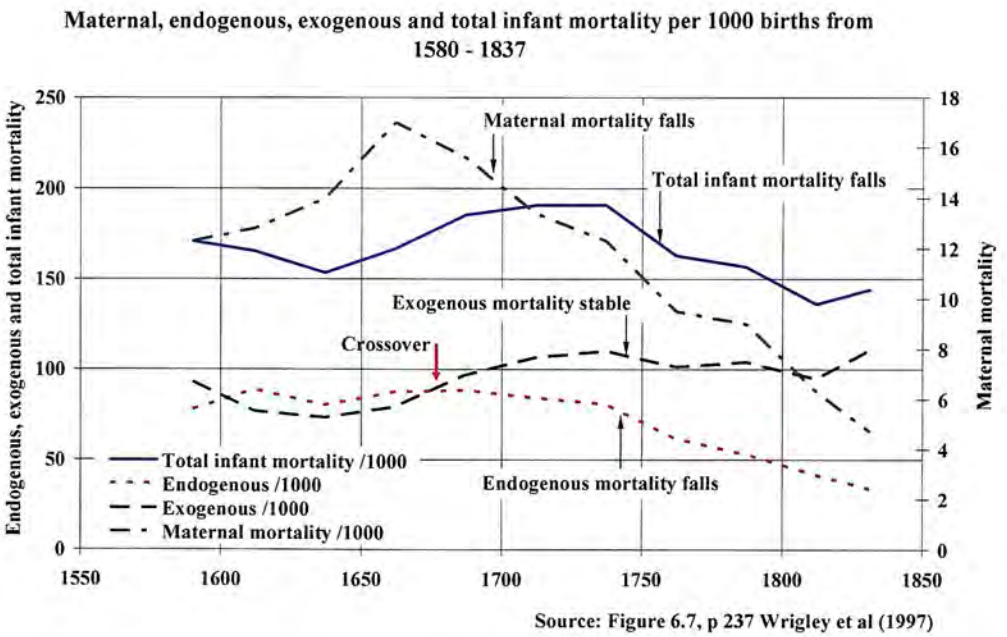


Figure 1.9 Maternal mortality together with endogenous, exogenous and total infant mortality per 1000 births from 1580 – 1837 (Table 1a Columns B and C)

While the drop in total infant mortality in itself is significant at a third, from approximately 1740-1800, the detailed make-up of these figures from 1680 onwards indicates a growing separation between exogenous and endogenous rates. The first month infant mortality (endogenous rate) (Figure1.9) fell by fifty per cent between 1680 and 1820.

Overall infant mortality (Figure 1.9) rose from 153 per 1000 in 1640 to a peak of 191 per 1000 in the 1740s. Exogenous mortality rose by 51% from 73 to 110 per 1000 in the same period, while the endogenous rate was almost stable for this period, at approximately 80 per 1000. When the major fall in the overall rate took place around 1750, the fall was concentrated exclusively in the endogenous rate, which tumbled from 81 per 1000 in 1725-49 to only 33 per 1000 in 1825-37. Over the same period as endogenous infant mortality was falling, maternal mortality was also falling and in much the same proportion (Figure 1.9).

Effect of the changing rates of stillbirths

However, having considered all the potential marital fertility variables and resulting births, Wrigley's view was that the changing incidence of stillbirths between the late seventeenth century and early nineteenth century offered the most satisfactory explanation for an increase in fertility rates. In his 1998 paper, Wrigley suggested that stillbirths, which were rarely recorded in English parish registers, and which he deduced by back projection from a much later English Census, followed the same trends as corresponding Scandinavian rates for the time period that also mirrored the decrease in infant mortality and accounted for a rise in fertility. Wrigley (1998, p. 461) considered two sets of likely figures, the first where the stillbirths fell from 100 per 1000 to 40 per 1000 and the second where the stillbirths fell to 40 per 1000 from a higher figure of 125 stillbirths per 1000. These two assumptions would yield increases in live births of 6.7% and 9.7% respectively, i.e.

$$100\text{x}\left[\frac{960-900}{900}\right]=6.7\,\%\ \text{or}\ 100\text{x}\left[\frac{960-875}{875}\right]=9.7\,\%$$

Wrigley takes an average of these figures (p. 453) as 8.2%.

In Wrigley's view, therefore, most of the rise in fertility may have been due not to a smaller average interval between successive conceptions, but to a reduction in the rate at which foetuses were lost during the third trimester of pregnancy.

However, the only parish record found so far for England that recorded stillbirths, the parish of Hawkshead, showed much higher figures at this period (Wrigley, 1998, p. 242). The registration documents for this parish will be discussed further in Chapter 10.

On the assumption that the change in the incidence of stillbirths caused the live births to increase by 8.2 per cent and that endogenous infant mortality fell by 5 percentage points (i.e. 50 fewer deaths per 1000 from the early eighteenth to the early nineteenth century), and assuming a crude birth rate of 30 per 1000 population, the intrinsic growth rate would have increased from zero to approximately 0.38 % per annum thus accounting for just one fifth of the acceleration (Table 1.1a Section D).

The resulting fall in stillbirth could have yielded more live births and if there was a further fall in endogenous mortality the overall figure for survival would rise further. Available figures from Wrigley of 8.2% (stillbirth fall) and 5% (fall in endogenous mortality) respectively leads to his suggestion that the intrinsic growth rate would have increased by 0.38% (p.461). This is close to a calculation based on a reduction of 5% on an increased live birth figure of 108.2 – i.e. $\left[\frac{5}{100}\right] x \left[\frac{108.2-100}{100}\right] = 0.4\%$.

Fertility

Why did this increase in fertility occur? If increased fertility was partly explained by the marked reduction in the stillbirth rate, Wrigley (1998) deduced that the rise in 'maternal net nutrition' was likely to be the reason and was highly likely to be reflected as a general improvement in health for all the population. Economic change could explain this increase in the rate of growth of the population. This view seems

very plausible and could be substantiated with further output indicators such as a rise in the height of people in England during this period and a rise in the life expectancy, as well as a corresponding rise in the health of the general population. Smith (1999) offered some reasons for this which he linked to relative prices, forms of agrarian labour and female marriage patterns in England up to 1800. He pointed out that, unusually, the suggested improvement in nutrition would have started in a period when there was pressure from an increasing population, but when food prices ceased to rise. Its effect was best demonstrated by both the significant improvements in height as an 'output' and significant inequalities within the working class height differential that narrowed during the late eighteenth century and early nineteenth century and then remained roughly constant (Floud, Wachter et al.,1990). The results are shown in Figure 1.10 and Table 1.1b Section J.

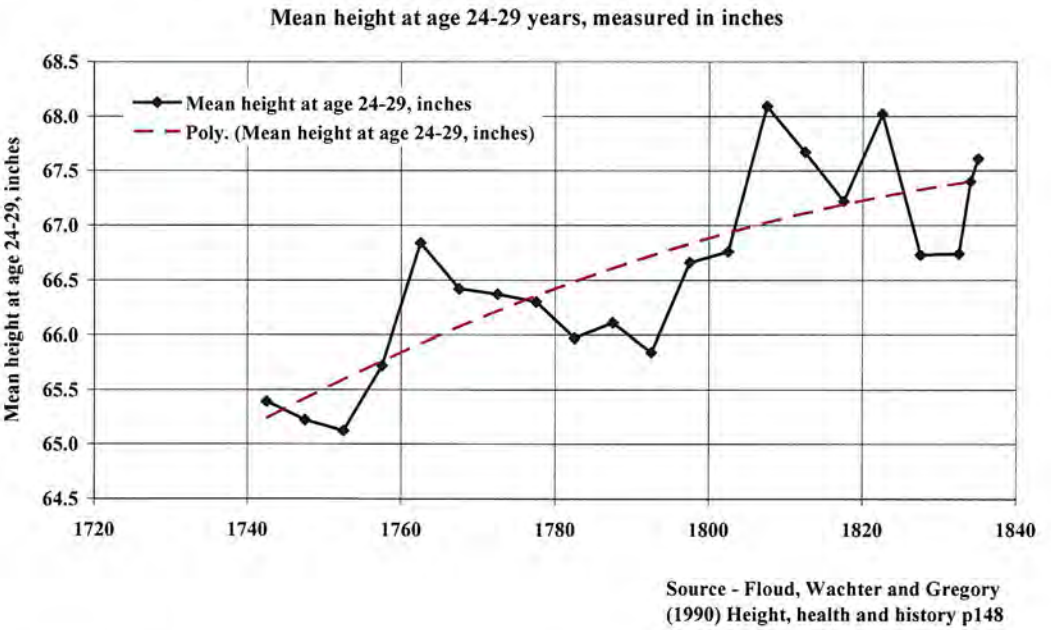


Figure 1.10 Mean height at ages 24 to 29, measured in inches; data are means over 5 year intervals (Table 1b Section J)

Their conclusion suggested that there were significant improvements in nutritional status over the whole of the century between 1750 and 1850.

Wrigley felt that this aspect of improvements in height fitted his hypothesis well while he suggested that stillbirth rates should really be counted as a mortality change

rather than a fertility change (p. 460). He reasoned that the rise in marital fertility was only defined as such because parturition is taken as the beginning of life. If fertility was measured from the end of the twenty eighth week, Wrigley went on to argue, the change in fertility would have been treated as a mortality change.

Wrigley (1998), however, drew attention to a problem with his hypothesis as shown in Figure 1.11. The mean birth interval began to fall, and therefore fertility began to rise, from about the end of the third quarter of the seventeenth century, and although the fall may have continued to the end of the parish register period, it became subdued after the 1780s (Table1.1b Section F and Figure 1.8). Endogenous infant mortality, however, though probably peaking in the final quarter of the seventeenth century and falling gently thereafter, descended sharply from around 1740 onwards (Table1.1a Section D Figure 1.11). He felt that it would strengthen and simplify the story if the changes in trend of the two measures had coincided more closely.

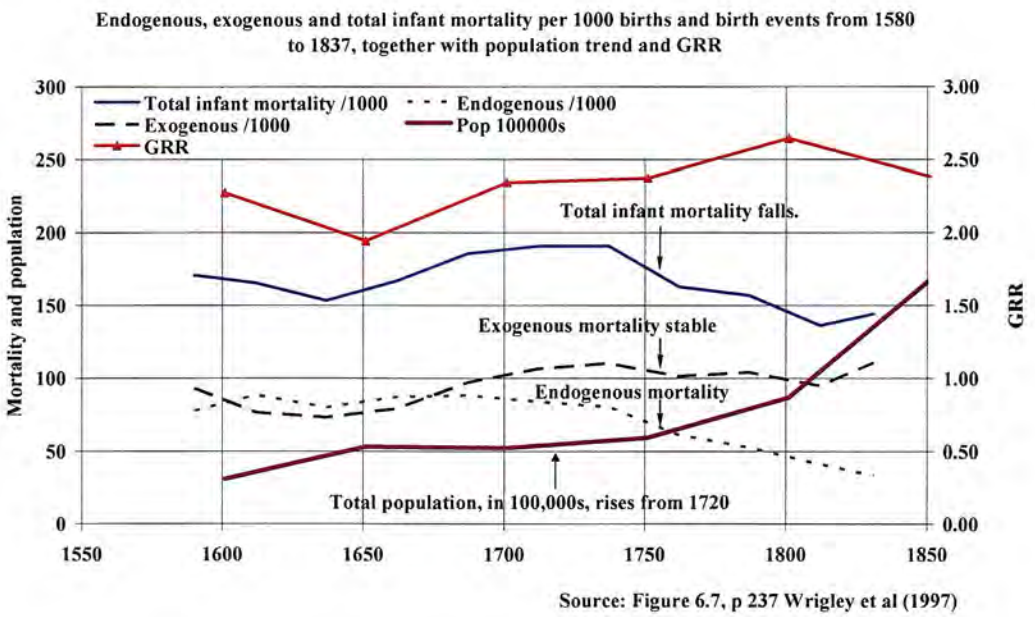


Figure 1.11 Endogenous, exogenous and total infant mortality per 1000 births and birth events from 1580 – 1837, together with population trends and GRR (Table 1a Columns A C and D)

Illegitimate births

Other issues that need to be explored further are the family reconstitution-based figures presented for live births, which did not include illegitimate births, as the reproductive careers of many women began before marriage (Table 1.1b Section I and Figure 1.12, figures produced for the Cambridge Group by Laslett (1980) and in 1991 by Adair). Wrigley et al., (1997), suggested that by the end of the eighteenth century it is probable that about a quarter of all first births were illegitimate and a further quarter was pre-nuptially conceived. Altogether they suggested that the steep rise in illegitimate fertility, which was closely linked to the fall in age at marriage, supplemented the rise in legitimate fertility considerably, adding about 5% to overall fertility.

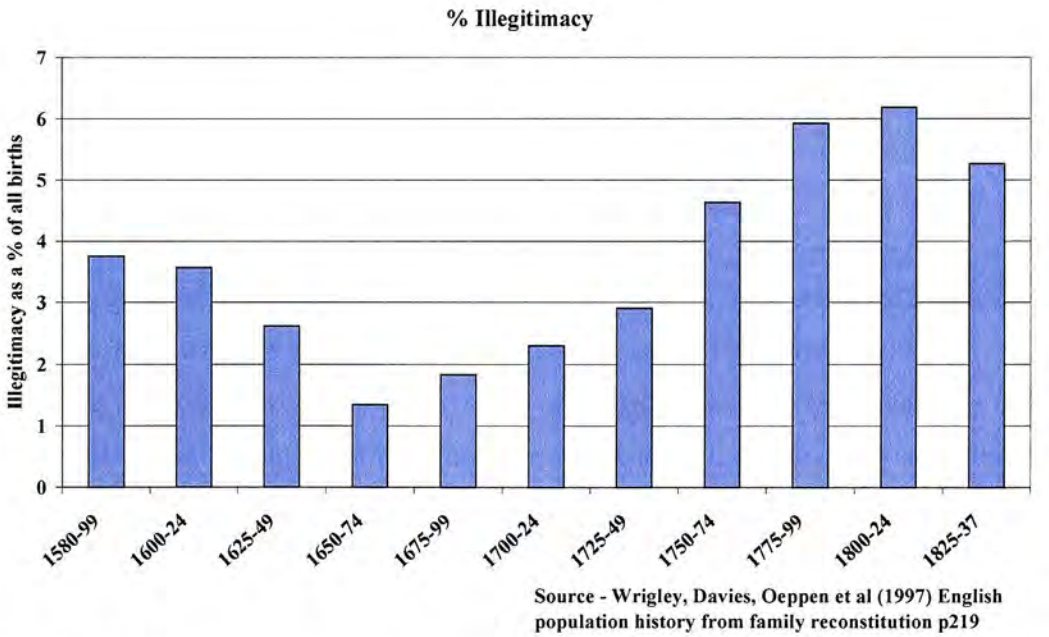


Figure 1.12 Illegitimacy as a percentage of all births in England 1580 to 1837 (Table 1b Column I)

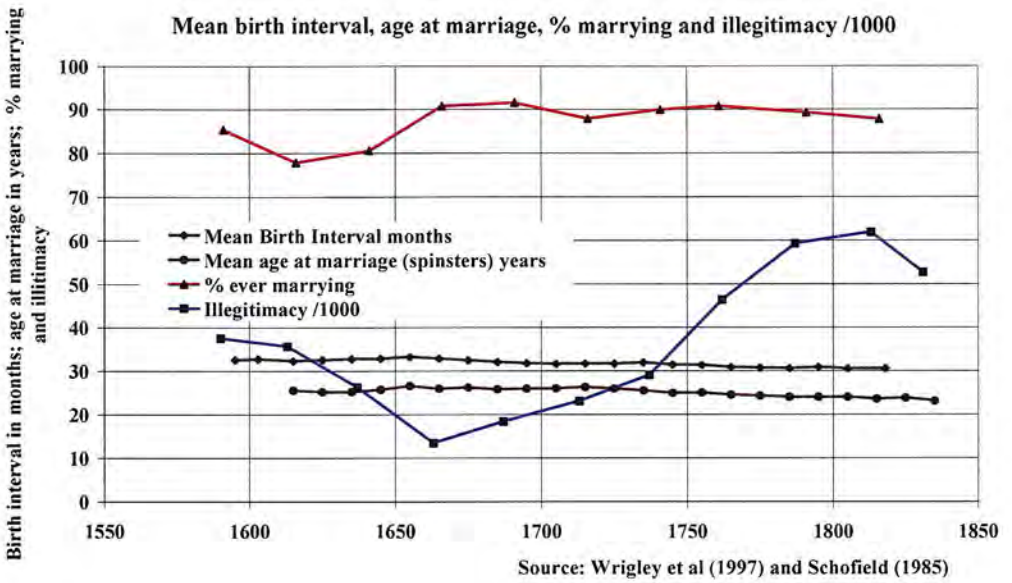


Figure 1.13 Mean birth interval, age at marriage, % marrying and illegitimacy per 1000 (Table 1b Columns F G H and I)

Discussion on the fertility changes and infant mortality

The occurrence of decreased or increased fertility changes, from whatever source, raises questions as to what actually caused the decrease or improvement. While Wrigley et al. (1997) have illuminated some of the features of the rise in fertility in the second half of the eighteenth century; some puzzles still remain as to why there was a previously low level of fertility in England in the preceding centuries and what explanation there was for the difficulty in keeping babies alive.

As has been already shown in this chapter, many historians have offered various explanations for this low level of fertility and the failure of babies to survive in the seventeenth century. The low levels in many cases were often thought to have been brought on either by acute harvest failure or by epidemics, but other factors also need to be considered, and it is useful at this point to discuss *'proximate determinates'* (Bongaarts and Menken, 1983) of natural fertility together with any contraceptive controls that may have been used at that time.

The differences among populations and trends in natural fertility can be understood by examining a number of proximate determinants. These include:

- Postpartum infecundability
- The waiting time to conception
- Spontaneous intrauterine mortality
- Onset of permanent sterility
- Age at marriage or at onset of exposure to intercourse
- Marital disruption for example through prolonged separation through seasonal migration or military service.

Interestingly, comparative studies of fertility showed that there was a large variation in *'natural'* marital fertility rates for different populations: the highest levels were about twice the lowest ones (Henry, 1961, and Leridon, 1977). Besides being highly variable, marital fertility was often well below the biological maximum. Hutterite women in 1921-30 bore mean averages of 9.6 children and experienced between two and sixteen pregnancies (Tietze, 1957, p. 90) while the average Amish woman in 1964 bore only 6.3 children. These were both pastoral communities in North America, based on the Anabaptist religion, who had secluded life styles and similar values, which did not include conscious birth control (Bongaarts, 1980). The mean interval between confinements for Hutterite women was found to be 25.5 months (Cross and McKusick, 1970 and Eaton and Mayer, 1953).

In contrast to the seventeenth century, Wrigley (1998, p. 459) argued that a rise in maternal nutrition was the most obvious candidate for the marked reduction in the stillbirth rate. The question is whether this can be substantiated by applying modern knowledge of the effects of famine and plenty.

Background variables affecting fertility, in relation to the controversial issue of famines and malnutrition were considered by Bulatao and Lee (1983). They concluded that the bulk of the evidence now indicated that moderate chronic

malnutrition would only have a small physiological impact on fertility, although famines unquestionably led to significant impairments (Gray 1983).

On food shortages, Bongaarts and Menken (1983) suggested that, when food supplies are scarce enough to cause starvation, fecundity is lowered as a result of some combination of cessation of ovulation, loss of libido in both males and females, and reduction in sperm production.

However, several studies have indicated that poorly nourished women may have later menarche (by 2 or 3 years) and earlier menopause as well as slightly longer post partum amenorrhoea intervals of 1 or 2 months (Frisch 1977 and 1983). Anorexic women who lost 10-15% of normal weight for height, which represented a loss of about one third body fat, developed amenorrhoea. During pregnancy an underfed woman's probability of a miscarriage is higher than a well-nourished one.

Research into the consequences of the Dutch Hunger Year, Winter September 1944 – May 1945, considered the effect on female reproduction and any resulting babies (Fogel, 2004, Lumey and van Poppel, 1994, and Rabb and Roberg, 1985 and Vernon, 2007). One of the most relevant findings to this discussion on famine and the ability to conceive and produce a viable baby, related to the women's previous health status, rather than the effect of hunger at the time. It was found that a highly significant factor relating to the ability to conceive and the outcome for the baby, in the Dutch Hunger Year, depended on the woman's previous '*embodied dimension of maternal wellbeing*' (Hart ,1993, p. 46).

So how does this relate to the period under study, especially the late seventeenth century when fertility fell and the period from 1750 when fertility rose?

There were no famines in the long eighteenth century, but there were periods of seasonal and local deficiencies of food or hungry years. In this scenario, fertility would have depended on the level of the woman's previous health and the length of time it was so, and the degree to which it affected her ability to become pregnant. As

there were no long periods of deficiencies in food it is unlikely to have been a factor in reducing fertility. However, it could have been a factor in the seventeenth century when longer crises in harvests occurred.

Control of contraception

Conscious contraception though discussed by historians has not in general been thought to be relevant at this point in history. Santow (1987 p.19) took issue with this approach. He argued that it was all too common for analyses of historical fertility levels, fertility decline, or even birth control to state that fertility was being controlled. He contended that no reference was made to the means of control or to the methods of control, which must have been *coitus interruptus*, abstinence and abortion, since nothing else was available.

However, despite the declarations of historical demographers, Hinde (2003, p.148) argued that the existing analyses were unable to discount the possibility that some form of birth restriction was being practised. In particular it is within the '*waiting time*', the year from the ending of exclusive breastfeeding to the next conception, that Hinde argued that we do not know if breastfeeding was an effective contraception or whether there was some additional effort made by the couple to delay the next birth, for example, by deliberately restricting the frequency of intercourse.

Conversely, and this is important in this thesis, it can be argued that it is not known whether couples were in fact having difficulties in conceiving in the late seventeenth century or how many early miscarriages occurred. The actual reasons for the delay in marrying are not known or the lack of fertility within marriage. The subsequent release from these difficulties, with a resulting rise in fertility in the middle of the eighteenth century, could be connected events.

This discussion has raised the problems in determining what are the most important of the proximate determinants used to understand fertility ; further historical research and debate is still needed and there may be factors not yet understood, some of which are to be raised within this thesis.

Conclusions and questions arising

In this chapter the discussion has shown that the rise in fertility over the long eighteenth century appeared to Wrigley and Schofield to be due to earlier marriage, a huge rise in illegitimacy, a lowering of endogenous infant mortality, stillbirth and maternal mortality, and what was thought to be an increasingly better nutritional status of the mother. This last aspect was thought to be demonstrated by the later age of mothers still able to conceive and give birth, (Table1.1b Section E1) against a backdrop of increasing expectation of life in the general population, height increases of the population, and decreasing mortality. Those aspects which previously prevented a rise in fertility have been discussed.

What is puzzling is the timing of the changing events within the long eighteenth century, and data presenting these main changes and events which have been discussed in detail are presented together in Table 1.1a and Table 1.1b.

However, the research findings presented from the Cambridge Group research, discussed above, specifically raises the following further questions concerning causation: in the long eighteenth century in England why was / were there:

- a fertility decline from about the end of the third quarter of the seventeenth century and a rise from around 1740 which was maintained throughout the century?

- changes in the age at marriage - was it really due to changes in custom or a response to sudden family mortality crises or could it in part be that there were changes in fertility which varied prenuptial and illegitimate conceptions?

- a greater fertility throughout marriage, especially in women towards the end of their fertile span, particularly from about 1740 onward and why did this happen?

- a slight decrease in the spacing between babies – of three months from 1790 onwards: - could this be linked with the previous two points?

- a decrease in infant mortality, especially endogenous, rather than exogenous mortality, commencing gradually from the start of the eighteenth century? As endogenous infant mortality, while peaking in the final quarter of the seventeenth century and falling gently thereafter, descended sharply from 1740 onwards, were the delivery skills and childbed practices changed and did this affect both the rate of endogenous infant mortality and maternal deaths? Conversely, could it also be related to better nutritional benefits for mothers and their babies, or to both points?

- a marked decrease in the death of women during childbirth after 1750 - was this linked to the point above or were there quite separate mechanisms at work?

- a reduction in the rate of stillbirths between the end of the seventeenth century and early nineteenth century (1680-1820)?

Analysing the above questions suggests the following themes: what were the causal factors that could have held down fertility and that, when removed, led to an increase in fertility. Separately, there seemed to be another factor affecting mortality of women and babies during pregnancy and childbirth. These issues will be considered further in the next chapter and both the hypothesis for the thesis introduced and the research method presented.

			A	B		C			D				E		E1	
Time (5y)	English population totals			Expectation of life at birth		English maternal mortality rates			Infant mortality of legit.children England				Age specific marital			Time (5y)
	and growth rates 1601-1851			combined sexes		per 1000 birth events			1580-1837				fertility rates		per 1000 w.y.l	
	DATE	Pop 000's variable	GRR variable	DATE	Expectation	DATE	Maternal mortality		DATE	Endog.	Exog.	Total	DATE	TMFR 20-49	40 - 44 50 year ave.	
1580						1580-99	12.30		1580-99	77.6	93.10	170.7				1580
1585																1585
1590																1590
1595																1595
1600	1601	3065.00	2.27	1600-09	37.50	1600-24	12.80		1600-24	88.5	76.70	165.2	1600-24	7.63	142.3	1600
1605																1605
1610				1610-19	40.10											1610
1615																1615
1620				1620-29	40.20											1620
1625						1625-49	14.00		1625-49	80	73.30	153.3	1625-49	7.46	128.1	1625
1630				1630-39	37.80											1630
1635																1635
1640				1640-49	36.40											1640
1645																1645
1650	1651	5308.00	1.94	1650-59	36.90	1650-74	17.00		1650-74	87.3	79.40	166.7	1650-74	6.90	125.3	1650
1655																1655
1660				1660-69	36.50											1660
1665																1665
1670				1670-79	36.30											1670
1675						1675-99	15.60		1675-99	88.3	97.10	185.4	1675-99	7.10	98.3	1675
1680				1680-89	31.30											1680
1685																1685
1690				1690-99	38.70											1690
1695																1695
1700	1701	5211.00	2.34	1700-09	37.30	1700-24	13.40		1700-24	84	106.70	190.7	1700-24	7.49	120.9	1700
1705																1705
1710				1710-19	35.80											1710
1715																1715
1720				1720-29	36.20											1720
1725						1725-49	12.30		1725-49	80.5	110.30	190.8	1725-49	7.60	132.7	1725
1730				1730-39	36.60											1730
1735																1735
1740				1740-49	37.30											1740
1745																1745
1750	1751	5922.00	2.37	1750-59	42.10	1750-74	9.50		1750-74	61.3	101.50	162.8	1750-74	7.46	128.7	1750
1755																1755
1760				1760-69	39.00											1760
1765																1765
1770				1770-79	39.40											1770
1775						1775-99	9.00		1775-99	52.6	104.10	156.7	1775-99	7.51	147.8	1775
1780				1780-89	39.20											1780
1785																1785
1790				1790-99	41.70											1790
1795																1795
1800	1801	8671.00	2.64	1800-09	44.80	1800-24	6.30		1800-24	41	95.00	136	1800-24	7.67	142.3	1800
1805																1805
1810																1810
1815																1815
1820																1820
1825						1825-49	4.70		1825-49	33.3	110.80	144.1				1825
1830																1830
1835																1835
1840																1845
1851	1851	16732.00	2.38													1851

Table 1.1a

Compilation of population, fertility and mortality figures for the 'Long eighteenth century' in England.

A Wrigley, Davies, Oeppen et al (1997) English population history from family reconstitution p538
B Wrigley, Davies, Oeppen et al (1997) English population history from family reconstitution p295
C Wrigley, Davies, Oeppen et al (1997) English population history from family reconstitution p313
D Wrigley, Davies, Oeppen et al (1997) English population history from family reconstitution p236
E Wrigley, Davies, Oeppen et al (1997) English population history from family reconstitution p355
F Wrigley, Davies, Oeppen et al (1997) English population history from family reconstitution p355
G Wrigley, Davies, Oeppen et al (1997) English population history from family reconstitution p134
H Schofield (1985) Journal of Family History, Spring, page 10 table 2
I Wrigley, Davies, Oeppen et al (1997) English population history from family reconstitution p219
J Floud, Wachter and Gregory (1990) Height, health and history p148

Table 1.1a Compilation of population, fertility and maternity figures for the long eighteenth century in England after Wrigley et al., (1997) and Schofield (1985)

	E		E1	F		G		H		I		J		
Time (5y)	Age specific marital			Mean birth intervals		Mean age at marriage		Proportion ever marrying		illegitimacy ratio%		Mean height		Time (5y)
	fertility rates		per 1000 w.y.l			(spinsters)						age 24-29 (inch)		
	DATE	TMFR 20-49	40 - 44	DATE	Interval			DATE		DATE		DATE	Height	
			50 year ave.											
1580				1580-1609	32.58					1580-99	3.76			1580
1585														1585
1590				1590-1619	32.79			1591	0.854					1590
1595														1595
1600	1600-24	7.63	142.3	1600-29	32.36					1600-24	3.57			1600
1605														1605
1610				1610-39	32.58	1610-19	25.60	1616	0.779					1610
1615														1615
1620				1620-49	32.78	1620-29	25.20							1620
1625	1625-49	7.46	128.1							1625-49	2.63			1625
1630				1630-59	32.90	1630-39	25.20							1630
1635														1635
1640				1640-69	33.27	1640-49	25.70	1641	0.806					1640
1645														1645
1650	1650-74	6.90	125.3	1650-79	32.92	1650-59	26.60			1650-74	1.35			1650
1655														1655
1660				1660-89	32.51	1660-69	25.90	1666	0.908					1660
1665														1665
1670				1670-99	32.11	1670-79	26.20							1670
1675	1675-99	7.10	98.3							1675-99	1.84			1675
1680				1680-1709	31.84	1680-89	25.80							1680
1685														1685
1690				1690-1719	31.61	1690-99	25.90	1691	0.916					1690
1695														1695
1700	1700-24	7.49	120.9	1700-29	31.69	1700-09	26.00			1700-24	2.31			1700
1705														1705
1710				1710-39	31.65	1710-19	26.30	1716	0.879					1710
1715														1715
1720				1720-49	31.93	1720-29	25.90							1720
1725	1725-49	7.60	132.7							1725-49	2.91			1725
1730				1730-59	31.44	1730-39	25.50							1730
1735														1735
1740				1740-69	31.33	1740-49	24.90	1741	0.900			1742.5	65.39	1740
1745												1747.5	65.22	1745
1750	1750-74	7.46	128.7	1750-79	30.85	1750-59	25.00			1750-74	4.64	1752.5	65.12	1750
1755												1757.5	65.72	1755
1760				1760-89	30.72	1760-69	24.50	1761	0.908			1762.5	66.84	1760
1765												1767.5	66.42	1765
1770				1770-99	30.62	1770-79	24.30					1772.5	66.37	1770
1775	1775-99	7.51	147.8							1775-99	5.93	1777.5	66.30	1775
1780				1780-1809	30.85	1780-89	24.00					1782.5	65.97	1780
1785												1787.5	66.11	1785
1790				1790-1819	30.54	1790-99	24.00	1791	0.893			1792.5	65.84	1790
1795												1797.5	66.66	1795
1800	1800-24	7.67	142.3	1800-37	30.57	1800-09	24.00			1800-24	6.19	1802.5	66.76	1800
1805												1807.5	68.09	1805
1810						1810-19	23.60	1816	0.878			1812.5	67.67	1810
1815												1817.5	67.22	1815
1820						1820-29	23.80					1822.5	69.02	1820
1825										1825-37	5.27	1827.5	66.73	1825
1830						1830-37	23.10					1832.5	66.74	1830
												1834	67.40	
1835												1835	67.61	1835
1840														1845
1851														1851

Table 1.1b

Compilation of population, fertility and mortality figures for the 'Long eighteenth century' in England.

A	Wrigley, Davies, Oeppen et al (1997) English population history from family reconstitution p538
B	Wrigley, Davies, Oeppen et al (1997) English population history from family reconstitution p295
C	Wrigley, Davies, Oeppen et al (1997) English population history from family reconstitution p313
D	Wrigley, Davies, Oeppen et al (1997) English population history from family reconstitution p236
E	Wrigley, Davies, Oeppen et al (1997) English population history from family reconstitution p355
F	Wrigley, Davies, Oeppen et al (1997) English population history from family reconstitution p355
G	Wrigley, Davies, Oeppen et al (1997) English population history from family reconstitution p134
H	Schofield (1985) Journal of Family History, Spring, page 10 table 2
I	Wrigley, Davies, Oeppen et al (1997) English population history from family reconstitution p219
J	Floud, Wachter and Gregory (1990) Height, health and history p148

Table 1.1b Compilation of population, fertility and maternity figures for the long eighteenth century in England after Wrigley et al., (1997) and Schofield (1985)

Chapter 2

Research methods: The hypothesis and justification for the research

Choice of research method

Social research has three main phases: planning, execution and reporting (Blaikie, 2001). Most research is based on one of two major complementary approaches: quantitative or qualitative research.

Quantitative research normally deploys at least a proxy of an empirical, scientific method where knowledge is acquired by forming hypotheses, pre-selecting variables that have been derived as theoretical statements in order to determine causal and measurable relationships, testing the data by the use of statistics, all undertaken in an apparently logical sequence. It is often considered a deductive process, but Popper (1972) considered that the scientific method to be hypothetico-deductive and usually based on a hypotheses. Medawar suggested that hypotheses are imaginative and inspirational in character and are adventures of the mind (cited in Phillips and Pugh, 1993, p. 13). Blaikie (2001, p. 8) argued that there is no such thing as the scientific method, and there are a variety of logical enquiry routes available in the social sciences, and that, in order to conduct social research, it is necessary to choose from among them.

Qualitative research by contrast more normally develops inductively from the data and is more frequently directed to bringing knowledge into view. Its greatest use is in understanding the meaning of behaviour from the person's point of view (emic), that is, the actor's or native's point of view, and is a process of analysis rather than a picture of society as seen from a particular vantage point.

Most qualitative or interpretative research uses an approach called '*verstehen*', which means '*to understand*'. The term is used to convey a subjective point of view in social science and was first used by Weber (1947, pp. 887-88). This type of research refers to the methods and techniques of observing, documenting, analysing and

interpreting attributes, characteristics and meanings of specific contextual or gestaltic features of the phenomena under study (Leininger, 1985, p. 5).

Some historians have actively debated whether quantitative or qualitative methodology is the best way to undertake research and have used a more social science problem oriented approach or else a more humanist method. In their American investigation on *History as social science*, Landes and Tilly (1971, p. 10) argued that the historian as social scientist aimed self-consciously at methodical rigor. *'He defines his terms, states his hypothesis, clarifies his assumptions and stipulates the criteria of proof'*. By contrast, they suggested the historian as humanist had no need of this elaborate procedure.

> *He starts with the subject rather than a question; he often does not begin with a preliminary hypothesis. Rather he derives his conclusions in the course of research and then writes his story in accordance with the evidence, framing the exposition in such a way as to convey his interpretation and the reasons for it. His primary concern remains the story and he prefers to weave his assumptions and interpretations into the account in such a way as not to distract from its fluency and interest. In general, he prizes subtlety more than precision* (p.11).

The historian as social scientist is keen to measure and argue that some number, however approximate, is better than no number at all, while the humanist would most likely use quantitative words such as *'usually'*, *'many'*, *'most of'*, *'often'* and the like.

Landes and Tilly concluded their inquiry by suggesting that the validity of inquiry is not its accessibility but its effectiveness (p.17).

In choosing a method for the research, the researcher has to select an approach appropriate to the purpose of the research rather than deciding that one approach is always right for him or her or any planned research. The research method has to be determined by the research questions and by the means available to obtain the information required.

For this research historical research is the method to be used to explore a hypothesis and this does not follow exactly either of the two methods above, but contains elements of both.

The hypotheses for this thesis arose from inspiration, based on prior expertise in a different discipline – an 'eureka' moment. Having formulated a hypothesis it has to be tested as rigorously as possible under the circumstances, using an appropriate methodology (Phillips and Pugh, 1993, p. 14), based upon deductive arguments. When the work is written up it tends to follow a logical progression more akin to the scientific method.

Polit and Hungler (1991, p. 204) stated that historical research is the systematic collection and critical evaluation of data relating to past occurrences. It is generally undertaken to test hypotheses or to answer questions concerning causes, effects, or trends relating to past events that may shed light on present behaviours or practices.

Polit and Hungler further define the process (p. 204):

> *The steps involved in performing historical research are similar to those for other types of research: the historical researcher defines a problem area, develops hypotheses or specific questions, collects data according to a systematic framework, analyses the data, and interprets the findings.*
>
> *Historical research differs from other types of research, however, in two important respects. First, considerable effort is usually required to identify data sources on events, situations, and human behaviour occurring in the past. Second, because the researcher has no control over the quality of data available, another research task involves the critical evaluation of gathered information.*
>
> *Historical research is inherently non - experimental. The researcher can neither manipulate nor control the variables, nor is there any possibility of random assignment. In fact, the historical researcher must cope with a number of handicaps. In ex post facto or survey research, the investigator may not be able to manipulate variables but usually there are opportunities to construct or select the data collection instrument. Historical researchers, however, have no control over the documents, records, or artefacts available for study. The historical researcher is at a similar disadvantage with regard to sampling. Only surviving records can be consulted, and these records may contain a number of biases.*

The goal of research is the discovery of new knowledge (p. 205) or as Blaikie (2003, p. 10) stated '*the aim is to advance knowledge in their field, to provide new or better understanding of certain phenomena, to solve intellectual puzzles and/or to solve practical problems*'.

In formulating a feasible area to explore, Polit and Hungler warned against the problem in historical research of the data becoming unmanageable because there is less closure than in a study that creates new data. It is, therefore, important for the researcher to be familiar with the background area of the study so that a well defined area can be studied in depth. Where there is enough data it may be possible to permit a test of the hypotheses formulated or to provide some answers to specific questions.

Hypotheses, Blaikie contends, if they are clearly stated, can be extremely useful in helping to find answers to '*why*' questions. Unlike hypotheses in a statistical sense, those in historical research more frequently produce broadly stated conjectures about relationships between historical events, trends, and phenomena (Polit and Hungler, p. 205).

To pursue the research it is important to pose research questions that define the nature and scope of the project. Blaikie (2003, p. 13) suggests that these should focus the researcher's attention on certain puzzles or issues, influence the scope and depth of the research, point towards certain research strategies and methods of data collection and analysis and set expectations for outcomes. The questions fall into '*what*' '*why*' and '*how*' categories. '*What*' questions seek descriptive answers, while '*why*' questions seek understanding or explanation and '*how*' questions seek to identify appropriate interventions that brought about change.

The data collection is based usually on written records: periodicals, diaries, books, letters, newspapers, and minutes of meetings, legal and other documents. Visual materials may also be available as evidence.

Polit and Hungler stressed that the identification of the appropriate historical materials will require a considerable amount of time, effort and detective work, using primary and secondary sources and historical evidence that has to be evaluated by external or internal criticism. External criticism is concerned with the authenticity and genuineness of the data, while internal criticism refers to the worth of the evidence, which may be biased or have a different point of view and may need to be compared with others' accounts of the event.

After the evidence has been assembled the researcher will need to synthesis and analyse the data and test the hypothesis. The process of analysing the data requires objectivity and judgement. As Polit and Hungler stated, *'the entire mass of evidence must be organised and weighed and problems about inconsistencies resolved and judgements made in an objective manner'* (p. 207).

Application of research methods and the aim of this thesis

The historical research for this thesis followed the methods outlined above using the working title of 'Ergot usage and contamination of foodstuffs in the seventeenth and eighteenth centuries and its possible implication in the population changes in England'. Using a hypothesis, specific questions that needed to be explored were identified. The method included using primary and secondary material, as well as a specific case study in one local area to highlight points of clarification. In writing up the research the process using the scientific method was used, therefore following a logical progression.

At the end of this self-funded research for the award of a PhD, the hypothesis in this historical study produced broadly stated conjectures about relationships between historical events, trends, and phenomena (Polit and Hungler p. 205) and contributed a new or enhanced understanding of the reasons for the changes in population in the long eighteenth century.

The research questions and the justification for the research method

Instead of looking individually at each of the questions raised at the end of the first chapter in detail and finding new interpretations, as some other historians have attempted, with the resulting outcome still being controversial or not totally convincing, a rather different approach is to be taken in this thesis.

Throughout the discussion on the population question in the seventeenth and eighteenth centuries, some kind of change in nutrition has been seen as one of the possible positive explanations for the changes which need to be explored further. In particular environmental factors, especially the changes in the general diet or even local harvest crises or hunger years that specifically affected women's fertility have yet to be fully explored. These have often been raised but have generally been thought to be improbable.

Of particular interest is the question, raised in the Cambridge Group's research, as to a possible rise in the *'maternal net nutrition'* after the middle of the eighteenth century in spite of the fact that it could be argued that the diet was worse than at the end of the seventeenth century. This then leads to the question as to whether there was something very specific that changed the diet generally for women at this point in the century, or that previously their fertility had been held back by something in their diet.

Wrigley (1998, p. 440) also suggested that delivery skills and childbed management may be important factors to take into consideration.

The justification for the research questions is therefore based on the notion that there could have been something in the general diet that specifically affected women in the past. While this has been considered by most historians as improbable, this thesis re-opens this question, addressing the possibility that the fungus ergot, which grows on rye, could have been a significant contributing factor.

Aims of the research study

There continues to be debate as to the causes of the increase in the population in the long eighteenth century and this thesis addresses one possible contributory factor or interpretation.

The hypothesis for the study is that ergot, particularly in rye bread, which was in the seventeenth century a major part of the staple diet of most people, may have affected the women's fertility in the long eighteenth century. In order to address these issues the method chosen to meet the needs of the study will be historical research.

A number of specific questions arising from the Cambridge Group research suggest that further investigation would be appropriate. These issues are listed below and the research questions that arise from them in the long eighteenth century will be addressed in this thesis:

- While an improvement in the nutrition of women normally has some positive impact on fertility, and the period under study had some good harvest years from the second decade of the eighteenth century, the diet of the mass of the population worsened during the second half of the eighteenth century. However, changes in the diet to mostly wheat around the middle of the century could have meant less rye in the food and the removal of the contraceptive effect of ergot in the women's diet. The amount of rye grown and ingested will be assessed and the likely incidence of contamination by ergot determined. The outcome will be compared with the timing of changes in demography already presented from the Cambridge Group work, in Chapter 1.

- Better maternal health and better midwifery could have meant that ergot was used in childbirth at the third stage, before the passing of the placenta, and therefore fewer mothers would have died from haemorrhages. Contemporary papers will be examined to determine the level of knowledge and usage of the

drug ergot and its possible effect on women during labour throughout the period under study and any changes in midwifery practice assessed.

- In contrast to improved mother's health, the high stillbirth rate of the period around the late seventeenth century could have been the result of the mother's ingestion of ergot from rye food which may have caused early delivery, as well as birth problems for the babies, which increased stillbirths. Ergot given during labour without the knowledge of its actual effect and understanding the importance of timing could have led to babies being born dead from asphyxiation during labour. Ergot also causes problems with the mother's milk following the baby's birth and the ability of the baby to suckle. This issue will also be examined at the same time and by the same method as the issue of the drugs used for women in labour.

- On the one hand the long period of spacing between babies could have been due to the ingestion of ergot from food and its contraceptive effect thereby preventing nidation (the implantation of the ovum into the womb). Modern knowledge of the drug ergot will be explored and an assessment made as to whether this could have affected women's fertility in the past.

- On the other hand, the decreased spacing of the birth intervals by 3 months in the later period of the eighteenth century and the increased fertility span of older woman could have been a sign that women ate less rye and the removal of the contraceptive effect of ergot had an effect on their fertility and their health. Therefore, changes in the diet which corresponded to the rise in fertility rates will be explored and compared for any parallel changes.

In addressing these questions raised, it will be important to ensure that the underlying basis on which the assumptions are made are also explored.

Potential use of the results from the study

From the study it is hoped that the results from addressing these research questions will correspond with the available data on demography and be so suggestive that ergot could have been a factor in women's fertility that this hypothesis cannot in future be disregarded. While it is probably not possible to actually prove the hypothesis conclusively, it is hoped to show that there is so much accumulated circumstantial evidence that the hypothesis cannot be ignored. In turn it is hoped that this will then stimulate further local research to determine its merit as another interpretation and contribution to the continuing debate on the population question.

It may also be possible to use lessons from the past to reduce ergotism and its sub-clinical effects from affecting people in underdeveloped countries or wherever it has become a problem in the world including the administration of medicinal preparations which are derivatives of the ergot fungus.

How the hypothesis was addressed

In order to explore the hypothesis presented, the following discussion introduced the hypothesis further and identified what aspects needed to be achieved.

The possibility that ergot may have been one of the agents of change that affected fertility and population changes in the seventeenth and eighteenth centuries in England was assessed. Of particular interest was the regular unintentional ingestion of sub-clinical levels of ergot in the diet and its intentional use in labour, as well as any records of full blown ergot epidemics.

The current knowledge relating to the fungus ergot was examined with special attention to its role in causing abortions, its action as a female contraceptive and its effect on women not only in pregnancy but also in labour and in the postnatal period. Its detrimental effect on the baby during labour (causing stillbirth) and, when born, damaging its ability to suckle was also ascertained. The possible operation of these factors in the seventeenth century, to check woman's fertility, was investigated.

During the last half of the eighteenth century, the gradual removal of rye from the diet of labourer's wives because of agricultural and medicinal changes could have resulted in sustained and even improved fertility rates. This possibility was explored.

Later decreases in rye usage was recognized and interpreted against the continuing population increases. In order to try to substantiate this approach it was important to identify during what period the population changes took place and to compare this with information on rye usage to see whether there was any correlation. Factors at work here were changes in diet and agriculture practice.

The underlying hypothesis is that the effect of ergot ingestion checked the rate of the population growth at the end of the seventeenth century, and that the gradual change in the diet to wheat released women from this sub-clinical contraceptive effect, so that the fertility rate was therefore maintained and possibly increased in times of harvest shortages and periods of hunger.

Another possibility was change and evolution of midwifery practice.

In order to build a case that ergot on rye could be a factor in population changes in the period under study the following issues were addressed in Chapters 3-10.

- Modern standards for growing rye and the avoidance of ergot fungal growth and standards based on research for milling and cooking rye, to prevent contamination of food stuffs.

- A historical study of ergot identifying its growing conditions.

- The effect of ingestion, frequency of epidemics of poisonings and general effect on women.

- An investigation of food and drink preparation and farming practices explicitly to assess whether ergot could have survived in sufficient quantities to enter the food chain, at a level which could have had significant detrimental effects.

- Using primary and secondary sources, the history of rye growing in England in the seventeenth and eighteenth centuries was explored.

- The general changes in agriculture in England that had an impact on society and the move towards a more integrated market economy that led to both an increase in wheat production and a change in the circumstances of the labourers were identified.

- Ergot epidemics and a particular case history were used to demonstrate whether ergotism was a feature of illness amongst English rural labourers, who were more likely to rely on a staple diet and were the most numerous group in the population.

- Ergot use in childbirth from early times was explored using primary sources. Changes in practitioner and midwifery practices were assessed, as well as the degree of ergot usage.

- Following Chapters 3-10, and the investigation of primary and secondary sources, the findings were analysed, summarized and critically reviewed and further work identified and the conclusions presented, in Chapter 11.

Methodology for the thesis

Within this thesis, although the author was familiar with the historical period covered by the research, as it was part of her undergraduate degree taken from 1977-1981, it was necessary to increase her limited experience of using primary sources and knowledge of the appropriate libraries and other sources of information that could be

accessed. In addition, discussions were needed with specialists in the social history of the long eighteenth century, to ascertain their view of the potential research proposal.

In preparation for writing the proposal and undertaking this thesis, a University of London course for postgraduate students on historical sources was attended in London in 1993. The preparation for undertaking the research and developing a research proposal was also helped by the award of a grant from the Wellcome Institute in 1994 which enabled visits to the following establishments and interviews with some key individuals. These included:

- The Flour Milling and Baking Research Association (FMBRA) library at Rickmansworth
- The University of Cambridge to discuss the proposal and the author's ideas with Dr Roger Schofield and Peter Laslett, and to have access to their specialist resource library.
- A visit to, and use of, the Wellcome Library in London, to determine the scope of the resources available there.
- Discussions with Alexander (Sandy) Fenton, an expert on agriculture methods, grains and equipment used in the past.
- Scottish Brewing Library, University of Glasgow
- Special collection in The University of Glasgow library

The questions to be addressed within this thesis arose from the quantitative research undertaken by the Cambridge Group and their interpretation of their results. Following publication of their research on population in 1981, the second reprint in 1989 contained a preface which discussed the reception of the findings by other historians. While the demographic data and methods used gave rise to some discussion and debate with other demographers, it was found that varying the methods offered by other demographers in fact made little difference to the overall results. However, the Cambridge Group's interpretation of their results led to much

more discussion, debate and publications. The questions raised in this thesis, as a result of their research, can be seen as a further call to understand more fully the demographic results presented. The fertility questions arising from the Cambridge Group's findings have not been fully explored here but they provide a background context for the discussion in this thesis of how ergot could possibly be implicated.

Two suggestions, offered by the Cambridge Group's research, to explain the increase in population were considered relevant to this thesis and were taken forward; an improvement in nutrition and management of childbirth occurring in the mid-eighteenth century. The food of the mass of the people in the Little-Ice Age seemed to be more varied than the food consumed in the mid-eighteenth century, yet the anomaly appeared to be that in the former period the population fell and in the latter the population rose. The management of childbirth appeared to be a different factor to that of better nutrition. The hypothesis underlying this thesis suggests that ergot may have linked the two themes.

This thesis, although using the quantitative results from the Cambridge Group as a starting point, employed qualitative methods in order to try to interpret some of the findings. This involved using primary and secondary document sources available in specialist libraries in conjunction with access to modern knowledge to compare and contrast with that available in the long eighteenth century. It was obvious from the beginning of this thesis that a lot of 'detective' work would be involved in assembling and assessing a diverse body of information from a great many varied sources and that any conclusions would at best be based on indirect evidence.

Once the proposal had been accepted and the thesis begun it was necessary to explore the hypothesis, in a manner which would inevitably be based on circumstantial evidence, from a diverse range of specialist areas including agriculture, the history of epidemics, midwifery, medicine, food processing and methods and the social history of the long eighteenth century.

Survey and critique of the sources used for the thesis

As can be seen from the outline of chapters presented, a great deal of time, effort and 'detective' work was required to discover primary and secondary sources for each of these diverse fields. Importantly, in bringing together the relevant circumstantial evidence from each chapter, it was also essential to decide when to stop searching and avoid following tangents that would exceed the limits of a three year PhD.

Once documents were sourced, judgements had to be made as to their importance and relevance to the hypothesis.

Within agriculture, corn market records, farming methods and changes, as well as weather reports, were investigated. It was important to determine whether rye was ever the staple diet of most rural people, particularly in the time period of the Little Ice-Age, and the timing and extent of the change to wheat during the eighteenth century. Ashley's seminal work of 1928 remains the text of choice, as even Overton in 1996 still referred back to this text. However, where possible, the primary documents Ashley referenced were checked for their contemporary contents and accuracy and found to be correct.

It was not easy to identify the extent of rye growth and usage because, although the market reports were found and used, it was discovered in the course of the research that much of the rye grown was for subsistence use and did not enter market records. The market records tended to reflect the surplus grain or grain grown for purchase. However, in the period of the Little Ice-Age, much subsistence grain was found to be everyday rye. Contemporary agricultural papers were consulted to identify the trends and problems associated with growing rye.

During this process it was also found that the contemporary records revealed that '*blasted rye*' was found to be caused by ergot.

Other primary sources, to determine whether ergot was ever a feature of agriculture and whether ergot epidemics were prevalent in England during the long eighteenth century, were traced in the *Philosophical Transactions*, the journal of the Royal Society, which were available from the beginning of the eighteenth century. Contemporary weather reports were found that recorded rainfall in particular parts of England, including Lake Windermere, relevant to what would become the Hawkshead case study, during the period of the eighteenth century.

While the documents examined were required in order to address the growing of rye and the returns from markets, there was also a need to investigate outbreaks of possible ergotism in England and the recognition of its symptoms and the effects of different levels of ergot ingestion, together with the resulting specific effects on the reproductive life cycle of women. This was addressed from differing perspectives. While contemporary sources were researched for these occurrences and consequences, modern knowledge was also researched and applied to each of the areas. Reference books and on-line resources, using search engines, were often employed to establish recent knowledge, such as the use of *Britannica online encyclopaedia* and access to websites such as *EMAN*.

Using modern information, as the context for developments in the period under discussion implied that caution was needed so as not to overstate the argument and that careful consideration was required to determine whether a particular conclusion was justified. Two examples can illustrate this from Chapter 7. Using modern knowledge concerning the contraceptive action of ergot as a benchmark for the period of the Little Ice-Age was felt justified. In attempting to discover whether some undiagnosed or misdiagnosed symptoms of certain diseases were in fact due to ergot ingestion it was recognized that caution should be applied.

Chapter 3, dealing with the history and knowledge concerning ergot, required particularly wide searches for sources, including information from a number of key publications on the subject, the principal authors being Berger, Bové and Moir.

Moir's private papers, concerning his research and the development of medicinal ergot alkaloids, were traced and consulted at the Royal College of Obstetricians and Gynaecologists (RCOG) in London. Discovering, within Moir's private papers (Sir John Chassar, (1900-1977) (S2/1-10), the original graph showing the activity of ergot on a woman's postnatal uterus, was a particular highlight.

While research was conducted into ergot epidemics in a number of other countries, the discussion of these in the thesis was shortened to give just a flavour of its impact in order to ensure that the chapter was in balance with the aim of the thesis.

The special collections at the University of Edinburgh and the National Library of Scotland were a constant resource for this thesis. They provided an unexpected wealth and helpful source of seventeenth and eighteenth century documents on midwifery: unexpected, as they were so readily available, and helpful, for the wealth of information on practice that was found there. However, these documents were often very difficult to read and understand as many of the early sources did not have an index or content lists and were often printed in contemporary styles and written in obscure old English.

The Eighteenth Century Books Online resource was also used and could be searched by using specific keywords. However, this avenue was no match for having the physical document in front of one. It was found that there was a real need to read the whole paper in order to discover new insights. For instance, if the word '*ergot*' was just searched for, it would have missed '*midwife's powder*' and '*forcing medicines*'. Once these new words were found, it was easier to search online with this enhanced set of keywords. Chapters 9 and 10 together represent more than a year spent systematically searching contemporary documents.

In discovering the contents of old medicines and prescriptions, the assistance provided by the archivist at the Royal Pharmaceutical Society was very detailed and

helpful. While the discovery of certain papers on pharmaceutical stockists, available for consultation at the Wellcome Library, led to the personal and business papers of one of the early pharmacists, unfortunately, while interesting, this line of research did not yield a list of the stock or the sources that had been hoped for.

Other avenues worth investigation, regarding the use of ergot during labour, were discovered during a year long search for evidence among primary sources of midwifery publication. It was not envisaged that caudle and gin, which could well have contained ergot, would be found in use during the long eighteenth century, or that these were used in midwifery practice. It was thought that finding out more about the process of making caudle, in the late seventeenth, through recipe books would have been possible; however, this line of research was curtailed, as the study of midwifery documents was much more productive. Not only did these refer to the ingredients of caudle, but they also gave detailed advice as to when it should be given, and with what expected outcomes.

Gin was a popular drink at the beginning of the eighteenth century, when rye was still an important grain. Having discovered that gin, often made with rye, was used during labour, it was necessary to show that gin might not have been pure alcohol but could have been adulterated and could have contained ergot. While gin produced from a distilling process today is highly proofed, it was possible, using a recent publication by Dillon, to question the purity of the gin produced in the early eighteenth century.

The publication of Dillon's research in 2002 proved a mine of information and offered exact references as to the use of poor, contaminated and coarse grains in poorly distilled gin, which was often also adulterated with many other substances. The discussions in the British Parliament, in the mid-eighteenth century, concerning the use of tainted and poor corn, added to the evidence that gin could well have contained ergot. Within the constraints and scope of this thesis it would have been impractical to have independently researched this topic and to uncover further

evidence that was needed to confirm the degree and type of adulteration. It was fortuitous that Dillon's research became available while the thesis was being undertaken, thereby fulfilling this requirement.

In order to visualise the social history and agriculture of the parish of Hawkshead, two visits were made to the town and the surrounding area. Swathmore Hall, the Quaker meeting place in Ulverston, was also visited.

While the Curwen Trust published an annotated version of the '*Kendal midwife's diary*', it was necessary to consult the original text and compare the data. The archives at the Town Hall in Kendal were visited, in order to examine the small leather bound list of cases, to determine the accuracy of the modern version and to see exactly how the cases were listed. This proved essential in comparing the method of entry with the methods used in the Hawkshead Parish records of baptism and abortions.

The primary sources of the *Quaker meeting record books* were held in the Lancashire archives in the Library at Barrow-in-Furness. The quote used by Hess concerning Mabel Brittaine's practice (Chapter 10), was examined to see if it was more fully discussed, but it turned out not to be. However, during the search other useful references were found to the two Quaker midwives who were practising in Hawkshead in the last quarter of the seventeenth century. Not only did they regularly attended the Quaker women's meetings, in Ulverston and Cartmel, but it was identified that they were responsible for distributing social benefits to 'Friends' in Hawkshead. The regular attendance at the meetings demonstrated that lanes and tracks were passable even in winter and bad weather which suggested that local people would not have found it difficult to attend baptisms or delayed their happening for that reason.

During this visit to Barrow-in-Furness the *account books for Swathmore Hall* were also consulted and references to the amounts of rye distributed by the Quakers to other Friends were discovered.

It had been suggested by Polit and Hungler that a variety of sources could be called upon within historical research. In this thesis, periodicals such as *The Philosophical Journal* and *The Gentleman's Journal* in the seventeenth century and some of the early newspapers towards the end of the eighteenth century, were consulted, as well as *The Kendal midwife's diary*, *Minutes of the Quaker women's meetings* and *The Swathmore accounts*. Early midwifery books, and papers and extracts from parliamentary debates and investigations, as well as old maps, agricultural reviews across England and Scotland, and visual material in the form of pictures of old ploughs and the famous picture of gleaners in the fields, were also used.

Chapter 3

Ergot: an identification of conditions conducive to its growth and life cycle, the effect of its ingestion, frequency of epidemics of poisonings and its particular effect on the reproductive system of women

'The story of ergot is old... but also very new' (Bové, 1970 p. vii)

Introduction

In this chapter the recognition of ergot as a fungus, its incidence, life cycle, pharmacology and chemistry, together with the effects of ergot ingestion, as well as known epidemics in Europe, is presented. Modern medical uses and recent discoveries as to its potential as a means of preventing an ovum from implanting itself in the uterus, as well as its effect during pregnancy and childbirth, will be considered, as these are the essential important background information on which the hypothesis is based.

Much of the present knowledge of the history of ergot is derived from the writings of Bové (1970) and Barger (1931), the research findings of Stearns (1807) and Chassar Moir (1932) and the more recent research by Shelesnyak (1963 and 1986) and Coutinho (1975).

Most historical material concerning ergot refers to dramatic accounts of ergot epidemics as the result of sudden widespread and mostly accidental ingestion of ergotised rye. Sometimes, within these accounts, other symptoms of the disease are remarked upon concerning the effect on the female reproductive tract. The more modern material relates to the use and prescription of ergot given in small doses of just three grains as a medicine for effecting abortion or as an aid in labour. Recent research has indicated that an even more important factor has been discovered - ergot can act as a contraceptive.

This chapter details the results of the literature search which sets the context for addressing the hypothesis.

Fungi

The fungi or Eumycetes are higher members of the Protista kingdom, (Bowman and Rand, 1980, par 35.1). Of the 50,000 or so known species of fungi they suggested that most are saprophytic, being involved in the essential processes of decomposition of vegetation and animal debris in the soil and elsewhere, but some are parasitic on plants, and about 50 species have been recognized as pathogens in man and animals. Toxins produced by saprophytic fungi (mycotoxins) may cause poisoning and disease.

Ergot

Langdon (1954), pointed out that fungi have a long history and that possibly the ancestral grasses had ergot-like parasites so that present day ergot evolved with their hosts contemporaneously. Ergot was the name given to the sclerota of the fungus claviceps purpurea (Fr) Tul. This infected many species of grasses and was particularly liable to infect rye. Barley, wheat and oats could also be attacked but comparatively rarely.

Historical botanical interest included, in 1596, Gaspar Bauhin, who mentioned ergot under the name of secale luxurians, and whose son Jean printed an illustration of ergot in his *Historic Planatarun* in 1658 (cited by Bové, p. 162). In 1639 the English botanist Ray (1677), alluded to its medicinal properties in the second edition of his *Catalogus plantarus anglio,* (p. 269, cited by Bové p. 162).

While ergot was identified in early plant books, it was also recognized by scholars who researched and wrote on the phenomena from 1779 onwards. A picture of ergot on rye is produced at the front of this thesis and it is usually described as a black cock-spur arising from the ears of rye.

Vincenzo Grasso in 1957 (cited by Bové, 1970, p. 39) compiled a bibliography of 400 references and reported on 600 host plants and 50 species of Claviceps. Within the grass family, Gramineae, ergot could be a parasite in Fetuceae which are fodder

grasses, in Hordeeae, which covered wheat, barley and rye, in Avenae which covered oats, Oryzae which covered rice, Paniceae which covered millet and Maydae, for Indian corn.

Growing conditions and life cycle

Historically it was not until the middle of the seventeenth century that the weather was found to be implicated in the growth of ergot. It was observed to be more plentiful after a long, cold and rainy Spring followed by a warm summer. At an even later date it was discovered that a lengthier than usual flowering time of rye increased the chance of ergot formation - this occurred when there was cool weather in Spring. Conversely, warm days at this time decreased the chances of infestation.

Louis Rene Tulasne (cited by Barger, 1931, p. 270) put forward the life cycle of ergot in 1853, but he was not able to describe the mechanism that was involved in the infection of the rye seed heads.

Hecke, in 1921, (cited by Barger, 1931, pp 96, 99-100), placed sclerotia in boxes covered with 1cm of sandy soil and left these in open fields throughout the winter. He then infected the blossoming rye with the spores and then, when the honeydew of the sphacelial stage was formed, he mixed it with water and sprayed the rest of the crop. He was able to produce a crop of highly ergoty rye. As the best ergot for medicine is still developed from natural sources, the commercial cultivation of ergot on rye has now been developed by the needle injection method, with tanks of inoculation fluid flowing through a whole row of rotating tubes spiked with hypodermic needles (imitating the action of insects on the rye).

Rye today is grown on soils, often sandy, which are too poor to give a useful crop of other cereals. On light acid soils rye gives a more satisfactory yield than wheat. Rye grown on good land, from fresh seed, is probably no more liable than wheat or barley to become ergotised (Kent, 1984). However, once a field becomes contaminated, in order to prevent ergot from re-infecting crops the following year, it is necessary to bury the ergot grains at least 10-12 inches deep, rotate crops and in the case of grass

The convulsive disease was often confused with epilepsy, as those affected had jerks in their arms and legs, fell to the floor, had general convulsions, rolled up like a ball or extended themselves rigidly and then recovered tired and exhausted but were able to return to work in the fields next day. Sometimes only the fingers or toes cramped up. Some victims became ravenously hungry. Some people developed confusion, delusions, hallucinations and vomited.

In the past, the disease was thought to be infectious as several members of the family could be ill at the same time (Bové, 1970), but it was later shown to have affected members of the same household because they ate the same ergotised food. The diagnosis of ergotism was often missed and instead attributed to the plague, pest, erysipelas, anthrax, typhus, exanthema (skin eruptions), leprosy and smallpox (Bové, 1970, p. 144).

The best paper written on convulsive epidemics, Barger (1931) contended, was by Hermann Taube of Germany in 1782, while working in the Hanover court. Bové also reported that in 1864, the Medical Department of St Petersberg had an *Ergot Commission* which listed, from 1832 - 1864, epidemics in 30 different districts, involving 900 victims with a mortality ranging from 11% to 66%.

The above epidemics also produced effects on the animal and human reproductive systems. Both forms of epidemics, gangrenous and convulsive, produced symptoms in women associated with infertility and abortion and these symptoms also affected domestic animals. Berde and Schild, in 1978, stated that poisoning with ergot alkaloids had long been known to be a powerful cause of reproductive failure in herbivorous mammals and man: thus ergots can induce abortions, stillbirths, agalactia, malnutrition or clinical disorders in the progeny. Rang and Dale (1991, p. 20) referred to abortions being frequent in both main types of ergotism and that it was clear that ergot contained an active principle which had powerful effects on the uterus. Matossian (1989, p. 673), while not identifying her source, stated that alkaloids of ergot suppressed fertility and stopped lactation while some toxins could

pass through the mother's milk and poison the nursing infant, who were especially vulnerable to such toxin.

As recently as 1978, an ergot epidemic was reported in Ethiopia, affecting 93 people and which caused 47 deaths. In addition some 40-50 infants and children died from starvation due to failure of the mothers to lactate (*WHO International programme of chemical safety environmental health criteria 105*, 1990, p.111.5.1). The report recommended, under further research, that the possible transmission of ergolines through the mother's milk to the infant should also be elucidated (par. 4.4).

Pharmacology, chemistry and historical medical discoveries

While these two dramatic forms of the disease caused major gangrenous or convulsive epidemics, the recognition and the full understanding of the usefulness of ergot as a drug that affected women's reproductive cycle occurred comparatively recently. Hofmann commented (1972, p. 235) that '*over the centuries its* (ergot) *role and significance have undergone a complete metamorphosis*'. Only from the nineteenth century onwards was ergot gradually accepted as a drug that could be used effectively and positively on women's reproductive cycles and could save them from death, rather than it being only considered as a dangerous substance if ingested. The mechanism by which ergot acted was at first poorly understood as its use in childbirth offered a range of outcomes. However, these combined experiences eventually led to an understanding of its potential and increasing research and investigation into its chemistry led to a discovery of many drugs within the substance.

One of the reasons for the slowness in recognizing the potential of ergot as a medicine arose because of the instability and freshness or otherwise of the fungi. Ergot is stable if kept dry and whole, for about 18 months. However, in the past, the variability and instability of ergot gave rise to controversy and confusing results as to its potency and effects.

Stearns, a medical practitioner from the USA, in a letter to a colleague, clearly stated that it was important to go to the granary and select fresh ergot from the rye (Akerly, 1809) but physicians found that the same crude drug gave varying responses. It had to be fresh, as the powder soon turned rancid. Many physicians used ergot mills - like pepper mills - to grind the substance for immediate use. Prescott, in his paper, recorded failures of the ergot to act as expected (1813, p. 94). The stability of ergot was also referred to by Buckheim in 1859 (cited by Clarke, 1927, p.10).

> *The activity of ergot is very unequal, from various causes. Ergot in very wet places is inactive. Preparations lose activity on keeping and no method of producing stable preparation has been discovered.*

In England, Adam Neale (1828), a practising general practitioner, also referred to the loss of quality of the ergot through age or transportation or being washed off (p 61/62), while Moir in his research on ergometrine (1932, p.1121) ensured that there was '*uniformity of action and keeping qualities*' in order to undertake his research on the effect of ergot on the female reproductive cycle. He showed, through testing of the ergots, that the '*most active*' of the liquid extracts was 6 months old. Another sample of 15 months showed a '*good activity*' while a solid extract 2 years and 11 months old was found to be '*very active*'. His paper concluded that different samples of ergot varied in their activity.

Medical understanding and prescriptive use of ergot past and present

Charles Tanret was the first to isolate crystals from ergot in 1875. New drugs continued to be found and their action on the body identified. Ergot had been described in the past as *'the problem child of the medical textbooks'* and as late as 1961, Tyler (p.629) suggested that *'the child may have started to crawl but it cannot as yet walk'*.

The standardization or assay of ergot can still be a problem as there are many constituents within ergot. Each small sclerotium contains ten different groups of substances with over 100 compounds. It can be produced in powder form, as a fluid and ergot extracts. Its chemistry remains complex and has been described as '*a treasure trove of drugs*' (Stoll, 1965). To simplify the pharmacology and

biochemistry effects, the constituents of ergot are now referred to in three groups - Central, Neuro-hormonal and Peripheral.

Robson and Lewis (1952, pp. 294-5) offered the following information on ergot derivatives.

> *The active alkaloids of ergot are all derivatives of lysergic acid and can be divided into two groups. The important constituent of the first group is ergometrine, which is a combination of lysergic acid with d-aminopropanol and is water-soluble and is therefore well and rapidly absorbed when given orally. The second group contains a number of rather more complex substances. The most important constituents of this group are ergotamine and ergotoxine, which are closely related chemically and are insoluble in water and are therefore unreliably absorbed when given orally. The ergot alkaloids exert three main pharmacological effects, namely:*
>
> 1. *Contraction of smooth muscle, including the uterus and the blood vessels. The stimulant effect is exerted directly on the smooth muscle and not through a nervous mechanism.*
> 2. *Antagonism of the action of adrenaline, and paralysis of adrenergic nerves. Motor effects are prevented much more easily than inhibitory effects, but large doses also paralyse inhibitory receptors such as those in the intestine. These effects are produced by ergotoxine and ergotamine, and not by ergometrine.*
> 3. *Stimulation of the sympathetic system by action on the central nervous system, causing sham rage. This effect is produced by ergometrine, as well as by ergotoxine and ergotamine. The action of the latter two drugs is rapidly counteracted by their effect on adrenergic nerve ending as described in (2).*

Dosage and timing

What is also important is that dosage and timing makes ergot either a poison or a prescriptive medicine. In a paper that Professor Clarke read to the Royal College of Obstetricians in 1927 (p.110), he stated that in 1582, Adam Lonicer of Frankfurt [1] mentioned the use of ergot in hastening labour. Moir (1974) reported that in describing the ergot spurs in diseased rye, Lonicer stated *'...they are held to be a special medicine for women in labour and for the purpose of awakening the pains three of the spurs are swallowed'.*

[1] Stoll (1965) referred to him as Adam Lonitzer, the author of the German 'Kreuterbuch'.

Bové agreed that Adam Lonicer in Frankfurt made the first mention of ergot, as a medicine, in his book on herbs - *Krauter-Buch* (1582) and that he stated that it was used by women in doses of three sclerotia, repeated if necessary, for the purpose of increasing and furthering contractions of the uterus. Thalius repeated the above information in 1585, with the additional information that it was also used to stop haemorrhage. It was thought to be used by midwives and that women knew of its use but Bove' found no records that physicians used it for childbirth, except it was used by some physicians in the sixteenth and seventeenth centuries to treat typhus.

Having outlined the main medicinal effects of ergot on the uterus it is important to note it was also used illegally to obtain abortions, often resulting in the death of the women and consequential infertility. As Clarke stated in 1927 (p.110) *'abortion occurred frequently in epidemics of ergotism and the oxytoxic action of ergot was recognized very early'*. In Germany in the seventeenth century, it has been claimed that it was used extensively for the purpose of criminal abortions, and in consequence *'its employment was forbidden by many authorities'*. Christison (1829, chapter 37) reported that at the end of the eighteenth century several states prohibited... the *'quacks and midwives'* from using it, but Clarke quoted Buckheim (1859) who stated that in the eighteenth century it was reintroduced as a therapeutic agent in obstetrics.

Prescriptive use of ergot in England

There are references to ergot being used in the Britain as well. Stearns stated that *'spurred rye has long been administered by the rural matrons of Scotland'*, but he did not give his source (Neale, 1828, p. 23). Adam Neale (1828), a Scottish physician, concluded however in his work that it had no effect on the uterus as an abortive agent and only worked at term (p.77). This is a finding that was rejected as new knowledge of the drug was discovered and the potency of ergot and its instability was understood. Dr Paterson, a medical practitioner from Glasgow, produced an article for the *London Medical Gazette* in 1838 in which he presented two cases where ergot of rye was given as a means of inducing premature labour at seven months.

In England, Dunn (1997) found an early original description of ergot use, documented by Dr Percivall Willughby (1596-1685) *'a pioneering man midwife of Derby'*, who wrote the following about the use of pulvis parturiens (ergot of rye), though his paper was not published until 1863 (p. 71).

> *I was then sent for, and found her sitting, whether in a chair, or on a women's lap, I do not now remember. Shee (sic) was very pale, and faint, having a dying countenance, and her midwife not attending her work, but pulling her by the nose, to keep life in her. I willed the midwife, with the women, to lay her on her bed. With good spirits, and uterine cordials shee came again to herself, and when afterwards, labour began to approach, I gave her a dose of pulvis parturiens, and put her into her midwife's hands, as shee was lying on the bed, and shee was speedily delivered of a dead child. And thus, at the second time, shee was recovered.*

Clearly in this case, the ergot had a direct effect on the woman's uterus by awakening the contractions and prevented her from bleeding further by contracting the uterus and allowing the dead foetus to be delivered.

Source of ergot

It was not shown in the search of the literature how widespread the use of ergot was in Britain in the seventeenth and eighteenth centuries, and this is to be explored later in the thesis in Chapters 8 and 9. What is important from the above discussion is that ergot was used by midwives or *'matrons'* in Scotland and England at least from the sixteenth century and would most likely have been available locally.

Contemporary references suggest that ergot was prevalent in wet summers in England. Rye, in particular, can suffer from ergot contamination especially following a cold spring. Darwin (1791) stated in a footnote to his *Botanic garden* poem that ergot was a disease affecting rye in France, and sometimes in England in moist seasons. His poem Part 1 canto 4 lines pp 511-514 declared:

> *Should the young harvest from devouring light*
> *The Smut's dark poison, and the mildew white;*
> *Deep-rooted Mould, and Ergot's horn uncouth,*
> *And break the Canker's desolating tooth.*

The native rye grown in the UK until 1945 was long strawed, gave low yields and had a high (10-13%) protein yield (Kent, 1984, p.8). Rye, ergot's most common host, was not native to Britain but was introduced by invaders, but exactly when it was introduced is debatable. Barger (1931) stated that rye was first introduced into England by the Teutonic invaders to the sandy soil of Anglia. Kerridge stated that rye was grown on the marshes of Essex in the sixteenth and seventeenth century (1967). Witch persecution was evident in the county at that time, characterized by hallucinations, fits, trances, gangrene and the death of cattle (MacFarlane, 1970).

The point about ergot occurring principally in wet seasons was reiterated in an 1813 article written by the American Dr Oliver Prescott on ergot contamination of rye, when he stated (p. 91)... *'and in such seasons as are very moist, is occasionally seen in Great Britain'*. This would suggest that some ergot must have been potentially in the soil all the time.

Modern understanding of ergot

The effect of ergot on the uterus, which is now better understood, is of particular interest in this historical study. The first real debate and modern publication on its medicinal use arose from a letter from Dr Stearns, a practitioner in the American State of New York. In 1807 Dr John Stearns exhorted a friend (Dr Akerly) to try a sample of *'pulvis parturiens'* (ergot) for patients with delayed labour.

It was the publication of this letter from Dr John Stearns to his colleague in 1809 together with a sample of powdered ergot, that introduced the widespread use of ergot in childbirth, across America and then to the rest of the western world. Stearns stated the dose to be used in 'lingering parturition' without producing any bad effects on the patient - *'boil half a drahm[2] of the powder in half a pint of water and give a third every twenty minutes till the pains commence'*. He stressed that in most cases

> *you will be surprised with the suddenness of its operation; it is, therefore, necessary to be completely ready before you give the medicine, as the urgency of the pains will allow you but a short time afterwards.*

[2] A drahm is a unit of apothecary weight equal to an eighth of an ounce or to 60 grains

Stearns's letter initiated much discussion on its usage in labour and marked the introduction of ergot into orthodox medicine, starting in the USA. Many other articles followed Stearns publication, Stoll (1952), stated that as many as 90 papers on the medicinal use of ergot had appeared by 1827. The use of the drug quickly spread but some practitioners failed to realize the danger of the *'almost incessant action which it induced'* and many lacked sufficient judgement to distinguish between labours which was merely slow and ones which was obstructed. The drug was often wrongly given and many a foetus was stillborn and many mothers died from rupture of the uterus (Moir, 1974). Prescott, in the USA (1813, p. 97), reinforced the need for caution after using it in over 20 cases.

> *It is a powerful agent, which requires prudent direction, but, when properly applied, will be highly useful, many times, to shorten a process, which, unaided, would prove extremely tedious and troublesome.'*

He reported that the death of the infant was a more frequent occurrence, in cases in which the ergot has been employed, than where its agency has not been used, but stated that this did not happen when he used it, as he was careful to use it at the correct time. He cautioned its use *'until the muscular fibre is properly relaxed, and the os.uteri considerably dilated'* (p. 97). Hosack (1824), in the USA proposed that the *pulvis ad partum* (powder to bring forth labour) should be renamed the *pulvis ad mortem.* Neale (1828, p. 28 and p. 30) also re- affirmed this view and stated that *'the art should never precede nature in hastening the act of delivery'* and *'the principal indication required to give ergot is the absence of sufficient uterine contraction to expel the contained foetus'*.

By the end of the nineteenth century the use of ergot during labour had become almost entirely abandoned, but not for the control of haemorrhage after delivery.

From this information it would seem likely that ergot use in childbirth could result in more deaths or stillbirths of babies while also preventing the mother from dying; conversely however, if given at a strong dosage, at the wrong stage of labour, it could cause the uterus to rupture and cause her death. This information is important to consider historically.

Chassar Moir, the man who eventually discovered ergometrine within ergot, was amazed by its action, as he undertook the clinical trials on ergot when it was subjected to chemical investigation in the twentieth century. In a series of experiments, Chassar Moir rediscovered the *'Stearn effect'* in 1931, when he traced on a graph the response of the uterus to ergot. What is also remarkable, as Moir found in 1931, was the importance of direct clinical evidence of the effect of the ergot and eventually ergometrine (1955 and 1974), that is, by placing a hand on the abdomen over the uterus the contraction could be felt.

Moir undertook the following trial in 1931 (1974, pp.293-294). After the insertion of a 3ml balloon into the uterus of a mother on the sixth or seventh day of the puerperium, which was linked to a recorder in the next room, he was able to test the effect of a number of stimuli before the introduction of ergot. To demonstrate these he used a kymograph chart. He recorded the stimulating effect on the uterine muscle brought about by the baby sucking at the breast. A more spectacular effect was produced, by giving a small dose of pituitary extract by intramuscular injection. Then two previously discovered alkaloids of ergot, ergotoxine and ergotamine, were administered intramuscularly and while shown to be reliable uterine stimulants, were slow to take effect after a twenty-minute delay. He then administrated these two drugs orally which made the effect even slower and much delayed.

However, when he gave the patient an oral dose of the liquid extract of ergot, (that is the original form of ergot), at first there was some *'meaningless excursions'* (p. 294) of the recording graph and then after about four and a half minutes with startling suddenness the pen recorder rose. *'Up and up it went until the movement resolved itself into vigorous and sustained oscillations'*. Moir thought at first that the equipment had malfunctioned, but a quick check revealed all was well. His second thought was that the patient must have been behaving in some unprecedented manner, but in the adjacent ward he could see her sitting in bed unconcernedly eating her lunch. His third impression (p. 294) was of sheer astonishment and he recorded his feelings in the words of Keats; '*Then felt I like some watcher of the skies when a*

new planet swims into his ken'. Moir realized he had stumbled on the long forgotten *'Dr John Stearns effect'*.

Dr Moir thought in retrospect that it was strange that any careful observer, by placing a hand over the puerperal uterus, did not feel the change caused by the ergot. Eventually on 9th February 1935 the team were able to produce the effective drug from the ergot, which they called ergometrine, and the findings were published in the *British Medical Journal* in March 1935.

At the time Moir was very open with other colleagues in Europe and America, sharing his knowledge and results before they were published (Moir, 1955,), but as Tansey documented from correspondence (2001, p. 209), this led to others publishing before him and causing *'trauma, involving priority and nomenclature disputes, patent controversies, and the competing interests and powers of commercial enterprises'*.

Dale, his supervisor, managed to persuade pharmaceutical firms in Britain to sell ergometrine as an alkaloid and not give it a proprietary name, and in return, gave them, in common, any information they required. Six firms agreed to this and sold it under the uniform and un-protected name of ergometrine (Cited in Tansey, 2001, p. 208). In the USA it was named ergonovine (Moir, 1974, p. 295).

With proper medicinal usage as Stearns and others documented, and Chassar Moir was able to clinically demonstrate, ergometrine could help when labour was prolonged, when there was a haemorrhage, to hasten the afterbirth or to help with its delayed passage. However, as demonstrated and documented, used in the wrong hands and at the wrong time, it could cause the baby to die during birth from the sustained contractions, and the mother, if her cervix was not dilated or the baby was in the wrong position, could suffer a rupture of the uterus. It has now been shown that small doses of ergometrine increase the frequency and force of spontaneous contractions, but in the cervical as well as the fundal regions of the uterus so it tends to compress rather than expel the uterine contents. While Bowman and Rand stated

in 1980, that ergot is therefore not now used to induce labour, with increased understanding of the action of ergot this has changed. As well as for the third stage of labour it is also used in small doses to start off labour contractions. It is used in labour today, in the form of syntometrine, which contains 0.5mg of ergometrine maleate and 5 International Units (IU) of synthetic oxytocin for stimulating the muscles of the uterus to produce rhythmic contractions.

The discovery of the drug ergometrine from ergot was an important breakthrough in obstetrics. Its use affected the maternal death rate from post-partum haemorrhage, which had for many years remained virtually unchanged at about 0.3 per 1,000 live and stillbirths. In 1940 however, this cause of maternal death rate started to fall and by 1952 it had reached an all time low of 0.06 per 1,000 live and stillbirths. In 2006 there was less than a 1 in 19,020 risk of dying from obstetric complications directly related to the pregnant state (Lewis, 2006), although the use of blood transfusions has also contributed to this decrease.

The stillbirth rate was recently recorded as 5.3 per 1,000 total births, while the perinatal mortality rate was 7.9 per 1,000 total births (CEMACH, 2008).

The contraceptive effect of ergot which prevents nidation or the planting of the fertilised ovum in the wall of the uterus

Stoll (1965) in his Hanbury memorial lecture on 'Ergot - a treasure house of drugs,' made reference to research at the time on the effect of ergocornine, another drug discovered in one of the alkaloids in the ergotoxine group. He referred to the work of Shelesnyak et al. (1961 and 1963), who had discovered that, with a single small dose of ergocornine, it was possible to inhibit pregnancy in rats, probably by preventing nidation (or implantation) of the fertilized ovum. Whether ergocornine and possibly other alkaloids with a similar structure exerted similar effects in humans that could be used for birth control could not be ascertained until large scale trials had been carried out over a long period of time.

One outcome of further research work that appeared in 1964 (Kraicer and Shelesnyak), was a clear relationship between the structure of the alkaloids and their ability to upset the hormone balance of progestation. The mechanism was not known at that time, but was thought to be either an enzyme blockade, either mediated by the pituitary via the hypothalamus, or that the ergot alkaloids set off a trigger effect, in which as part of a chain of events, progesterone was decreased. It was later discovered that with enough ergot the progesterone can be overcome, which then prevented nidation (ovum implantation). His pioneering work was celebrated by his colleagues in 1986, with a symposium on *Nidation* in New York.

One consequence for women who took one single tablet of a suitable ergot alkaloid each month during the second half of the menstrual cycle was that they were unable to bear children. Bové (1970) commented that it would certainly be an anomaly if ergot, the drug used in so many millions of childbirths in the past, could be used in future to prevent even more millions from being born.

Coutinho (1971), with funding from the International Committee for Contraceptive Research (ICCR), the World Health Organisation and The Ford Foundation, found that ergot compounds were powerful stimulants of oviductal motility inducing long lasting contractions from relatively small doses. He also found that the response to ergot compounds were induced at all stages of the menstrual cycle. Preliminary trials reported in the 1975 paper showed that ergonovine maleate (ergometrine in UK) given at a daily dose of 0.20mg orally indicated that the compound had a contraceptive effect.

However, it did not give full contraceptive protection, since several pregnancies occurred which were considered drug failures. In this study, 48 women took ergonovine maleate daily (called ergometrine in UK) for 262 women months. It was calculated that 30 to 40 pregnancies would occur normally in this group if the women were unprotected. However, only six pregnancies occurred, suggesting that the fertility of these women was reduced by the ergonovine maleate treatment (p

550). What is important from the above research is that it was the water-soluble ergometrine (UK name) which had the effect as a contraceptive.

Further experiments combined 0.2mg of ergonovine maleate and 200mg of sparteine sulphate and produced:

> *compounds that offered the first alternative for the development of a truly post coital contraceptive, whose anti-fertility action could derive exclusively from direct action on the lower circuit of the reproductive system leaving undisturbed the function of the endocrine glands* (p.554).

The more recent literature on birth control seems not to have continued with this drug as a way forward but have explored other ways of decreasing progesterone to prevent fertilisation. Following Coutinho's research on the contraceptive action of ergot and Shelesnyak's work on nidation, the further development of the use of ergot seems to have petered out as more information on the action of progesterone became available which eventually led to the development of other kinds of safer and more consistent contraceptive drugs and abortive agents.

The information in this chapter has shown that ergot was considered first of all as a poison, but through experience of using it in small doses, its use in childbirth could often result in more stillbirths of babies while also preventing the mother's death. Conversely, however, if given as a large dose or, at the wrong stage of labour, it could also cause the uterus to rupture and cause her death. As Tansey (2001, p.195) has expressed it '*the history of ergot thus reveals an early ambivalence: on the one hand a cause, on the other an alleviator of disease and suffering*'. While the ingestion of rye claviceps purpurea caused ergotism, varieties of this fungus are now used in the modern commercial production of alkaloids of ergot for medicines in many parts of the world (Bové, pp. 71-72). However, the research discovered by Coutinho concerning the contraceptive effect of ergot and its interruption of the protective action of progesterone, is particularly significant to this thesis. His research showed that ergot had the potential to have affected fertility in women, in the past, where small amounts of ergot were ingested in fairly regular small amounts.

Accidental prescriptive poisoning by ergot

The side effects of giving ergot as a medicine can still produce unwanted problems for women and the drug has to be prescribed with care, otherwise the problems associated with historical ingestion can be invoked.

Ergot also contains many alkoloids which have variously been used as drugs or in therapy. One such was developed by a Swiss chemist who discovered the hallucinatory effect of ergot in 1943. Albert Hofman created lysergic acid diethlamide, LSD or *'acid'* while researching a migraine cure at the Swiss chemical company Sandoz in Basle. He tested the drug he discovered on himself (1972, p. 244). There was eventually a world-wide ban on its use, due to the abuse of *'the drug culture'* by the 1960s hippy generation. Its discovery eventually led to an understanding as to how historically the effects of eating rye contaminated with ergot could have led to the so called mass hallucinations and *'hysteria'* and which often led to witchcraft trials. The Salem outbreak in 1692 was characterized by disordered speech, odd postures and gestures and convulsive fits and *'unknown distempers'* (Caporael, 1976, p. 21). Caporael was the first to suggest the connection of eating ergot in rye bread in Salem, in 1976, and others such as Matossian (1989), developed this further and produced circumstantial evidence of maps and weather tables which supported the proposition.

Ergot has been used experimentally in other conditions: it has been used in the treatment of migraine, psychiatric conditions and old age disturbances, and in tuberculosis as a haemostatic drug (Bové, 1970, and Goodman and Gilman, 1975).

Ergot is currently used as a medicine in migraines and postnatal haemorrhages and there are some important points of interest to note about the side effects in prescribing it, as its dosage has to be carefully controlled, particularly due to possible sensitivity to the drug. Used as a medicine ergot does not readily kill in a single large dose, but in small doses over a long period. Currently, the accidental poisoning of women by giving ergot tablets for migraine is still a problem in modern medicine and can cause ergotism or effects on the reproductive systems. These effects have

now been more generally recognized by those prescribing the drug. Fatal effects, when they occur, usually develop from long continued use of small doses. As early as 1854, in the UK, in the *Medical Jurisprudence*, it was recorded that a teaspoon of tincture of ergot, taken 3 times a day for 11 weeks, was alleged to have caused the death of a woman three months pregnant (Taylor, 1854).

Van Rensberg and Altenkirk (1974) also stated that tolerance to ergot alkaloids undoubtedly varied enormously between patients. Toxic symptoms were not always a consequence of errors of dosage, but were ascribed to unusual sensitivity. Less than 4 mgs of ergotamine tartrate orally was reported to have caused gangrene of both legs (Bross et al., 1963). Provocative tests for patients with migraine, to establish whether the drug or a particular dosage suited them, using doses as small as 1mg, elicited *'serious symptoms'* (Enge and Sivertssen, 1965). Acute poisoning with gangrene was reported after a patient had taken 5 and 72 mgs ergoline and 9 mgs ergometrine for migraines (London et al., 1970).

A case was reported in the *Lancet* in 2001, in which a 43 year old woman had been taking 2-6 mgs of ergometrine tartrate and caffeine suppositories since the age of 18 for migraine attacks. On review of her case notes it was found that she had had a spontaneous abortion at 12 weeks gestation at the age of 35 and two pregnancies complicated by premature labour at 40 and 41 years of age. She was admitted with a life-threatening mesenteric ischemia due to chronic ergometrine use (Christopoulis et al., 2001). The paper also gave references for a number of other cases of fatal internal gangrene in pregnant women in Fiji, with suspected ergotamine poisoning (Holmes, Martin and Tabua, 1969).

The *British National Formulary* (BNF, 1994) suggested that ergot alkaloids for migraine should be limited in their use, should not be given frequently, and are best avoided.

One further action of ergot also needs consideration. All the ergot usage considered so far has been associated with ingestion, but it is feasible that in confined spaces it

may also act on the skin and mucous membranes of those persons exposed to the substance in the surrounding air. This could occur through lying in the grain fields at harvest time or grinding the rye for flour in the home or in the mill. Dr Henry Allen (2005) in the *The Material Medica of the Nosodes* referred to a report from a miller in Pittsford New York (1883-84) who was unable to grind rye, even for a short time. When he entered the mill where it was being ground he had a sensation of constriction in the throat, great difficulty in breathing, difficult inspiration and expiration and pricking of the tongue. This did not occur when he ground wheat.

The miller also reported similar problems in two rye mills in Rochester, where others suffered as he did but with the addition of eruptions on the neck, chest, ears and around the waist. The eruptions were reported as pustular, itched violently and discharged a yellow matter. Many other grinders had enlarged finger joints and poor teeth.

Historical background and epidemics

A summary of other historical material is now presented for completeness of this chapter, to show the longevity of the effect of ergot from the past, worldwide.

Bové suggested that knowledge of the history of ergot poisoning and its use is limited by scholars' ability to decipher ancient scripts, hieroglyphics and cuneiform writing. Rye was not reported in the bible, even though Moldenke and Moldenke (1952) examined the scripts in detail, but tares or darnel on which ergot is often parasitic is mentioned.

It was however referred to in Ancient Chinese texts. It is mentioned in Chapter 13 of Thya written in 1100 B.C. as an obstetrical remedy and was called Meih-meh. Bové attributed the absence of further knowledge of the use of ergot in China and in India to lack of scholarship, either due to failure in translation or because the question was ignored. However the Aztecs were known to use ergot for its hallucinogenic properties in their religious, semi-religious and healing ceremonies, one of the sources from plants was called Ololiuqui or Morning Glory.

Korbert (1899) argued that cereal crops were blamed for many types of poisoning in animals and man, but it was not always the cereals that were at fault, but the weeds which grew at the edge of the fields and those that grew amongst the wheat and rye. Korbert surmised in his study of the ancient classics, that where Hippokratesm 460-357 B.C. and Pedanios Dioskurides, in the first century, offered remedies which included eating coarsely powered barley flour and wheat flour cooked with water, these took for granted that ergotised cereals were used. He also referred to Galen, who referred to bread made from a cereal called Briza which became blackish and acquired an unpleasant odour. Briza erysibodes is a term used by modern Greeks to refer to ergot. Galen also referred to the necessity to sort out the bad and black impurities in the grain. Bové suggested that most of Koberts's views were deduced from Galen's text. However one of his students pointed to the possibility of the word melanthium meaning ergot, and not nigella (love-in-the-mist) as translated, as the principal cause of our lack of insight from ancient texts. The translation from Greek meant *'arising out of the grain'* as well as *'sorting out from the grain'*; two expressions which do not apply to nigella, because of its size and the fact it did not arise from the grain. Another student of Hippocratic writings, Beck (1909, cited by Bové, 1970 p.141) made a firm decision to translate melanthium as ergot after studying the text.

In the Orient, a Persian physician Abu Mansur Muwaffak bin Ali Harawi, living in the tenth century, stated that ergot was a powerful poison (translated by Achundow, 1893, and cited by Bové, p. 141). Ergot was called qurun as-sunbul. It was also mentioned and described in two forms by Abu Musa gabir ibu Hayyau as-Suffi al-Umarwi, thought to have lived approximately 720-725 A D, who was considered to be the greatest alchemist of the eighth century. The two forms he described were first one black with the shape of small horns and the other blackish tingled with yellow with a stalk like the stem of a clove. The difficulty in attributing the information to his name, Bové contended, stemmed from the debate over his existence and the timing of the documents which were said to emanate from the period, being possibly written by many people, much later.

Within his searches of ancient texts, Kobert also examined Roman writings. A reference by Julius Caesar 100-44B.C. following the siege of Marseille that an epidemic broke out due to lack of food and that people were faced with eating spoiled oats and barley could, suggested Bové, be interpreted either as eating ergot or decayed cereals.

Titus Lucretius Carus 95-55 B.C., a poet philosopher, in a poem referred to pests in Athens in 430 B.C. resembling *'ignis sacer'* or *'holy fire'*. Aurelius Cornelius Celsus a medical writer of the first century also referred to *'ignis sacer'* as well as necrosis. These confirmed to Kobert the presence of bread poisoning. Caius Plinius Secundus, 23-79 A.D., a naturalist, reported grain spoiled by bad weather and also conditions that affected the planting. Some called them rust, burn and carbuncle. Roman religious festivals seemed to have been set up to address the farmer's fears for three different periods of the year. In particular the first was *'robigalia'* or blighted grain festival, celebrated on April 24th as the start of the period when some of the kernels of grain started to burn or became black. The God Robigus guarded the planted field against blight.

Pliny, cited by Bové (p. 143), referred to grain being *'burned'* in valleys where there were no wind streams and a lot of mildew. In another of Pliny's writings he referred to melanthium juices being poisonous if taken in large amounts: such seeds gave bread a certain spicy tang as well as furthering menstruation and in doses of thirty seeds could even cause abortions.

From about the 11th century, names such as *'holy fire'* (ignis sacer), due to the burning sensations, which had been applied to gangrenous ergotism were replaced by *'St. Anthony's Fire'* because people suffering from gangrenous ergotism were treated in hospitals dedicated to the saint (Barger, 1931, pp. 54-57 and Hofmann, 1972, p. 238).

Rudolf Kobert (1899) pointed out 65 epidemics of the convulsive type of ergotism from 1581 to 1889, 29 in Germany, 11 in Russia, 10 in Sweden, 4 in Italy and others in Finland, Holland, England, Switzerland, Norway, Hungary and the United States. Counting both types of ergotism he stated that Germany had 60 epidemics. Epidemics when they occurred tended to happen after the harvest, but could occur for 18 months afterwards. However as Creighton (1899, pp. 52-68) recognized

> *the types of ergotism can be so varied that the task is, not to search the records for the name of ergotism, but to scrutinize any anomalous outbreak of disease, or any outbreak distinguished ... by some unusual mark, with a view to discovering whether it suits the hypothesis of ergotism.*

Nomenclature

The name ergot is probably a derivative of the French word 'argot' or cockspur or rooster's spur that it resembles. The farmers of Gatinais called it Bled Noir meaning black rye. The extent of ergot infection of rye can be understood in terms of the number of names for ergot. Bové discovered over 600 hundred names worldwide. He listed 47 French names for ergot, 63 German terms with many regional variations as well and 21 Dutch names and 9 English and 34 Latin ones, as well as the main terms for it in 13 other countries. The problem can therefore be considered to have had international recognition, and from early times.

The English did not have a word for it and adopted the word ergot. However Bové (1970) listed the following other terms they used:

- Claviceps purpurea
- Cockspur
- Cockspur rye
- Compact mycelium
- Ergota
- Ergot of rye
- Horn seed
- Horned rye
- Mother of rye

- Rye of ergot
- Rye smut
- Sclerotium
- Secale cornutum
- Spawn
- Spiked rye spur
- Spurred rye.

Creighton (1899) and Drummond and Wilbraham (1958, p. 252) suggested it was also referred to as *'raphania'*, from the Latin, while Bigelow (1816) a medical botanist from Boston, stated it was a Linnaean name and in his text used the expression *'raphanus'* as well.

However, compared to England, other European countries had many names for ergot and many further names among the dialects. The German word *'mutterkorn'* was mostly universal. The term *'mutter'*, as in *'mutterkorn'*, could have meant mother or uterus or womb, but also other words were used, such as *'kindesmord'* - meaning child killer - in relation to its abortive action (Bové, 1970, pp. 3-14).

Conclusions

This chapter has described ergot as a fungus, outlined its incidence, life cycle, pharmacology and chemistry, together with the effects of ergot ingestion, as well as highlighting known epidemics across the world from earliest times. The modern medical uses and recent discoveries of drugs within ergot with the potential of preventing an ovum from implanting itself in the uterus were examined, as well as its effect during pregnancy and childbirth. The main features concerning the negative effects of ingestion identified in this chapter were that ergot could cause ergotism by high intakes over a short period of time, low intake over a long period of time or when ingested by people who were sensitive to the fungus, demonstrated by the need for careful use as a modern medicine for migraines. The literature survey also drew

attention to the effects of a sub-clinical level of ergot intake that could act as a contraceptive, be effective as an abortive agent and could be used as an aid in labour.

These points were considered as essential background information on which the hypothesis is based and from this chapter a number of points have been identified to further the hypothesis.

Implications for research on population and fertility

The outcomes from this chapter help to reinforce the hypothesis that there was potential for poisoning by ergot contamination in England in the past and in the long eighteenth century. This would therefore depend on whether the following points concerning ergot can be established:

- The amount of rye grown and eaten and the likelihood of its contamination and subsequent effects on the health of women

- The approximate date of the introduction and use of ergot in midwifery and later by doctors

- The application of the knowledge that ingestion of small doses of ergot over time could cause infertility by acting as a sub-clinical contraceptive, to the period under consideration

- An examination of the knowledge that large doses at certain times during pregnancy could cause abortions

- Its positive medical use in helping women who experienced slow non-obstructed labour to maintain contractions or start them off, to help the passage of the placenta and to stop haemorrhaging in the third stage

- The application of the knowledge that when used at the wrong time and the wrong doses it could cause abortions, rupture of the uterus in labour and the death of the infant in obstructed labour, or, if given in too high a dose, could kill the baby in the womb through the pressure of the sustained contractions and the effect this could have on the interpretation of the demography presented in Chapter 1.

On the one hand the demography examined in Chapter 1 has already highlighted a series of possible factors that suggested that stillbirths and endogenous infant births, abortions and possible infertility were particular areas of importance in the study of the population at the start of the long eighteenth century. On the other hand, an increase in fertility in the young, demonstrated by early marriages and an increase in illegitimate births as well as increased numbers of older women continuing to be still fertile in later life, were also thought to be reasons for the reversal of trends from approximately the middle of the eighteenth century onwards. However the view that an improvement in midwifery care could also account for the increasing survival of mothers and their offspring needs to be assessed further.

Before turning back to the demography, in order to apply the above information on ergot to fertility in the seventeenth and eighteenth century in England, it is necessary to determine how much rye was grown and under what conditions, what standards could be used to prevent ergot growth and contamination, whether there was any change in the ingestion of rye by poor families in particular during the period under examination and if there was any gradual trend away from its use that corresponded to the demography. These are the themes of the next four chapters.

Chapter 4

Modern standards for the prevention of contamination by ergot in the sowing, growing and harvesting of grain and the minimisation of any residue during milling, cooking and brewing of food and drink

In order to establish whether ergot could have caused health problems for people in England in the seventeenth and eighteenth century, especially agricultural labourers and the poorer farmers and craftsmen and their families, the standards that are used today for growing grain, particularly rye and other susceptible types of grain, need to be established in order to provide a basis for comparison of the available processes to exclude contamination. Modern methods to prevent the processing of ergot into flour and other foodstuffs, and the temperatures needed in cooking to destroy the toxins, will be described. The standards used in the brewing industry will also be addressed.

Having established the modern standards for avoiding ergot poisoning by ingestion, Chapter 5 will then examine the amount of rye grown and eaten during the period under study and will compare modern standards against growing conditions, farming practices, the processing of meal and flour and the effect of baking in the seventeenth and eighteenth century. The process of making home beer will also be examined.

The establishment of voluntary codes of good practice and standards

The United Nations environment programme, the International Labour Organisation and the World Health Organization under joint sponsorship produced an expert report in 1990 on selected mycotoxins including ergot (*International programme on chemical safety, environmental health criteria 105,* 1990). It stated that ergotism is by far the oldest known mycotoxicosis in man and animals, with recent episodes occurring in Ethiopia.

The report also discussed the main research into occurrences in foodstuffs then available. Concern was particularly raised that contamination of grain with ergot is expressed as a percentage on a weight basis, without measurement of total and individual amounts of ergolines.

Current approaches in Britain are two fold: to prevent contamination of cereals in the UK; and to avoid importing ergot in grain from other countries.

The Home Grown Cereal Authority (HGCA) was previously the government authority dealing with management of arable farming in Britain, but from 1st April 2008 it became part of the single levy board, the Agriculture and Horticulture Development Board with a web site at http://www.hgca.com. This is the point of contact for up to date information on farming problems and information and there is a range of sources of advice included on its website. In 2002 it included a topic sheet (56) on managing ergot in cereal crops, published by the Royal Highland Education Trust. In the UK, the Agricultural Supply Trade Association (UKASTA) standards for ergot are 0.001% by weight for feed grain (1/100th of a gram per kg), and a zero tolerance for all other grain.

Ergot was only considered a serious, but occasional, problem in 2002, but recent literature from HGCA in 2005, after a damp spring and repeated wet spells in the summer, raised concerns that ergot would be an increasing problem due to climate change. HGCA (2008) is currently funding research on a sustainable whole-farm approach to the control of ergot (project 2992).

Currently HGCA's advice is to avoid ergot contamination of cereals by not sowing those crops which are most susceptible to infection during flowering: triticale, rye and hybrid wheat and other particular wheat varieties such as Rialto and Durum wheat (Topic sheet 56, and Yarham 1993). Continuing problems still need to be resolved concerning cross contamination by native grasses and black grasses along verges and tramlines, and more recently in fields where organic farming has become popular. The UK higher voluntary seed standards therefore demand no ergots in basic seed and no more than one *'ergot'* in certified seed in a 1kg sample of wheat, oats or barley.

HGCA's current advice to prevent contamination in grain, from their website, is listed below (2002), while Figure 4.1 illustrates the life cycle of ergot.

Action:

- Do not sow contaminated seed. Clean farm-saved seed thoroughly to remove ergot
- Where ergot is often a problem, avoid growing susceptible crops and varieties.
- Rotate cereal and non-cereal crops.
- Control grass weeds that may act as hosts, e.g. black-grass, annual meadow-grass.
- Use herbicides to control susceptible grass weeds in set-aside before they flower and can become infected with ergot.
- Harvest heavily infested areas, e.g. headlands or tramlines, separately to avoid contaminating large bulks of grain.

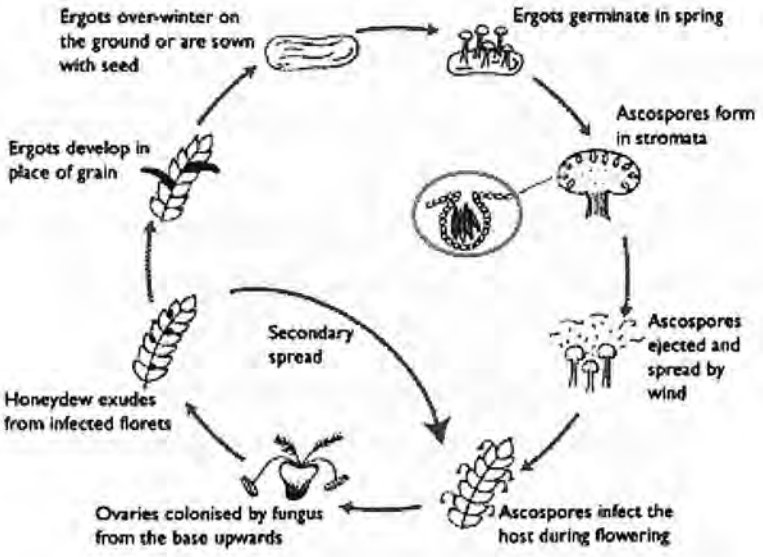


Figure 4.1 The life cycle of ergot
(Source HGCA Website http://www.hgca.com 2002)

HGCA also suggest that an understanding of the life cycle of ergot is the key to a range of cultural and hygiene measures (Figure 4.1). Areas where the weather is cold

and prolonged during Spring favour the development of ergot and should avoid growing rye, while deep ploughing and resting of the ground following a crop of ergotised grain would help to prevent further contamination.

The European Mycotoxin Awareness Network (EMAN) is a multidisciplinary group of 14 organisations, with expertise in the field of mycotoxins, representing government, industry and academia in 13 European countries. EMAN exists to provide high quality scientific information and news about mycotoxins to industry, consumers, legislators and the scientific community, through the medium of a website (2003). EMAN (2000, p. 3) maintains that there is no legislation in place for ergot alkaloids, but many countries have recommended or made compulsory maximum limits for the percentage of ergots allowed in cereal. The tolerance level for ergot in grain in the U.S. is 0.3% (3 grms per kg) crude ergot alkaloids, in Canada it is 0.33%. British standards suggested that it there should be zero tolerance.

However, Goodman and Gilman (1975) state that in North America and Europe in dry years the rejection rate of grain is usually less than 1%, but in other years it has been as high as 36%. A great deal of grain is imported into Britain, but the method of detection for ergot in imported grain is variable.

In areas where ergot is a problem, EMAN advice is similar to that in the UK, that ergot resistant grains such as wheat, barley, or oats should be grown, rather than rye or triticale. The use of clean seed, crop rotation, and deep cultivation can assist in minimising ergot infestation of grain. Farmers are advised that ergots only survive one season in soil so a break from growing cereals should provide good control.

There is also concern for animals and reports highlight that animals should be removed from ergot-infected pastures, and contaminated grain should not be used for animal feed. While it is generally recommended that feed containing more than 0.1% ergot should not be given to animals (Young, 1981a and b) quality is not always carefully controlled and ergot does enter the food chain.

In a survey of ergolines in ergot contaminated cereals, in North America, the average total ergolines content was 0.24% (Young, 1981a and b; Young & Chen, 1982). Of these pooled ergoline compositions in sclerotia in rye, wheat, and triticale, those drugs that affected the female reproductive cycle, already identified in Chapter 3, were found to be in the percentage of ergotamine (17%), ergometrine (5%) and ergocornine (4%). The survey stated that the individual ergoline composition was uniform throughout a single sclerotium or in different sclerotia from the same head, somewhat less uniform between different fields throughout a region, and highly variable from head-to-head in a given field. In contrast, the total ergoline content was highly variable within-sclerotium, within-head, head-to-head, and on a field-to-field basis. In a comparative study of ergoline in ergots from rye and wheat and in ergots from pearl millet (caused by infection with Clavicep fusiformis) in South-East Asia, the total ergoline content in the sclerotia of pearl millet was much lower (320 mg/kg) than in the sclerotia of rye (700 mg/kg) and wheat (920 mg/kg i.e. approximately 0.1% Bhatt et al., 1976).

Another study highlighted by the WHO international report concerned a survey of cereals and cereal products on the Swiss market in 1985. Using a high-performance liquid chromatography procedure, the following average concentrations of total ergolines were found: wheat flour, 4.2 µg/kg; wheat flour (coarse), 30.7µg/kg; wheat flour (more coarse), 103.4µg/kg; rye flour, 139.7 µg/kg; and "bioproducts", 10.2-22.7 µg/kg (Baumann, Hunziker and Zimmerli, 1985, (paper in German)). The daily intake of total ergolines by human beings in Switzerland was estimated to be 5.1 µg / person.[1]

None of the above amounts of ergot found in the flour or food are in themselves a great danger to the general public, as most diets are so varied that only very minute amounts would be ingested as a proportion of the whole diet. The examples are presented to illustrate that in recent times even with all the high level of standards in

[1] Note 1 microgram = µg = 0.001milligrams. 1milligram = 0.001 grams. 1000 milligrams = 1.0 gram

the sowing, harvesting and processing of rye in particular, ergot contamination is still able to enter the food chain in varying amounts.

However, when ergot contaminated bread or flour products are regularly eaten as a high proportion of the human diet, ergot contamination becomes more of a problem than with occasional intake, unless the food product was heavily contaminated.

In their further recommendations, the *WHO environmental health criteria 105 expert report* (1990) suggested that further work should be carried out on the possible effects of low levels of ergolines on the human population and that the possible transmission of ergolines through the mother's milk to the infant should be elucidated.

The problem still remains that while grain is still assessed on a voluntary basis after harvesting, and acceptable levels vary from zero to 0.33% in developed countries, it then relies on other stages of processing in which the ergot can be detected, eliminated or decreased and these are not necessarily effective either.

Removal of ergot during processing to flour

Kent (1984, p. 176) stated that as grain was liable to contamination with ergot, ergot should be separated before the grain reached the machines, such as scourers, that might break up the ergots and render their removal more difficult. The process of rye cleaning involved the use of milling separators, with suitable sieves, indented cylinders or discs and table separators, in addition to the rye being washed in a washer and whizzer. Ergots, which are generally of greater length than rye grains can be separated this way, but those that are smaller can get through the process. These can be separated by flotation in a strong salt solution in which the rye grains sink while the ergots float.

Heat as a method of destroying ergot alkaloids

The EMAN report also stated that the pharmacologically active alkaloids are not very heat stable and are substantially reduced on baking bread. Only low levels of the active alkaloids remain in prepared foods as cleaning and milling remove the sclerotia and baking or other heat processing destroys most alkaloids.

However ergot can still be found in food and the processes undertaken to eliminate it are not always 100% effective or always applied. From the WHO international report the following points were highlighted concerning research on contamination through ergot of flour and foodstuffs across continents.

Baking can reduce the ergolines present in contaminated flour by 25 -100%.
Ergolines melt during food processing, due to their chemical and physical properties. EMAN stated that most alkaloids form colourless crystals that are readily soluble in many organic solvents but insoluble or only slightly soluble in water. Most melt with decomposition over a range of temperature.

Table 4.1 Physical and chemical properties of selected ergot alkaloids

	Molecular formula	Molecular weight	Melting point (Deg C)
ergotamine	$C_{33H35O5N5}$	581.6	212-214 (dec[2])
ergocornine	$C_{31}H_{39}O_5N_5$	561.7	182-184 (dec)
ergocristine	$C_{35}H_{39}O_5N_5$	609.7	165-170 (dec)
ergocryptine	$C_{32}H_{41}O_5N_5$	575.7	173 (dec)
agroclavine	$C_{16}H_{18}N_2$	238.2	210-212 (dec)
ergometrine	$C_{19}H_{23}O_2N_3$	325.4	175-180 (dec)

Source: European Mycotoxin Awareness Network, p1, 25.2.2005.

[2] Dec=decomposition

Treatment of sclerotia from wheat with chlorine (1%) and heat (150-200 °C) resulted in a 90% reduction in ergoline content within 4 hours (Young et al., 1983). The reduction affected all the ergolines (ergotamine, ergocornine, ergocryptine, ergosine, ergometrine) in identical ways. Autoclaving sclerotia at 121 °C for 30 min resulted in a 24.6% reduction in total ergoline content.

Studies to show the potential rate of decrease of ergot with differing processes

For the safety of humans, ergot should not be present in grain. In samples of flour in Canada, a main exporter of grain to much of the European market, quantitative analysis for total and individual ergolines in 14 samples of rye and wheat flour (Scott & Lawrence, 1980) indicated contamination with 6 Group 1 ergolines (ergometrine, ergosine, ergotamine, ergocornine, ergocryptine, ergocristine) at concentrations ranging from 0.3 to 62 μg / kg for individual ergolines. Ergocristine was the major ergoline present in the flours: in dark rye flour, 62 μg / kg was the maximum concentration found, while there was a maximum10.4 μg /kg of ergometrine.

In 17 samples of rye grain collected from health shops in Sweden, six contained ergot; ergoline concentration and composition were not indicated (Akerstrand, 1980, paper in Swedish, cited by WHO International programme, 1990).

In a Canadian research study, the baking of bread and pancakes using grain that contained naturally occurring ergot, a 59 - 100% reduction in the individual ergolines (ergosine, ergocornine, ergometrine, ergotamine, alpha-ergocryptine, ergocristine) was observed in whole wheat bread, a 50-86% reduction in all-rye flour bread, and a 25-74% reduction in triticale pancakes (Scott & Lawrence, 1982).

In Switzerland, when bread made of rye flour spiked with finely ground sclerotia of C. purpurea, (containing a total ergoline concentration of 312.8 μg/kg), was baked there was an overall reduction of 50% in the ergoline concentration, as measured by high performance liquid chromatography (Baumann et al., 1985).

Brewing standards

Alcohol may also be a problem if contaminated with ergot. All beers are brewed using a process based on a simple formula. Key to the process is malted grain depending on the region, traditionally barley, wheat or sometimes rye. When malting rye, care must be taken to prevent ergot poisoning, as rye is particularly prone to developing this toxic fungus during the malting process. *The Assured UK Malt Technical Standard* (version 3.4 January 2008 para 2.3) states that checks need to be carried out on all barley for brewing to ensure that it is acceptable and meets the purchase specifications. Among the list given, as a minimum check, is ergot, although detail of how this should take place and the level of training required by the checker is not specified.

Conclusions

In conclusion then, ergot contamination of food stuffs and alcohol and the potential for poisoning can now be kept under control. The standards therefore reflect the importance of clean seeds, careful crop management, and good sorting techniques at the mill, the use of analysis techniques to check the flour, and careful cooking and heating techniques which will kill most of the alkaloids, depending on temperature and length of time – a process extending from planting to food preparation. However research has shown that after processing, ergot in small amounts can still be found in some food stuffs, or if the voluntary standards have been ignored or not fully applied.

The following list of modern standards and preventative methods can help ensure that the minimal amount of ergot reaches human food, alcohol and animal feeds. They are a combination of the list previously given earlier in this chapter from the HGCA'S advice for 2002 and drawing points from various sections discussed above. Together they form the standards against which agriculture and food processing should be tested in seventeenth and eighteenth century, in order to consider whether there was a likelihood that the staple diet of the people was contaminated with ergot.

- Do not sow contaminated seed. Clean farm-saved seed thoroughly to remove ergot.
- Where ergot is often a problem, avoid growing susceptible crops and varieties.
- Rotate cereal and non-cereal crops.
- Control grass weeds that may act as hosts, e.g. black-grass, annual meadow-grass.
- Use herbicides to control susceptible grass weeds in set-aside before they flower and can become infected with ergot.
- Harvest heavily infested areas, e.g. headlands or tramlines, separately to avoid contaminating large bulks of grain.
- In areas prone to long cold Spring times crops susceptible to ergot should not be grown.
- Where ergot appears on crops after harvesting there is a need for deep ploughing and resting of the ground following a crop of ergotised cereal to prevent further contamination.
- Careful checking for ergot before processing to flour and then the use with specialist machines that separate, sieve, wash and whiz etc. is needed.
- Varying temperatures can be used to kill alkaloids during cooking, especially those heated for 4 hours.

More recently the brewing industry has become aware and concerned that ergot should not enter the malting process and has begun to check the quality of its grain supplies on reception from the growers.

In Britain the onset of climate change involving wet Springs and warm Summers together with the increase in organic farming indicates that the above standards need careful application.

In conclusion, the modern standards used to prevent the growth of ergot, particularly on rye and other vulnerable types of grain, and the detection of ergot in flour and bread, define what levels and doses of ergot could be considered safe for humans and

animals. British standards suggested that it there should be zero tolerance. Applied to the seventeenth and eighteenth century, this would mean that the bread of the people, which would have been the main diet, should have been completely free of ergot or it could have affected their health. The following chapters explore whether this was probable.

Chapter 5

Rye growth and consumption in England in the seventeenth and eighteenth centuries

In Chapter 1 the main issues relating to population and fertility during the long eighteenth century were discussed using the results from the Cambridge Group's family reconstitutions and inverse projections, and, as part of Chapter 3, the effects of ingesting ergot in rye products and from medicinal usage were described.

To establish whether ergot could have had any effect on fertility through the ingestion of rye during the period of the seventeenth and eighteenth centuries in England it is now important to consider the extent of rye cultivation and usage throughout that period. This is crucial to the development of the hypothesis proposed in this thesis as rye is the main crop on which ergot grows, although it can develop on poorer kinds of wheat and other cereals depending on the agricultural conditions and techniques. It is also important to assess whether there were any changes in this usage or availability, and whether these changes in turn corresponded to the population changes already highlighted and presented in Table 1.1a and 1.1b.

In order to determine the potential impact of ergot, the discussion presented in this chapter draws heavily on Ashley's (1928) seminal research *The Bread of our Forefathers, an Economic History* which appears to faithfully reproduce primary sources for the relevant period and has not been superseded or challenged by any later analysis. Overton (1996, pp. 93-98), as well as using Ashley's work, does however, offer some other figures. These were obtained from county studies of probate inventories showing the proportion of arable land under cereals and pulses, which, although incomplete, demonstrate regional differences in the types of crops grown and trends in the decline of rye and the introduction of new crops.

Ashley's main objective in his research was to ascertain how long wheat had been the bread diet of the English people and what constituted the basis of the diet before its introduction. He deduced that, by the end of the eighteenth century, *'pamphleteers'* of the period widely asserted that eating wheat was a comparatively

recent state of affairs and that not many decades previously people had subsisted on very different fare (p. 3). Ashley asserted that in earlier centuries the bread of the population was chiefly of grain other than wheat, as suggested by economic investigators such as Eden (1797) and Tooke (1838) and other general historians. Ashley set out to discover whether rye had been the staple diet.

However, his first paper on the issue (1921) came under criticism as he challenged some of the views of Thorold Rogers who was highly regarded for his *History of agriculture and prices* (1866) and who held the view that rye was never an important component of the Englishman's food (1866 and 1884). His son wrote a critique of Ashley's paper (1922) but this in turn was challenged by Ashley who devoted his research to proving the importance of rye as the food of the English people and published the conclusions of his work in his subsequent book in 1928.

Ashley maintained that:

> *the tradition of things medieval survived in England right down to the time when the enclosure movement had finished its work, and then, in a curiously brief space of time, hardly more than a generation, even the large outlines of the age-long rural economy of England passed completely out of memory* (1921, p. 285).

He put this down to *'the heavy veil of early Victorian forgetfulness and self-satisfaction'*. Ashley (1921, p. 285), however, pursued the question, *'if by the eighteenth century wheat bread was the diet of the English people, how long had this been the case?'*.

In order to achieve this outcome Ashley attempted to prove his theory that rye was previously the staple food of the mass of the people, by starting at a point in the late eighteenth century and then working backwards. Ashley selected three particular points in the eighteenth century to demonstrate the changes: namely the end of the eighteenth century, around 1764 and 1696. These time periods will be examined in turn, working backwards as Ashley did.

Ashley started with reference to the *'Speenhamland Act of Parliament'* (*sic*; it was actually a system), in which the Berkshire justices in 1795 took the price of wheaten flour as the basis for their calculation of bread prices to determine family allowances under the parish Poor Law. He commented that:

> *the attempts of well meaning philanthropists to persuade working people to content themselves with bread of other corn were received with indignation and were totally unsuccessful* (Ashley, 1928, p. 2).

The rural labourers and the poor small farmers and cottagers, he concluded, had learnt to like and expect wheat as their main grain for bread.

As there were very few statistics available to help establish how much rye and wheat were actually grown and used, Ashley (p. 2) suggested that Arthur Young's assertion that *'in 1789 nineteen times as much wheat was grown and used for bread in England as rye'* (Young, 1794, p.123), was a guess approximating pretty closely to actual conditions at that time.

The reports of the Board of Agriculture were important intelligence as to the state of agriculture in England towards the end of the eighteenth century and often referred back to previous decades, and were a source that Ashley fully exploited. The Board was established by Pitt in 1793, with Sir John Sinclair as President and Arthur Young as secretary, and was abolished in 1822. Agricultural information was gathered in a series of county reviews. The Board directed its attention first of all to collecting information as to *'the cultivation of the surface and the resources to be derived from it'* (Young, 1804, vii). Clergymen were often the main enquiry agents. The findings were collated and two *General Views* of each county were published by the Board. Young also edited forty-five volumes of the *Annals of Agriculture* from 1784 -1815 (Overton, 1996, p.19).

By expressing their opinions on the then current state of rye production, the recorders for the Board of Agriculture also affirmed the earlier status of rye as a crop. It became clear from these reports that many authors thought that, by the end of the

eighteenth century, rye was little grown and very little eaten, but that much more had been grown and consumed in the past. In Arthur Young's *Annals of Agriculture* (volume xxv, 1796, p. 580) it is reported *'in Nottinghamshire opulent farmers consume one third wheat, one third rye, and one-third barley; but their labourers do not relish it, and have lost their rye teeth, as they express it'*. There were other examples. In 1808, for instance, in the Board of Agriculture report by Bachelor on the county of Bedfordshire, it was stated that *'the quality of this corn*[1] (*sic* rye, in this instance as under a small section headed Rye*) which is grown in Bedfordshire is much decreased of late years'* (p. 386).

However, Burnett (1989, p. 4) argued that Ashley's low estimate of rye usage even in 1795 was *'premature'*, because mixtures of grains continued to be used regularly in country districts for many years after this, especially in years of scarcity and high prices. Ashley (1928, p. 1) on the other hand stated that in the records of the previous Great War that ended with Waterloo (1793-1815), wheat had become the *'almost'* universal bread corn of the whole people, of all classes and occupations. The following discussion shows that both were right: Burnett because the mixture of flour in bread helped to moisten and prolong the keeping of bread and Ashley because in times of necessity, especially in the north of the country, there was a resort to poorer grains, as will be discussed later in this chapter.

Variations in the quality and types of bread in towns and rural areas

The type of bread marketed and eaten varied between rural areas and the towns. Burnett (p.4) maintained that, however poor, the townspeople ate wheat bread in the nineteenth century, which was mostly white, a product of *'high milling'* and total removal of the bran. This change in public taste had originated in fashionable London society early in the previous century, reaching other provincial towns like Norwich by about 1745 (Fay, 1923, p. 89). Burnett reported that by the time of

[1] The word 'corn' was then used to mean all grains except wheat and in communications grain was usually grouped together and called corn, and wheat was listed separately. E.g. *'The lower class of people in this country formerly lived upon the coarsest food. Wheat a hundred years ago was almost unknown to them, and so lately has it been cultivated in Lancashire that it has scarcely yet acquired the name of corn which in general is applied to barley, oats and rye'* (Percival, 1807, p. 44).

Waterloo the object of every baker was to produce the whitest possible loaf, and household bread had all but disappeared.

It is worth outlining factors affecting the quality of the bread, as eventually bakers became more important by the end of the eighteenth century. The bakers' second or third quality flour was used to bake the darker breads, which went by a variety of names, e.g. *'cheat'* and *'crocket'*. 'Brown' breads were sometimes wholly wheaten; they contained the whole of the ground grain and were very coarse and rather dark. One early name for such breads was *'tourte'*, but this name was also applied to dark *maslin*[2] or rye breads which were also referred to as *'brown'* or *'black'*, *'bis'* or *'trete'* (Drummond and Wilbraham, 1958, p. 43).

While the Assize of Bread, introduced in the Middle-Ages to protect the standard of bread, was periodically enforced at local level, Ashley maintained that the role of the baker in the sixteenth century had been grossly exaggerated and that most of the poorer classes in the town did not buy bread from the baker, but baked their own bread and were unaffected by the Assize (1928, p.154). Fay also held that view and suggested that *'while consumers ate their own produce, no regulation of the trade was necessary for there was no trade to regulate'* (1923, p. 85). However, while many people did not necessarily buy the bread from the baker, many paid the baker for the use of his ovens or shared among themselves a common oven in a particular lane or corner of the town (Ashley, p.154). In 1573, *'the poor have baked in their common ovens since Michaelmas last 7,956 quarters'* was the reply by the Mayor and Aldermen of London to a series of questions about bakers and baking (Gras, 1915, p. 450). The Midlands and the North of England clung longer to home baking than the south. Burnett suggested the main reason for this was the easier availability of fuel for the oven. Using the work of Acton he stated that by the mid-eighteenth century the art of home baking was almost forgotten in Kent, Surrey and Middlesex and only Suffolk and Devonshire still retained a reputation for their cottage baking

[2] Maslin or miscelin bread was mixture of wheat and rye. The mixture could either be grown together or mixed at some stage at the mill or in the baking. The name maslin was quoted as late as 1841 in the Hexham market returns

(Acton, 1857, p. 85). A contemporary statement by Davies (1795) emphasized the problem concerning access to fire wood.

> *As acre upon acre of common land became enclosed, the fuel of the poor grew even scarcer: whereas in the past the labourer had been able to gather sticks, logs and brushwood merely for the trouble of it, he now had to buy, or risk pilfering it from the hedgerows* (Davies, 1795, p.118).

Chalmers explained in his *Estimates,* in 1782, that not only had the population increased since 1754 but many consumers who, in less opulent times, ate rye meal and oatmeal, then used wheat flour (Cited by Ashley, 1928, p. 22, but not traced). While even later, writing in the 1840s, Porter, a nineteenth century statistician summed up the changes in diet, which included potatoes.

> *Unless in years of scarcity, no part of the inhabitants of England except in the extreme north, and there only partially, have now recourse to rye or barley bread, but a larger and increasing number are in great measure fed upon potatoes* (1847, pp. 37-38).

The movement of labourers' tastes in bread can clearly be seen towards the last decade of the eighteenth century. By then the poorer people in the towns were no longer content to eat dark rye breads and had little milk to wash the course bread down. Even in rural areas people had formed a taste for fine wheaten loaves and sometimes fresh meat or cheese, although the latter two often disappeared from their diet in some areas. An anonymous comment in the *Gentleman's Magazine* in 1776 highlighted this change: *'the ploughman, the shepherd, the hedger and ditcher, all eat a white bread as is commonly made in London, which occasions the great consumption of wheat'*. Young in 1771 (p. 207) quoted a Mr Harte who had stated in a Farmer's letter in 1764 (p.176) that *'rye and barley bread, at present, are looked upon with a sort of horror, even by poor cottagers'*.

Consequently, when attempts were made to change their eating habits at the end of the eighteenth century, due to the price and shortage of wheat and the high costs of benefits paid out by parishes under the Poor Law, this was not well received. *The Accounts of Experiments on Bread* by the Board of Agriculture in 1795 (pp. 12, 17 and 29) reported that rye was well known to be a wholesome and nutritious grain and its consumption was strongly recommended, but the labourers did not agree. This

was a particular problem in the South of England where a wheat diet had occurred much earlier than in the North.

What can be deduced from the evidence provided by these contemporary writers at the time and those who commented at the beginning of the nineteenth century was a shared view that by the end of the eighteenth century wheat had become the main grain for flour for bread, even though this would have been to a lesser extent in times of shortages, when some poorer grains would again be resorted to, especially in the North of England.

In trying to assess the cause of the change, Ashley concluded that agricultural improvements, leading to an increase in wheat production over the period, were the main explanation and that the increase was partly due to the substitution of wheat for rye or barley on land already under tillage, and partly due to the cultivation of wheat on moors and sheep runs which had never before been brought under the plough.

One of the reasons for the differences in the diet that varied from north to south was the type of soil available. Contemporary views at the time confirmed that the soil could still influence farmers as to whether they sowed rye, although the outcome for growing different grains seemed to have varied. The Rev Davies, in 1795, in a pamphlet, *The Case of Labourers in Husbandry*, stated that the connection of diet with the progress of agricultural practice was clearly seen *'where land had not been so highly improved to produce much wheat, barley, oatmeal, maslin bread were still in common use'* (pp. 31-32). The improvements in the soil were thought to be due to the use of marling, which improved sandy soil by digging in the subsoil so wheat could be grown, thus increasing grain output.

The above discussion suggests that the high wheat usage, where it was more available at the end of the eighteenth century, was the result of both a change in the general public's taste and agricultural developments. This latter point will be developed further in chapter 6.

was a particular problem in the South of England where a wheat diet had occurred much earlier than in the North.

What can be deduced from the evidence provided by these contemporary writers at the time and those who commented at the beginning of the nineteenth century was a shared view that by the end of the eighteenth century wheat had become the main grain for flour for bread, even though this would have been to a lesser extent in times of shortages, when some poorer grains would again be resorted to, especially in the North of England.

In trying to assess the cause of the change, Ashley concluded that agricultural improvements, leading to an increase in wheat production over the period, were the main explanation and that the increase was partly due to the substitution of wheat for rye or barley on land already under tillage, and partly due to the cultivation of wheat on moors and sheep runs which had never before been brought under the plough.

One of the reasons for the differences in the diet that varied from north to south was the type of soil available. Contemporary views at the time confirmed that the soil could still influence farmers as to whether they sowed rye, although the outcome for growing different grains seemed to have varied. The Rev Davies, in 1795, in a pamphlet, *The Case of Labourers in Husbandry*, stated that the connection of diet with the progress of agricultural practice was clearly seen *'where land had not been so highly improved to produce much wheat, barley, oatmeal, maslin bread were still in common use'* (pp. 31-32). The improvements in the soil were thought to be due to the use of marling, which improved sandy soil by digging in the subsoil so wheat could be grown, thus increasing grain output.

The above discussion suggests that the high wheat usage, where it was more available at the end of the eighteenth century, was the result of both a change in the general public's taste and agricultural developments. This latter point will be developed further in chapter 6.

One issue however needs to be discussed here as a point of clarification. The late eighteenth century changes that came about with the agricultural revolution and the increasing ability to send grain to more distant markets, meant that subsistence farming would have died out across most of the country and particularly in the South. The flour or bread would then have had to be purchased from the labourers' wages and was no longer grown or expected as part of their labouring, as earlier in the century. The market returns for the end of the eighteenth century would therefore have reflected more accurately the amounts of different grains grown locally or in each market's hinterland.

Rye growth and usage in the mid-eighteenth century

By contrast, Ashley stated that in 1764 wheat was still far from being a very general part of the diet and referred to the supplement to the *Three Tracts on the Corn Trade*, published in 1764, to argue that above one third of the nation ate bread of oats, rye or barley at that time. The *Corn Tracts* (new edition, 1804), originally a series of anonymous articles, began just before the accession of George III, and were an important source for Ashley. These publications were also referred to by Adam Smith, who commented on the abilities of the writer as ingenious and well-informed (cited by Ashley, p. 4). Charles Smith, who turned out to be the author, succeeded his father in the ownership of a large milling concern in Essex and married into one of the wealthiest malster families. He set out to obtain a *'trustworthy quantitative basis'* (p.5) for the discussion of national policy on the corn trade, especially with regard to the system of bounties on the exportation of grains, which had been introduced in 1689.

Through his own business connections, Charles Smith gathered statistics on the amount of home produced cereals, the amounts of imports and exports, the total quantity of grain in the country and the relation of this data to the population of the period, *'particularly the labouring people who are best acquainted with the bread they eat'* (Smith, 1804, new edition, p.105). Smith used official figures and calculated the population from the number of houses, across England and Wales.

> *It is certain that bread made of wheat is become much more generally the food of the common people since 1689 than it was before that time, but it is still very far from being the food of the people in general; and some, who have considered the matter with great attention, and are bettered informed in regard thereto than most inquirers generally be, were inclined to think that in the year 1764 one half of the people could not be supposed to feed on such bread* (cited by Ashley, 1928, p. 5).

Smith's own investigations in 1764 led him to believe that this was too low a proportion. Smith's figures worked out for England and Wales as Wheat 62.5% (i.e. 3/5ths), Rye 14.8% ($1/7^{th}$), Barley12.3% ($1/8^{th}$), and Oats 10.4% ($1/10^{th}$).

Smith also indicated that he was aware that mixtures of grains were used in bread in some parts of the country. He tried to calculate these figures after deducting estimates for grains used for other purposes, e.g. barley for malting and distilling (Ashley, p. 24, Table d and p. 25, Smith's estimates). Smith also made it clear that conditions varied in different parts of the England and Wales and Figure 5.1 shows the distribution and the differences in 1764.

Ashley considered Smith's geographical division 'rather arbitrary' and commented that the population in them were not equally dense. However, in summary, compared with the evidence at the end of the eighteenth century when wheat was the fashion, in the period around 1764 it would definitely seem that rye was still being used, although reports as to how much varied from 42% to 8.8% across England and Wales, and in the West Country hardly any (Figure 5.1). While the density of people in the areas may not be accurate, the map at least gives a general view of the percentage make up of the amounts of grain in each area and confirms the significant presence of rye within the diet at this time in some areas.

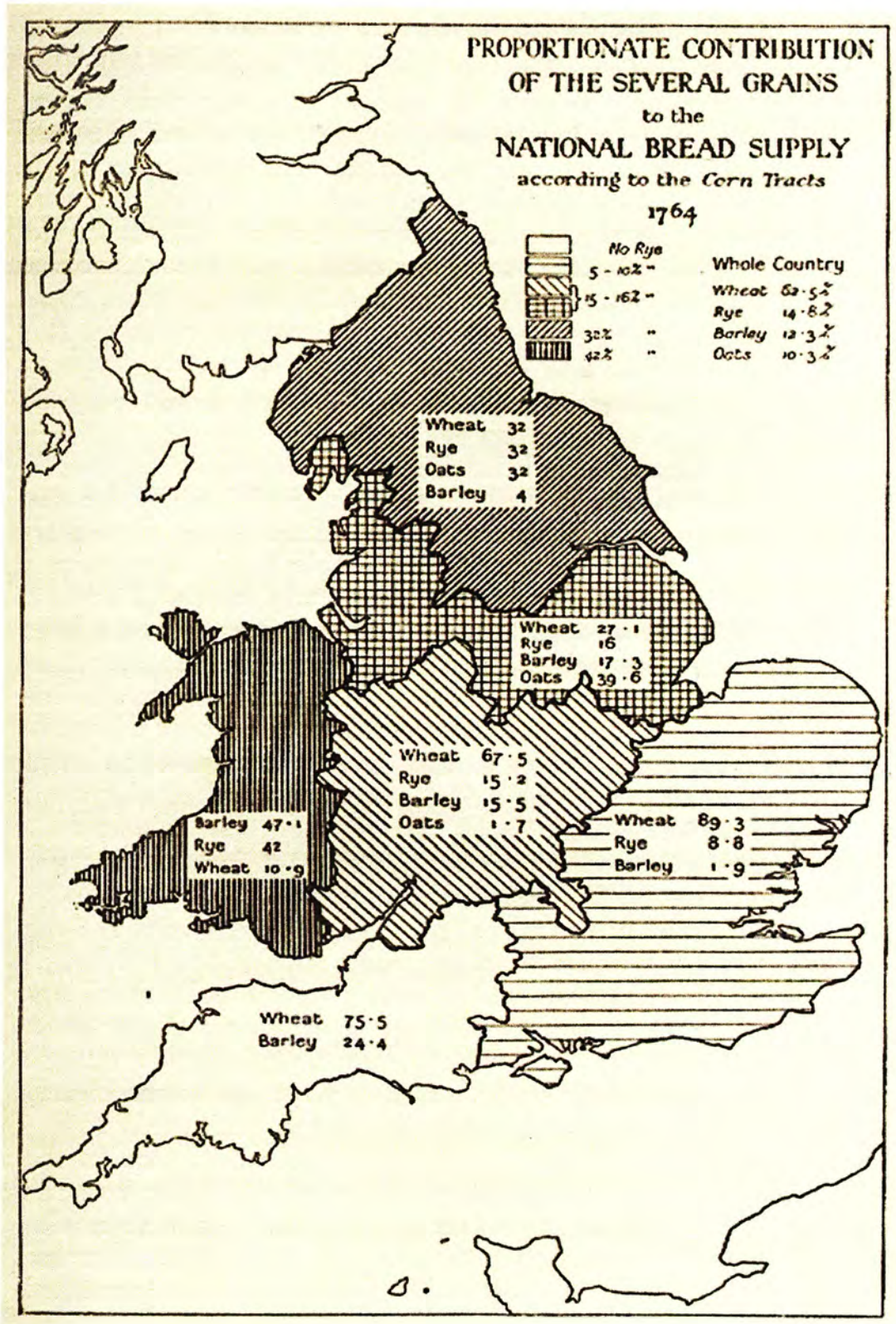


Figure 5.1 **Map to show the ratios of different grain for bread supply in 1764 (Ashley 1928, p. 24)**

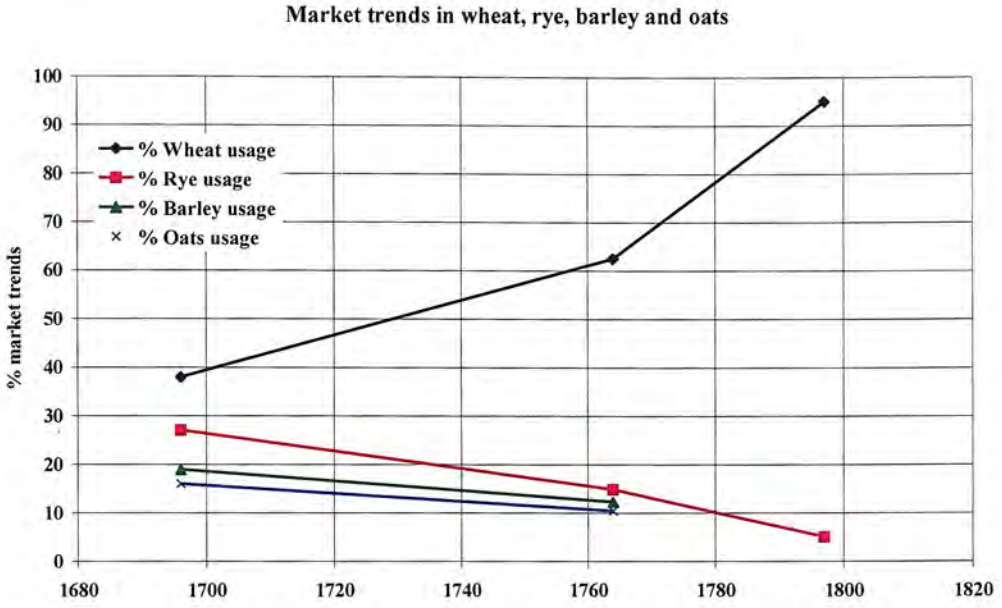


Figure 5.2 Market trends in wheat, rye, barley and oats, 1696 to 1797 (See text for sources)

During the later years of the seventeenth century and up to 1770, England was a grain exporting country and the export trade was stimulated by the system of bounties, which was introduced in 1687 as a national policy. Bounties were paid on the exports of wheat, barley, rye and oats (Ashley, p. 9). Exports of wheat and rye in 1771-1788 were 2,000,000 quarters of wheat and 100,000 quarters of rye (Ashley, p. 10). The export of rye to wheat was in the proportions of 1:20.

Based on the data, Ashley presented the following proportions of net rye and wheat exports.

	Rye %	Wheat %
1697-1706	30	70
1706-26	24	76
1726-46	10	90
1746-65	12	88

The above percentages produced by Ashley (p.10) showed that, within the eighteenth century, not only did wheat increase and rye decrease for home consumption but there was a decrease in the export of rye while the export of wheat increased. In the

reign of George III, England ceased to be entirely self-supporting and began to be an importing country.

Another important source used by Ashley was John Houghton's collection of market returns of wheat and rye prices from 1692-1703, published as a weekly journal entitled *A collection of letters for the improvement of husbandry and trade.* The records showed the markets and the returns for wheat as well as rye, varying from 39 to 64 markets, with an average of 52 markets a year, and importantly included prices for the whole of the Midlands and Eastern Counties, which were both heavily populated areas. Three out of four of the markets regularly gave rye as well as wheat prices and, as Ashley pointed out, as most corn markets in that period obtained their supplies almost entirely from the crops of the surrounding district, thereby confirmed local rye production trends. Ashley concluded that at the end of the seventeenth century rye was therefore seen as a regular source for bread in Central England and in the most highly populated areas, as well as other important rural markets, as indicated by a black solid point marker on the map reproduced as Figure 5.3.

Having offered support for his theory of a change in the make up of the supply of corn in the eighteenth century, Ashley confidently offered the view that rye varied from
40% at the beginning of the century to 5% at the end of the eighteenth century, and presumed that going backward from the year 1700 there was a growing proportion of rye consumption.

Ashley's arguments seem to be clear and his primary sources certainly support a view of a much higher rye usage in the seventeenth and early eighteenth centuries, compared to the end of the eighteenth century, by which time there was contemporary evidence to demonstrate that a significant transition in the diet of the population of England had taken place.

Figure 5.3 Markets returning rye from Houghton's collections (Ashley 1928, p. 13)

Ashley considered that as well as agricultural improvements, which will be explored further in Chapter 6, some of the other reasons for the changes in the labourer's diet were individual preference, imitation of the upper classes or their superiors who ate wheat, and an ambition to aspire to a higher social position (Ashley, p.164).

The importance of subsistence cultivation, as well as market statistics, in assessing the amount of rye eaten by the rural poor

While the primary sources that Ashley produced for rye and wheat available at the markets are very important pieces of evidence, another statement that he made also needs to be given consideration. Ashley (1921) suggested that the amount of rye grown, though it was sold at market and even exported from England, was even more extensive than was obvious from accessing national figures. He deduced that

> *the probability that rye was the main food of the people is to suppose that under a system where most of the farming was subsistence farming, rye did not enter into trading to anything like the extent of its place in the national dietary* (1921, p. 303).

Here, Ashley was contesting Rogers' view concerning wheat being the staple diet of the people. Rogers, he suggested, based his calculations on demesne manorial sales and excluded the output from tenants' land and open fields under cultivation. The discussion above on the amount of rye was based on agriculture in England before the improvements that came with the eighteenth century agricultural changes.

Contemporary sources, as has been discussed earlier in this chapter, showed that significant changes even in the diet of the rural poor had taken place from the middle of the eighteenth century onwards. It is important to explain how these changes in diet from rye to wheat took place as growth in markets began. These will be examined locally in detail in Chapter 6, with examples from Norfolk, where evidence exists.

Late seventeenth century and early eighteenth century agriculture

While it is important to know what grain was sent to market, it is more important in this thesis to try to gain a picture of what was sown, harvested and used for food by

the rural poor, who were the most numerous within the population at that time. . This usage at source needs to be examined further.

Geissler and Oddy (1993 p. 4)) considered that there it was not easy to find the evidence of what people ate before the seminal work of Eden and Davies. In considering the seventeenth and early eighteenth centuries there are two main background points to make. Firstly there would be no records of all the rye which was grown just as a subsistence crop within any market records and secondly only scant indications as to the amount and manner of the rye ingested. It is important to consider how, in the long eighteenth century, rye and other grains were grown, gathered, prepared and used, as a context for addressing the hypothesis and discussion presented in this thesis. Also, in spite of the tentative nature of the evidence, accumulated circumstantial evidence can be used to make some general statements about what the rural labourers may have grown and eaten.

Leading up to the period under discussion, Overton (1996, p. 22) stated that it was likely that about eighty per cent of farm families were living at subsistence levels at the start of the sixteenth century and roughly three quarters of the population was engaged in farming in 1520. There would of course be some market activity between them as well, as some excess produce would also have been exchanged and sold. Acton (1857, Preface) also made the point that *'bread is the first necessity of life to the great mass of the English people; being in part the food of all, the chief food of many and the sole food of many more'.*

Thirsk (1987) also considered that many of the small farmers' livelihoods, before the agricultural changes in England, were based on farming for subsistence. They had to produce the basic necessities for their households. Grain was essential for their bread, gruel and drink, while animals were indispensable to fertilise the arable fields as well as to produce meat, milk and other dairy produce.

In the late seventeenth and early eighteenth centuries, the old customs and varied systems of agriculture were in place and there was a status hierarchy within

agricultural society (Overton, 1996, p. 38). The close proximity of farmers and labourers in all aspects of the land meant that social and economic relationships could often be described as paternal in the seventeenth century. In many areas cottagers, as part of their lease or employment on the farms, often had a garden, an animal or two, access to the common land and grazing rights over fallow land. Access to the common land also meant access to fuel, rabbits, and other sources of food. Neeson (1993, p.9) suggested that for many their diet at this time could have been very good because of the extras they obtained from the common land and the cultivated land they were by custom allowed to glean as well. She suggested that the commoners' *'stubborn memory of roast beef and milk'* (p.11) and its swift removal of both from the labourers' diets after the enclosures, illustrated this.

The bread of the mass of the population, especially in the country districts and in times of scarcity, was often composed of a mixture of whatever grains and additives were available, these included peas and beans and later buckwheat (Young, 1770, pp. 230, 255 and 423). Drummond and Wilbraham (1958, p. 41) argued that, in the past, it was a common response, when grain was the *'core of the diet of the poor'* and the harvest failed and the price of daily bread began to rise, that economies were made by switching to a lower priced grain such as rye, oats or barley, as available. Ashley (1928, p. 58) suggested that it was highly unlikely that the poor had any cheap alternative foodstuffs in a period of grain shortage. *'Probably the poor tightened their belts and cut down on all purchases except basic grains stretched with peas, beans and other fillers.'*

This seemed to have been a common approach across the centuries, from the times of actual famine to periods of harvest crises. For instance, William Harrison in 1577 (quoted in Ashley, 1928, p. 58) reported that the poor were reduced to living on *'horsse corne, beanes, peaso, otes, tares and lintels, when the grain harvest failed'*. William Buchan, even as late as 1772 (p. 50) in his *Domestic Medicine*, stated that *'labourers eat unfermented bread made of peas, beans, rye, and other windy ingredients'*.

Bowden (1985, p. 29) observed that wheat prices usually fell during the summer whatever the forecasts and that demand declined more sharply than the existing supply of wheat, i.e. by summer people had run out of money, and they either ate less bread or they switched from wheat to inferior grains.

The bread of the rural poor in the late seventeenth and eighteenth centuries

For the purposes of this thesis, the actual food that the labourers and poor farmers grew and ate needs, as far as possible, to be determined in order that some rough estimate can be made of the balance of grain cereals in the diet. At the beginning of this chapter reference was made to the bread used by many people living in the towns but not necessarily the poorest of them. Besides rye bread, in the rural areas, mixtures of bread corns were often used, either after being sown together, milled together or combined in the process of baking (Ashley, 1928, p.15). Different areas seemed to have had different approaches as to when to mix the grain.

The practice, Ashley suggested, was that *' it was advantageous to sow two sorts together, from the notion that if either failed there would still be the crop of the other'* (p. 18). He based his views on the writings of Rev. Rham in 1675 (1844 edition). However, Rham suggested that though based on a policy of security it was a bad practice. Ashley remarked that the wheat would have failed on inferior soils, when rye would have thrived, but the reverse was seldom or never the case as rye came to maturity at least a fortnight before the wheat. Prothero (1888, p.13) cited Rham's *Compleat Farmer (sic)* (1760) where, referring to maslin (one of the names for this mixture), it was stated that it is said to be *'ill-husbandry to grow wheat and rye together'*. In terms of yield, *'mestilon'* of wheat and rye, if it was equally mixed, would yield six times that sown, and if there was more rye than wheat it yielded more, but if there was more wheat than rye, less. The bread could also be made of oats and barley mixed with the rye. The Rev Rham remarked that excellent bread was made of two parts of wheat and one part of rye ground together (Ashley, p. 19).

In summary, then, at the end of the seventeenth and the beginning of the eighteenth century, there is evidence to suggest that much more rye was grown than indicated from market returns and other available sources, as a subsistence crop. Rye was grown as a single crop but also sown with wheat as maslin (Ashley, 1928, p.16). However, maslin was also a mainly subsistence crop and would have only been traded locally. It is unlikely that contemporary newly acquired knowledge concerning increasing output of grain was easily passed down to the smallholders, though it would have circulated among the so called *'Great Men'* (Overton, 1996, p.4) who undertook experiments to improve their output of grain. Grain could also be mixed at the mill or at the baking stage and used to make maslin bread, as well as rye used alone to make the rye bread.

The consequence of growing the wheat and rye together would mean that, if ergot was present on the rye, it would be difficult to sort this from the wheat on harvesting it. If mixing took place at a later stage, then substituting other grains would be possible if the contamination was detected.

Harvesting techniques and the potential for contamination by ergot

While it has now been established that rye was more extensively grown and used as a subsistence grain in the seventeenth and early eighteenth centuries than indicated by just market returns, it is also important to ascertain how the grain was normally harvested and prepared, in order to address ways that the resulting flour could have been contaminated with any ergot.

It is not known what quality of seed was grown, but it was mostly saved from the previous season for sowing in the next. There must have been some kind of problem as, often in lists of grain, rye was referred to as *'clean rye'* e.g. by Henry Best, a Yorkshire squire writing in 1641 (1847, p. 99). This could have meant free of other grains or free of contamination.

The conditions needed for the ergot fungus to grow on the rye have already been discussed in Chapter 3, which showed that the type of soil, the lack of soil hygiene,

poor ploughing techniques and long cold Springs, were the main contributory factors. Once the rye was contaminated with ergot other problems concerning the harvesting and preparation of the meal or flour have then to be considered to show the process by which the contamination failed to be detected or considered unsafe and consequently entered the food chain.

In the late seventeenth century and early eighteenth century and before the major changes to agriculture started to take place around 1750, it is possible to show that it was the married women, rather than the men, who were more likely to use and ingest the subsistence rye crop as bread, gruel or beer. Women had a key role in the main harvest procedure. Also the women and children as part of their contribution to the harvest were allowed by custom and tradition to glean the field, a process that also helped the farmer clean the field. This consisted of picking over both the fields for grain that had been dropped and searching areas close to the hedge and borders that had been missed by the scythe (Overton, 1996, p.12). Baker (1974, p.162) maintained that the women and children could provide flour for a few months bread in the autumn and usually enough up until Christmas. Eden (1797, (2), p. 547) calculated that gleaners in Roade in Northamptonshire gathered enough corn after harvest to make bread to last the rest of the year, worth about 6 per cent of the family's annual income.

The importance of this tradition, which varied in form across the countryside, is vividly described by Neeson (1993, p. 3) and Baker (1974, p.162). Every year after the harvest the field officers opened the fields to the gleaners and cried the hours of gleaning round the village. Baker (p.162) records that at Little Shelford, gleaners came in procession, the women and children led by their *'Queen'*, who sat in state all day in the field *'shoeing new gleaners, signalling when work must begin and cease, arranging meal breaks and seeing that all enjoyed fair shares'* (see Figure 5.4, Jean-Francois Millet's famous picture of the gleaners in nineteenth century France).

The system of farming across England varied in the seventeenth century and the turn of the eighteenth century but it often meant that there were strong ties between

labourers and farmers, and both young men and women before marriage very often lived in close proximity in the farmer's home: the young women as servants and the men as farm labourers and servants. Where this was the case, they tended to eat together and the same diet was shared. Married men would live at home but would, as part of their employment, often eat their lunch at the farm, usually at the farmer's table, or were fed in the fields and obtained certain shares of food and milk from the farm for use at home. At harvest time the married women and their children would be expected to help and share the same conditions, but for most of the year they ate and drank what was available in the home.

Figure 5.4 The Gleaners (Jean-François Millet 1857)

The grain that the labourers grew or were given as part of their employment would be threshed with a flail as it was needed. The threshing would have taken place either on the farmer's barn floor or at home. It was then winnowed and sieved. While the

threshing for home use was carried out locally, most of the grain produced did not necessarily go to the mill, but was probably crushed with hand mills. Ashley (1928, p. 119) used information from Eden (1797, vol. 1, p.19) who suggested that hand mills may have been used either for the crushing of grain for cattle or for the various forms of porridge or cereal soups which were consumed in the home. The rye was not only used for bread, it was the basis for soups and gruel as well as home-made beer and rough spirits. Thirsk and Cooper (1972, p.168) reported that rye yielded a great store of spirit or aqua vitae. The long, strong straw produced from rye also contributed to the household economy as valuable roofing material.

When consideration is given to the potential for contamination by ergot, as outlined in Chapter 3, and the high modern standards needed in order to prevent its entry into the food chain (Chapter 4), no safeguards were apparent in harvesting the grain in the seventeenth and eighteenth century that could have sorted out any ergot from the rye. Indeed, every step of the harvesting, if ergot was present, especially from gleaning the fields at harvest time, would have meant that the most heavily infected grain from the sides of the fields or those gathered after being dropped, had the potential to contaminate the staple food of the poor. If the dark coated ergot was not removed from the rye, then every action during processing to meal or flour, i.e. threshing, flailing and sieving, would have gradually battered the outside of the fungus until it revealed the white inside which then would not have been distinguishable from the good rye. Home grinding would also have meant that the miller, if he had such knowledge about the importance of removing the ergot, would not have had the opportunity to communicate that information to the poor.

If ergot grew on rye in England in any year, the poor would undoubtedly have eaten it within their staple diet in varying doses according to the conditions for growth and, as already shown, women in particular would have been affected. The crucial issue is, of course, was ergot present in agriculture at the end of the seventeenth century and the beginning of the eighteenth century in England? This will be addressed in Chapters 6 and 7.

Conclusions and significance of eighteenth century changes in agriculture

At the outset of this chapter it was deemed important to ascertain the extent of rye cultivation and usage in the long eighteenth century as this was crucial to the development of the hypothesis proposed in this thesis, as rye is the main crop on which ergot grows. In order to determine later in this thesis whether ergot could have had any significant effect on fertility through the widespread ingestion of rye during the period of the seventeenth and early eighteenth centuries in England, this chapter, as a first step, set out to consider the rye usage throughout that period. It has been argued, in spite of the lack of continuous documentation and statistics, that from accumulated circumstantial evidence, there were changes in usage. A gradual decrease in rye cultivation and usage, which began around the second decade of the eighteenth century, has been demonstrated. However, earlier, in the late seventeenth century and the early eighteenth century, rye was an even more significant crop in the markets, while subsistence amounts of rye as the staple diet, which were not necessarily recorded in any of the contemporary calculations, were used in rural homes, either as rye bread or in mixtures of maslin bread as well as in homemade beer and spirit. At this time the quantities grown as subsistence crops would have been greater than the market returns of rye would have suggested.

It was shown that, when rye was the staple diet of most poor people, women and children at home were more likely to eat rye and ingest any ergot. If the ergot was not rejected in the fields or separated from the rye at an early stage, it would have quickly lost its black identification coating during processing, especially at the flailing stage, so that it would probably have been unknowingly consumed in varying amounts; sometimes in large amounts over a short period of time and at other times in small amounts over longer and sometimes continuous periods of time.

The detailed customs, the dietary trend from eating rye to eating wheat and the relevant dates have been introduced and analysed as important factors to help confirm the hypothesis for this thesis. During the long eighteenth century rye usage gradually decreased as the amount of wheat used increased. From the market

statistics wheat as a percentage of all edible grain use went from about two fifths in 1696 to about three fifths by 1764 and by the end of the century it had well exceeded nine tenths. Much more rye was grown in the late seventeenth and early eighteenth century than indicated from market returns, and other available sources, as a subsistence crop. It was grown as a single crop but also sown with wheat as maslin and could also be ground together or mixed at the baking stage and used to make maslin bread, as an alternative to rye used alone to make rye bread. Rye was also used in home brewing.

However, what is important to restate is that while market returns did not give a full picture of all the rye that was grown in the late seventeenth and early eighteenth centuries, as it did not include the subsistence crops grown by many poor farmers, by the end of the eighteenth century, due to agricultural changes, the market returns would have been a more accurate indicator of grain available and rye at this point was recorded as only 5% of the total grain. There was far less by way of subsistence crops to add to the market returns at this time, because most poor farmers, who previously farmed their strips or patches of land, had been ousted by the drive for larger farms and the increased pace of enclosures. Also, with the rise of day labourers, the paternal social structure was also rapidly disappearing. Jenkins (1869, p. 473, cited by Overton, 1996, p.185) summed up the situation at the end of the eighteenth century. There was *'no such thing as a yearly labourer, no boarding paid by the farmer, and, in short, no connection between master and man except work on the one hand and payment on the other'* (p. 473).

It has therefore been shown during the long eighteenth century that there was a change in diet and a discernable trend among the labourers and poor people, who were the most numerous in the population, to move to a higher quality staple diet, namely from rye to wheat (Figure 5.2). This trend from the use of rye to wheat when compared with the trend in the population rise, already highlighted and presented in Tables 1.1a and 1.1b and Figure 5.5, showed a strong correlation.

In summary there was a rise in the population over this period and this change was paralleled by the decline in rye usage and the rise in the use of wheat. The questions then raised from the discussion are why and how did this change in diet take place and is there a link to fertility or the population increase?

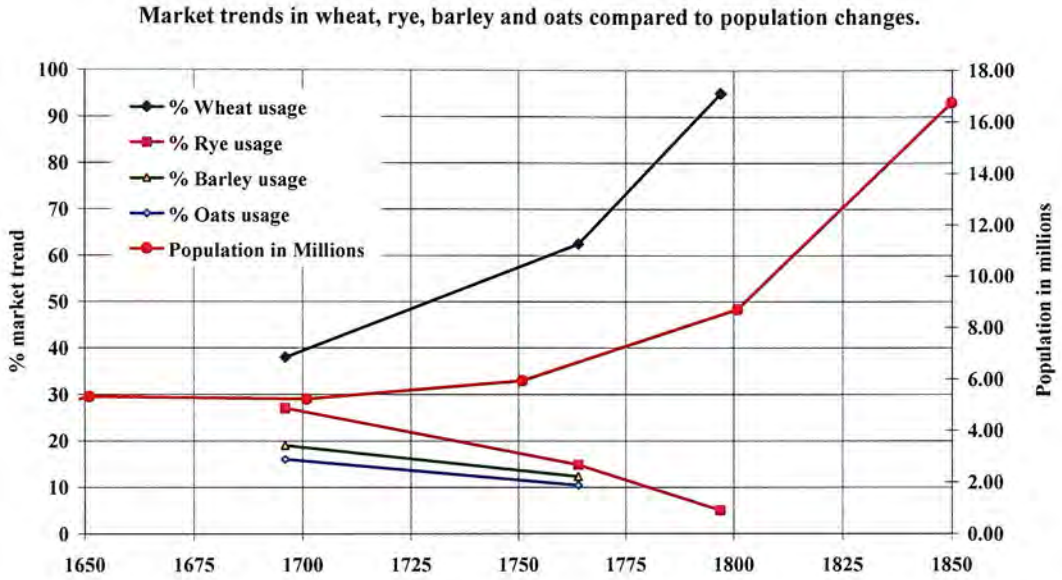


Figure 5.5 Market trends in wheat, rye, barley and oats compared to population changes in the long eighteenth century

On the first point, concerning diet change, Ashley suggested that this was due to both agricultural changes and the wish by the poor to imitate the upper classes or their superiors who ate wheat, together with an ambition to aspire to a higher social position (Ashley, p.164). It is therefore important to determine the nature of these agricultural changes and how they affected the growing of rye and any possible ergot contamination. These agricultural changes will be addressed in Chapter 6.

Crucially, for this thesis, the second issue to be determined is whether ergot on rye was ever a feature of agriculture in England, and particularly in the period under discussion. This will investigated in Chapter 7.

A third point also needs exploring, in Chapter 7, concerning changes in fertility. It needs to be established whether there was a major decline in the simple methods of husbandry and the growing of rye which could have produced conditions for ergot to flourish, and then be harvested, processed and ingested, with the potential to contaminate the staple diet and affect the women's fertility. If ergot is discovered an assessment will be made as to whether it was known that its ingestion had such dangerous consequences, either at low levels over long periods or in large quantities over short periods of time as described in Chapter 3. As part of this analysis, if ergot was found to have been present, consideration will be given as to whether ergot was permitted, or even tolerated, to easily contaminate the staple diet.

While finding epidemics of ergotism would dramatically show that ergot was a feature within agriculture in England, actually its presence in small amounts, over much longer periods within the diet of women, would be even more significant, as its sub-clinical effect would be to act as a contraceptive or an abortive agent.

Chapter 6

The impact of agrarian change and the potential effect of the reduction in ergotised rye on living conditions and female fertility

While Chapter 5 examined the amount of rye growth and consumption in England during the long eighteenth century, this chapter will investigate whether ergot contamination, if present on rye, could have been affected by any of the agricultural changes implemented during the long eighteenth century and if, in turn, these agricultural factors could also have had an effect on the standard of living of rural workers and the fertility of the women.

Local farming conditions will be judged against the modern standards employed to monitor the growth and use of rye; in particular those farming practices that could have had a direct effect on the growth of ergot will be assessed. Norfolk is chosen to illustrate this discussion because it was the area in which the dramatic change from growing rye to wheat during the late seventeenth and early eighteenth centuries can be most clearly seen, and it was one of the first counties to introduce new experiments in farming on a wider scale in order to increase grain output. It was also particularly chosen because relevant evidence exists for this county, representative of changes occurring widely elsewhere.

Agrarian change

The following changes in agriculture that affected rye production, in terms of farming practice, conditions and overall grain production and selection, will be examined:

- method of cultivation and production of rye
- weather during the long eighteenth century and its effect on the conditions necessary for ergot to flourish
- the decline in usage of rye as a subsistence crop and
- the new practices that contributed to these agricultural changes
- the consequences of subsequent living conditions on female fertility

It was shown in Chapter 5 that, within a short period of time at the beginning of the eighteenth century, rye, once a major subsistence crop in the counties of Southern England became a lesser crop. Nevertheless, it was a crop that could still contribute to the new expanding market economy within agriculture. It will be shown that even grain which was considered *'spoilt'* was sent to be sold.

By contrast, by the end of the eighteenth century rye was mostly rejected in favour of wheat as the main food source of many poor people and labourers, as landlords and farmers, eager to take part in the commercialisation of regional markets, changed to growing wheat. It will also be shown that, in the South of England in particular, agriculture flourished as markets widened. The change in diet could have had the potential to increase fertility, while the move to satisfy market needs altered the economy of counties such as Norfolk and the living conditions of poor cottagers and farmers and agricultural labourers.

So why and how did this happen and what aspects of change support the hypothesis of this thesis?

It has already been shown in Chapter 1 that fertility appeared to be affected in times of bad harvests. Within this chapter, in order to develop the hypothesis, it is important to understand the changes that took place during the later eighteenth century harvest crises that differed from those in the late seventeenth and early eighteenth centuries, and consider whether a link exists to explain why fertility in the later period did not follow the same pattern as before and become curbed.

Agriculture in the late seventeenth century and the first decade of the eighteenth century

In this period in England there was regional variety in farming and rural economies generally, including farming systems and practices, settlement patterns, field systems, landholding and social structures (Overton, 1996, pp. 46-47).
Most contemporary descriptions of agriculture in any area, in the late seventeenth and early eighteenth centuries, Overton (p, 47) suggested, were based on soil type as

described in the *Cambridge agrarian history*. Farms were dependent on sheep to maintain soil fertility for arable crops, and were described as *'sheep-corn'* farming or later as *'arable'*. The sheep-corn regions were associated with a preponderance of subdivided fields and common field farming centred on old settled nucleated villages within relatively small parishes. The labour demands of arable farming left little opportunity for farmers or their families to engage in some other occupation, except growing produce from their cottage gardens and tending their limited livestock.

The cultivation of rye was most often found on light and sandy soil and on marshland. Figure 6.1 shows the areas of different soils across England and Wales. Sandy soil areas predominate in Norfolk and are clearly shown on the map submitted to the old Board of Agriculture around 1800, Figure 6.2 (Map of Norfolk from Young (1804) inside front cover).

Rye growing in England and the potential for ergot to contaminate foodstuffs

Rye growing is to be considered in three periods of the long eighteenth century, which also coincides with three defined weather patterns; the Little Ice-Age (late seventeenth and early eighteenth centuries), 1715-1765 and after 1765.

During the first period under study, up to the early eighteenth century, across much of England rye was sown in the autumn each year for two or three years and then a year of fallow was needed as otherwise the ground would be exhausted. Crop returns tended to be poor. The old systems of one fallow year within four years rested the soil but did little to renew or fertilise it except with animal manure from grazing (Overton, 1996, p.2).

Figure 6.1 Map of the soils of England (Ashley 1928, p. 209)

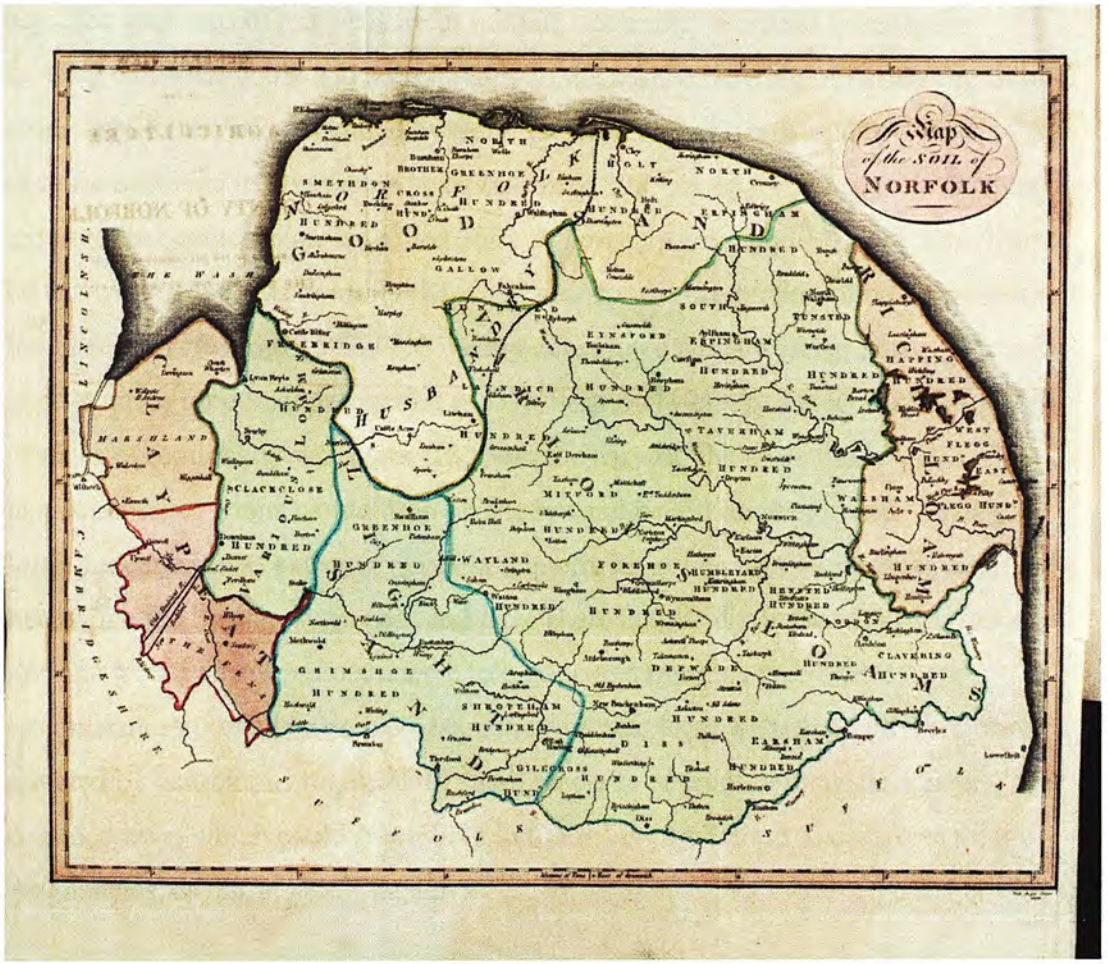


Figure 6.2 Early map of Norfolk showing the soil types (Young 1804)

Against modern standards, described in Chapter 4, the consequence of this approach was that a continuous sowing of infected rye would allow a build up of ergot in the soil, especially as the old large eight-horse-drawn ploughs could not have ensured the deep turnover of soil necessary to prevent ergot survival and growth from year to year, therefore favouring its over wintering in the soil. In the hedgerows, ergot could spread easily if the weeds were not cut down before flowering.

The influence of the weather on crops and the subsequent fertility of women

Due to the weather at the end of the Little Ice-Age there would have been many instances of farmers experiencing bad harvests and a failure to bring in the grain and

hay. The extremes of temperature or rainfall, occurring at crucial times in the farming calendar, could add substantially to the costs of sowing or harvesting field crops, while the yields obtained by some farmers might be only one half or one third of those achieved in favourable years (Bowden 1985, p. 46). For instance, Bowden reported that contemporaries called 1692-9 *'barren years'*, and 1708-13 were little better, while 1709 was possibly the worst year for the production of bread cereals in half a century. Overall 1692-1713 clearly constituted a bad weather phase, generally unfavourable for cereal production (p. 57). Stratton (1969, p. 7) recorded the same years as exceptionally wet years. The later the harvest, the more likely it would be that some ergot grains would drop off the rye and be left on the ground. During the Little Ice-Age it was extremely cold in winter with strong east winds from the North Sea, while the Springs were cold and late. There is little doubt that the long late cold Springs would have been conducive to ergot contaminating rye. Under these circumstances it would also have been the case that local women could have been affected by continuous ingestion of small amounts of ergot in their diets, acting as a contraceptive, which could result both in infertility or a failure to complete their pregnancies, as outlined in Chapter 3.

After the awful weather at the end of the seventeenth century and the beginning of the eighteenth century, there were 16 '*good*' years from 1715 and then many more up to1765. From 1714-1749 the summers were generally warm, dry and the only disastrous years for harvesting were 1725-8 and 1739-40 (Tooke, 1838, Stratton, 1978 and Bowden, 1985). Beginning with 1714, the Spring was cold and dry, and in Summer and Autumn drought was combined with heat. Yields of barley and oats were rather poor but that of wheat was very good. The years 1741-43 were particularly abundant harvest years. Only one harvest, in 1739-40, was decidedly unfavourable (Tooke, 1838, (1), p. 59).

Both contemporary reports of weather and modern analysis of temperatures and wetness in England demonstrate the extremes during the three periods under discussion. A contemporary, David Gwilt of Ickingham Suffolk, writing in his diary in the spring of 1738 (p. 58) wrote *'We are in this kingdom blessed with healthy and*

fruitful seasons... our vallies (sic) are so thick with corn that they laugh and sing' (quoted by Bowden, 1985, p. 58).

Figure 6.3 illustrates Lamb's representation of the climate in England during the period under discussion, describing both temperature and seasonal weather fluctuations. Lamb (1969, p. 227) produced both a *'Summer Wetness Index'* and a *'Winter Severity Index'* in order to define the effect of a prolonged wet or dry summer, or a severe or mild winter, on the viability of agricultural communities.

The Winter Severity Index, shown in Figure 6.3, is defined as the excess number of unmistakably mild or cold winter months (December, January and February only) over months of unmistakably opposite nature, per decade. (Excess of cold months is taken as negative). Average decades score zero while extreme values range from +10 to -20. For the Little Ice-Age and period 1715 to 1765 Lamb's index confirms the points already made concerning good harvest years.

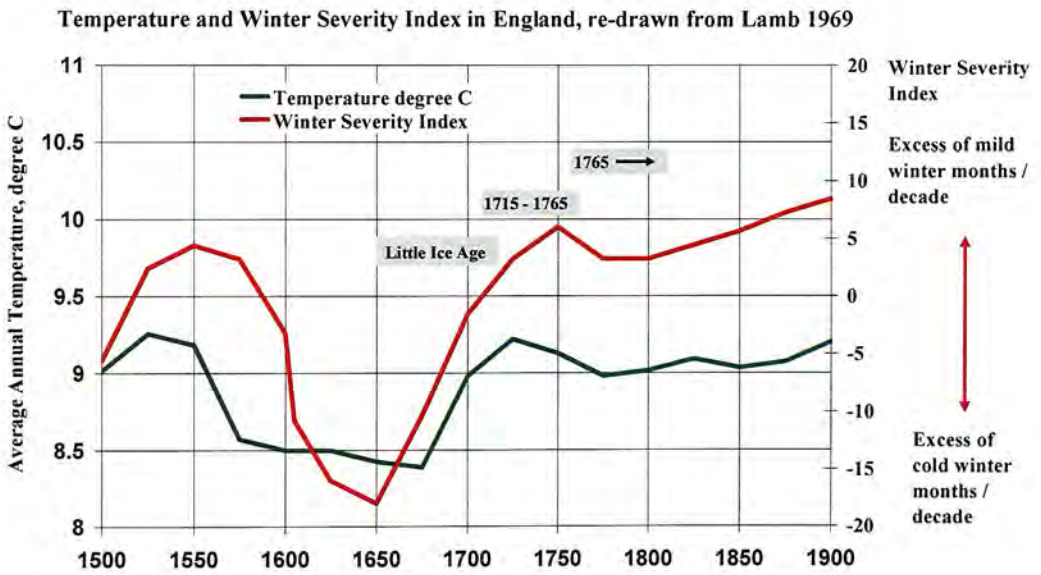


Figure 6.3 Average annual temperature and winter severity for the three periods considered (re-drawn from Lamb 1969, p.227)

Within this thesis, the weather is seen as an important determinant of the amount of ergot contamination and it is therefore not implausible that there could have been

decreases and increases in fertility which followed the rainfall patterns and the success or otherwise of the harvests. Wet seasons produced more ergot than dry seasons, especially in cold wet Springs when the flowering rye stayed in blossom longer and was therefore more prone to contamination. Figure 6.3 therefore, also indicates when ergot contamination might have been high.

The Cambridge Group identified, on a series of maps, a number of parishes in Norfolk in 1727 to 1730, 1741 to 1742 and 1762-1763, where following a poor harvest there were local crises, resulting in vulnerability to infectious diseases (1989, pp. 681- 684) . In these kinds of circumstances most people would have had to fall back on a basic or reduced diet, but they were short term harvest crises.

Taken together, the climate improvement following the Little Ice-Age and the good years from 1715 would have had the potential to reduce ergot contamination and would have therefore, have supported improved fertility.

Crop changes to barley and wheat and the new markets

During the eighteenth century, especially in parts of the South of England, many farmers were able to change from growing mainly rye to growing wheat and barley. Besides the helpful weather from 1715 onwards, the changes in agriculture were a response to new markets for cereals, particularly in London and other English centres of population. There was a change from local to wider networks of trade and those areas slightly further afield from London began to benefit from this.

In the South of England it was the brewers, bakers and distillers that required the wheat and barley. Wheat fetched a better price for making fine white bread (almost twice as much as barley) and was therefore a profitable crop to grow. However, barley was the first grain to herald the changes in trade and markets (Overton, 1996, p. 92) and this was stimulated by the brewers. Between the 1660s and the 1730s the mean area of barley in East Anglia rose threefold and the proportion of the barley in relation to all grain rose from around 40% to almost 60% (Overton, 1989, p. 82). The expansion to markets further afield meant that, by 1700, over one million quarters of

grain, approximately 200,000 tons, were consumed in London for food and drink from counties distant from London (Overton, 1996, p.140).

Confirmation that Norfolk was a prosperous rye growing area up until the end of the seventeenth century and changed thereafter

National factors relating to agriculture change, during this period and the eighteenth century, can be clearly demonstrated locally, by exploring the evidence available from Norfolk.

Ashley (1928, p. 92), based on Rogers's tables of taxable wealth, stated that, in the Middle-Ages Norfolk was one of the richest counties in England after Middlesex. He showed that there was a preponderance of rye in Norfolk by using the records of the Corn Certificates for the years 1527-8, 1586-7 and 1623. In the years 1586-7 the certificates showed rye returns for nearly the whole of Norfolk and, of the 27 markets across the county, 17 recorded rye as the main grain (1928, p. 39-40). Using John Houghton's work, Ashley (1928) demonstrated that Norfolk was also a rye growing area from his lists of market returns for the price of rye and wheat from 1692 -1703. In fact, Norfolk farmers were renowned for their persistent loyalty to growing rye from very early times. Norfolk men were considered figures of fun because of their attachment to growing rye and stories abounded of their habit of keeping a special loaf of wheat bread in the cupboard for guests. A popular poem included a section which suggested that, when Norfolk men saw an ear of wheat growing, they thought it the work of the devil and would beat it down. Variations of the poem date back to the twelfth and thirteenth centuries (quoted in Ashley, 1928, p.128 and 190 and originated from Wright, 1838, p. 93, *Early mysteries and other Latin poems of the twelfth and thirteenth centuries*).

However, in spite of this almost ageless commitment in Norfolk to rye, by the end of the long eighteenth century there was a sudden and almost complete change to wheat and barley. Ashley, throughout his research on rye and wheat, raised the question of why and how did this conversion of rye fields into wheat fields happen and how were

the fields brought under tillage from land that had never before been tilled. This question will be addressed together with the consequential outcomes.

Norfolk in particular, benefited from the new trade because of its numerous ports which gave farmers seaborne access to both London and international markets. Kent (1794b, p. 37) referred to records of Norfolk ports and the rye exports in the period 1693 onwards from *'Yarmouth, Lynn, Wells, Blakeney and Cley'*. Bacon (1844) in his prize essay for the Royal Agricultural Society repeated these figures and also included figures for Wisbech which also exported rye. Other ports may also have been used. Marshall (1795, p.5), stated that *'the smaller ports of Blakeney, Cromer and Munsley are beneficial in assisting to draw off the produce of the district; especially of the Northern Hundreds'*.

The Holkham estate accounts in Norfolk are particularly interesting as this was the scene of the later agricultural improvements which the 1st Earl of Leicester (Coke) applied to his land. It was known as the *'Norfolk Course'*, a policy for the production of wheat. The accounts show the changes from rye output over the whole period under discussion.

In the years 1731-6, Ashley (p.11) maintained that, of the sales of grain off the estate, those for '*barley and malt'* were much larger than any other grain; £1,428; oats were only sold in one year for £102, but wheat and rye were sold for £743 and £337 respectively. During this period Ashley (p 11) maintained that the price of rye was about half that of wheat, so the quantity of rye sold must have been proportionately greater. He substantiated this with the cost of threshing of rye which was £49 and 5 shillings and for wheat £ 58 and 10 shillings. He deduced therefore, that the proportion was 46 to 54. However, in contrast to the years 1731-6, the sales of grain at the end of the century included only trivial quantities of rye grown on the estate.

Dillon (2002, p. 83) maintained that, in Norfolk, tenants were allowed to plant three grain crops every six years and two had to be barley, not wheat. He suggested that the economics of eighteenth century farming only worked if a market was found for

all the barley. In terms of barley, Dillon stated, that in 1728, 96% of England's 200,000 quarters of malt and barley exports left from Norfolk ports (PRO T64/274/58-9 quoted in Dillon, 2002, p. 85). The export records showed that the farmers responded to these markets and began specializing their crops.

The consequence of having so much barley led to its use as a cattle feed, which in turn resulted in cattle being driven down to Norfolk from Wales and Scotland for fattening. This led to regional specializations such as in eastern Norfolk where stall feeding of bullocks developed (Overton, p.104). *Miller's Gardener's Dictionary* of 1733 (Turnips) stated that in Norfolk *'they cultivate great quantities of turnips... whereby they procure a good dressing for their land, so that they have extraordinary good crops of barley'*. Dillon (p. 86) also used a reference in *A Gentleman's Magazine* (October- November 1752) that featured Norfolk farming and tabulated the Norfolk rotation as turnips, barley, wheat and clover.

While, at the start of the expansion of the new markets, the barley had been sold to the brewers, following the introduction of the Gin Acts (1690, 1729 and 1736, onwards) the distilling industry and the London gin craze opened up further opportunities. Not only did the distillers take the good grain but also the bad corn and bad malt as well. In the House of Lords debate on 22^{d} March 1743 a supporter had commented that the arrival of the distillers had been *'sensibly felt by our farmers because it opened to them a market for spoilt and coarse sorts of corn, which they never before could make anything of'* (quoted in Dillon, 2002, p. 84). Unmarketable grain was now marketable and no longer needed to be set aside or given to the poor in times of harvest crises.

The increased output of grain from the eastern counties, that had access to the coast, was the key factor in the expansion of the distilling industry. Surprisingly, in the past, farmers had always been more afraid of a good year than a bad one, as prices for their grain would drop when there was a glut and the cost of taking in the extra harvest was much higher (Overton, 1996, p. 20). However, Dillon maintained that the distilling industry transformed East Anglian farming, as the farmers became

unafraid of over production and having surplus barley (Dillon, 2002, p. 86) and he suggested from his research on the gin trade in England that:

> *Madam Geneva (gin) wore many disguises, but her most unlikely role was as an agricultural reformer, out in the windswept Norfolk fields where barley was sowed and harvested, and loaded in ships bound for Schiedam and London to be made into gin.*

At the end of the eighteenth century Nathaniel Kent commented that:

> *The Government must certainly draw from Norfolk a much greater revenue than from any other. The return which barley must make when traced through the malthouse, brewhouse and distillery, will be found to amount to a sum almost incredible* (quoted in Mathias, 1959, p. 435).

Improvements in soil and agriculture methods

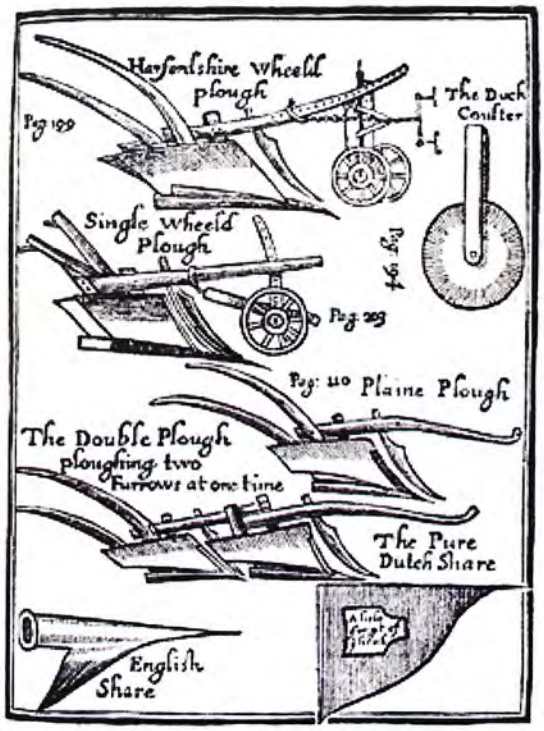
Until recently some historians believed that the agricultural revolution came early to Norfolk and this was the reason that it was the first county to flourish, but Overton (1996) was convinced that the main changes of the so called *'revolution'* did not appear until later in the eighteenth century. The Norfolk four-course system of rotation, which eventually replaced the old system that included a fallow year, was only gradually introduced and not widespread until after 1800 but it was first documented on three farms in Norfolk from 1739-51 (Overton, 1996, p.120). However, he felt that there was an earlier stage up to 1750, which enabled agriculture to increase output to unprecedented levels.

In this earlier stage in the first part of the eighteenth century, Overton highlighted the importance of the development of the design of the plough in Norfolk, while he also referred to two other major changes within agriculture. These last two points are important to this thesis, as he raises both the decline of rye and the appearance of the potato in the eighteenth century. Among other changes were the introduction of marling to improve the soil, turnips and early enclosures. Of these changes, the plough would have had the potential to effect the growth of ergot, the enclosures would have had an affect on the standard of living of poorer people and the potato was a new food source within the diet that had the potential to improve nutrition. The question is would any of these factors have also improved fertility?

The introduction of new designs of ploughs in Norfolk and its significance in terms of reducing ergot contamination of rye

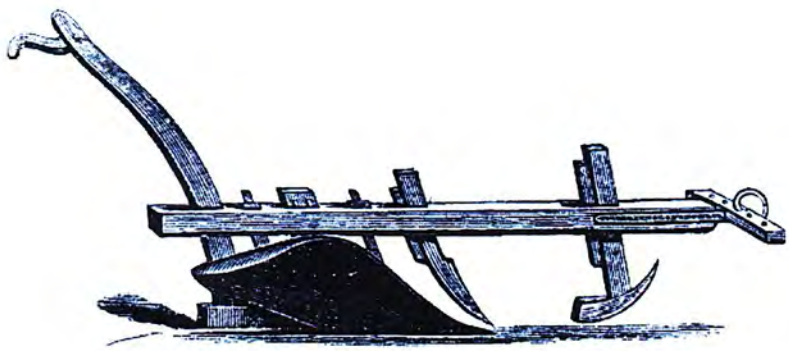
While Overton (p.194) acknowledged the virtues of deep ploughing, he agreed that there was in the late seventeenth and early years of the eighteenth centuries little knowledge of how to control pests and diseases. Only slowly did farmers understand the need for the nutrients, nitrogen, phosphorous and potassium, then available as chemical salts, which would increase output. However, there were immediate benefits from ploughing deeper that would have had an effect on any ergot. As has been discussed previously in Chapters 4 and 5, deep ploughing is very important in preventing the over wintering and growth of ergot spores in the soil, resulting in the year on year contamination of rye and other poorer grains.

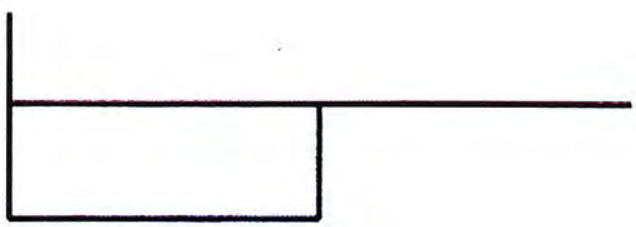
Innovations in design also enabled farmers to economize on labour and horses, as smaller ploughing teams ploughed more acres in a day. Figures 6.4 to 6.7 show the different designs of ploughs used from the Middle-Ages to the end of the eighteenth century. The new designs included changes to the coulter, the share and the mould-board. Brunt (2003, pp.446-449) outlined the impact of the new plough design on agriculture and output particularly in Norfolk. Norfolk ploughs were, in 1721, the first to have iron-plated mould boards, which increased durability and reduced friction. However, the most important point was that the new designs allowed deeper ploughing and this would have a negative impact on the growth of ergot.



Seventeenth-century Ploughs. From Walter Blith, *English Improver Improved*, 3rd. ed., 1653.

Figure 6.4 Seventeen century ploughs





Traditional Plough Design

Note: The traditional plough exhibits a rectangular construction pattern and the use of a share beam
Source: Rotherham, 'Agriculture of the Netherlands', p. 58

Figure 6.5 A traditional plough design (Brunt, 2003, p. 448)

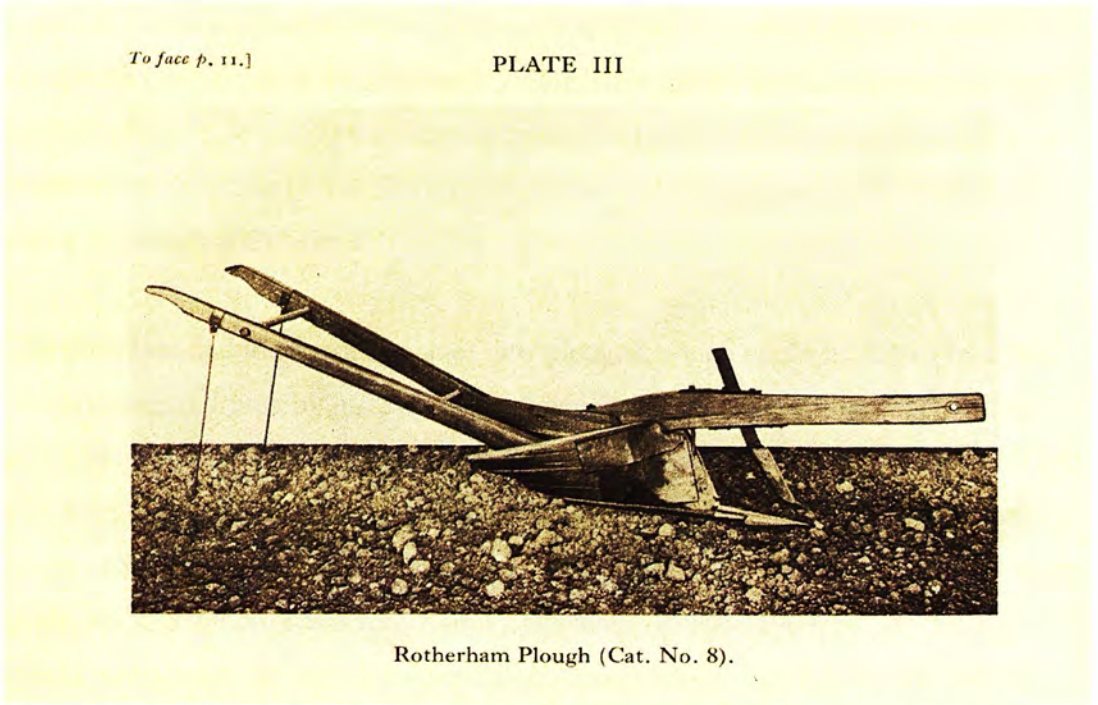


Figure 6.6 Rotherham plough (Spencer and Passmore, 1930, p.11)

The Rotherham plough marked a great advance in soil cultivation. Patented by Stanyforth and Foljambe in 1730, the knife or coulter fixed to the shaft cut the soil for the passage of the share. The curved mould-board, which was later made of sheet-iron, turned the furrow right over (Spencer and Passmore, 1930, p.44).

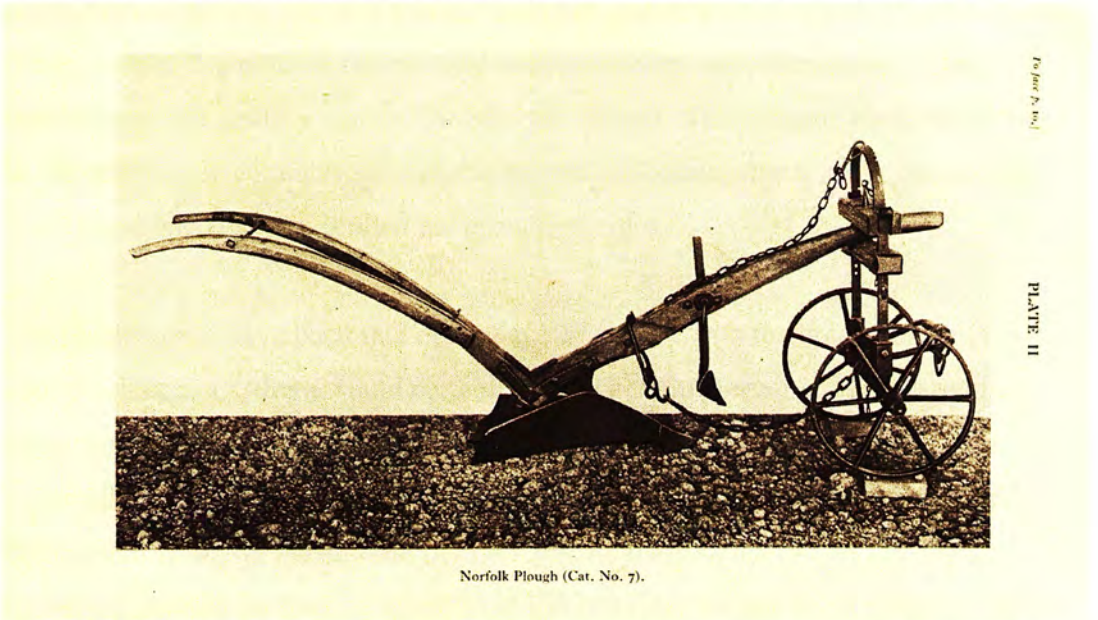


Figure 6.7 Norfolk plough (Spencer and Passmore, 1930, facing p.10)

Figure 6.7 shows a later model of the Norfolk plough, from the latter part of the eighteenth century, with the high angle of the beam which was a common feature of Norfolk ploughs, which threw pressure on the heel of the plough, preventing any tendency for it to ride on the share-point (Spencer and Passmore, p. 43), making it easier to plough with horses.

The invention and the introduction of new ploughs, which could be drawn by one or two horses and driven by just two men, as opposed to the heavy eight oxen of the past and a team of men which was difficult to manoeuvre (Prothero, 1888, pp. 10 and 43), would have made an impact on the amount of any ergot remaining in the soil. Some of the new ploughs could plough as deep as eighteen inches, while the average depth of the older ones was only about five inches (Riches, 1967, p.113). Ergot would now tend to be buried deeper and the spores would find it difficult to survive. Furthermore, due to enclosures, fields were larger and there were fewer hedges and edges as in the old strip system, so that ploughs could get closer to the edges and the fields were better maintained. To illustrate the industry and endeavour to make the most of the land, Riches stated that in Norfolk the *'plough teams stepped along at three or four miles an hour'* compared to one or two miles an hour in other counties and it was usual for the ploughman to do a split day in which he did two *'journies'* (*sic*) (Riches, p.112). While it was not until the middle of the eighteenth century that these ploughs began to be widely used nationally, they were introduced at the beginning of the century across Norfolk. All of these effects would have contributed to the decrease in contamination and improved soil management and hygiene, and would have increasingly limited the growth of ergot.

The result would have been that even if rye was added into the bread during the eighteenth century, there would certainly have been little ergot in it, because the sunny conditions and the introduction of new ploughing techniques would have inhibited its growth. On its own the good weather would have had a singular and detrimental effect on the amount of ergot able to grow on the rye, as the shorter flowering periods for the rye would have left less time for any ergot spores to infect the grain, while its ability to remain in the soil to re-contaminate cereals were

lessened by developments in ploughing. It is argued that one consequence would be that the fertility of the wives of the labourers should have started to improve and this has already been shown to coincide with the demographic rise in the population of England from around 1730 onwards, already presented in Chapter 1.

Thus changes in agricultural practice could overall have limited ergot contamination and potentially supported improvements in fertility around the middle of the eighteenth century.

Enclosures

Improving ploughing techniques and the need for greater output of grain led to the need for larger fields and the removal of labour intensive strip farming for subsistence. While enclosures by informal means, or by formal but local agreement, accounted for all enclosures across England before 1700 and for a majority of enclosures in the eighteenth century, this was increasingly superseded by enclosure enforced by Act of Parliament in the second half of the century. This became possible by the promotion of private Bills which, when passed as an Act of Parliament, had force of law. Neeson (1993, p. 4), lists 39 Acts in the 1730s, 393 in 1760s and 640 in the 1770s in Norfolk.

However, landowners in Norfolk, in order to enlarge their fields, undertook enclosures at an early stage. In 1770, Arthur Young recorded the fact that:

> *Parliamentary inclosures* (sic) *are scarcely ever so complete and general as those in Norfolk. Had the inclosures of this county been by acts of parliament, much might have been done, but on no comparison with what is done* (quoted in Sylvan's *Farmer's Magazine,* 1776-1780, p. 216).

Marshall (1787, p.4) reinforced this in his *Rural economy of Norfolk: 'Upon the whole, East Norfolk may be said to be a very old-inclosed (sic) country'.* The consequence for poorer farmers and labourers was that larger fields and continuous use of the fields meant that fallow land was no longer available for their cows, pigs and sheep to graze on. For the land owners and larger tenanted farmers, bigger fields

meant that they could be managed more easily and ploughed using fewer animals and labourers, with higher returns.

The landlords and farmers were very successful and earned a great deal of money from the new markets, and in order to continue this success used enclosures by Act of Parliament to create a revolution in farming. A consequence of enclosures and limited grazing for the labourers' animals meant that milk became scarcer and more expensive to buy in some areas, especially when foot and mouth visited England in the severe outbreak of 1745 which continued for 12 years. It had already been *'very violent'* in 1730-32 in parts of Wales (Bowden, 1985, p. 51) and a previous outbreak had occurred in London in 1714 (Bates, 1717, pp. 872-85).

Other restrictions ensued with the increase in enclosures and, although much of the legislation was in place, it was initially only gradually enforced. The Game Act of 1671, which was only slowly implemented, made hunting of game, particularly rabbit, hares, pheasants and partridges, the exclusive privilege of landed gentry: *'taking food from the poor to give sport to the rich'* (Jenkins, 1869, p. 473). It also applied to deer and, in 1723; the penalty for taking a deer was death. What was previously a custom now became a crime, along with other common rights such as gathering wood, furze and peat for fuel (Overton, 1996, p. 185). Removing the labourers' right of turbary was a real loss as it had been essential for providing heating and cooking. Rules of trespass on private land were strengthened and more rigorously applied. For a time in the south gleaning in some areas was more restricted, and even picking berries and nuts on the farmers land was seen as stealing, although this varied across England.

Whereas previously the laws were only occasionally enforced, from the middle to the end of the eighteenth century their effects began to bite. Salaman (1989, p. 491) suggested that the majority decision in the Court of Pleas in 1788 reinforced gleaning as trespass, but when the price of wheat fell again in the second half of the nineteenth century, gleaning once more became general and was regarded as a *'valuable privilege by the labourers' womenfolk'*.

Riches (1967, p.139) commented that farming in Norfolk increasingly deprived the labourer of even an acre on which to supplement his bread diet, and enclosures had taken away his chance to keep a cow, or even geese. They also found it difficult to find fuel and it was expensive to buy which would have had the consequence that they would cook less, together with a change in their diet to the most basic food stuffs, which would have been wheat.

Effect of the early agricultural changes on the standard of living of labourers in contrast to the landowners

Acquiring more land and producing more and more grain was important to the landed proprietors. Overton (1998, p.60) reported that Norfolk lost three quarters of its medieval woods from 1600-1790. For the farmers the gradual introduction of these changes had beneficial consequences for the quality and output of the grain and crops across Norfolk, and many became opulently rich, while many labourers suffered from the farmers' success. The comparison between the labourers and the farmers became obvious as the whole social and former paternal interaction between farmers and labourers lessened. Young in his tour of 1760 commented that *'the farmers have raised large fortunes, and bid fair to become possessors of the whole country'* (Sylvan, 1776-1780, vol. 2, p. 216) and in a footnote described their affluence: *'it is no uncommon thing to see, on a Saturday, many Norfolk farmers come to Norwich market, in their coaches, or post-chariots and four, with two or three powdered footmen in livery'*.

With the change to wheat and abundant barley in the county of Norfolk, the labourers moved to eat wheat and not rye as their main grain for bread. Fay (1923) thought that the public taste for white bread had reached Norfolk by about 1745. By 1760, Prothero (1888) considered that wheat was the breadstuff of 5/8ths of the population, and this was especially true of the capital and the south of England.

With plentiful crops of wheat and at first, a constant price for bread, the poor farmers, cottagers and labourers would not have been very aware of the resulting

impact that enclosures would eventually have on their social and economic lives. The poorer farmers during 1715-1765, the '*golden age of the peasant*' (Prothero, 1888, p. 39), enjoyed the fruits of their labours and probably benefited from the new markets, but after 1750 it was not to last. Thus the combination of deep ploughing, the reduction of subsistence farming and the increasing move to wheat from rye necessitated by the market, reduced the likelihood of ergot ingestion in the middle period 1715-65.

The agricultural revolution and the resulting occupational and social changes for labourers, from about 1765 onwards

It is now important to show the effect of further agricultural changes in the third period from 1765 onwards and to understand why, in spite of harvest failures, and the limited diet of the poorer classes due to enclosures, fertility appeared not to have been checked as in previous occurrences of crises in the past.

There was another change in the weather pattern from the middle of the eighteenth century. The weather was bad in 1756 and worsened again after September 1763 (Figure 6.3). From 1771-1780 annual rainfall in England averaged 26 inches compared with 18 ½ inches in the period 1741-1750 (Prothero, 1888, p. 40). Porter (1851, pp. 35-36) stated that *'in the closing years of the last century there occasioned a succession of deficient harvests which caused a considerable importation of corn (grain) into the country'*. He listed deficient harvests in 1767 and in 1768, and fluctuating seasons between 1780 and 1789, and between 1790 and 1799 England ceased to be an exporting country for wheat. Dearth was a problem again in the period 1800-1801 and in 1810, while bad harvests occurred again in 1816 and 1817. The down turn in the weather, as has already been shown, is apparent in Figure 6.3.

Bad weather and the continuing determination of the farmers to meet the needs of the markets led to a revolution in agriculture that had social and economic consequences for all the poorer farmers and labourers. What then were the main ingredients of the agricultural revolution and why on the one hand did it lower the standard of living of the labourers while fertility was maintained?

While many of the agricultural changes had started as experiments in agriculture, as already discussed in the context of Norfolk, Overton (1996, p.1) combined evidence with findings from the specialist literature to argue that the main changes of what others called the agricultural revolution took place in the century after 1750.

Riches (1967) and Overton (1996), within their respective publications, considered that the agricultural revolution was concerned with issues that included:

- the application of new methods to farming for the purpose of making money
- little to do with machinery
- abandonment of the old open field strip system
- the gradual substitution of elaborate crop rotation and land not allowed to lie idle
- turnips, lucerne (alfalfa) and clover were used to restore soil fertility
- productivity increased by a more general use of marl
- animal manure used, made more available by the additional cattle supported on the turnips, lucerne, and clover
- an introduction of *'so called artificial grasses'* for keeping larger number of cattle.

Overton stated that, in Norfolk, the proportion of the arable area sown with fodder crops was between thirteen and seventeen per cent for the entire period from 1250-1730s but by 1830s it was over fifty per cent. The introduction of the Norfolk four course rotation meant that the old fourth year of fallow was replaced with fodder crops that could be used both for animals to graze and, in some cases, for enriching the soil with nitrogen. A fourth year rotation, instead of fallow, meant that labourers and cottagers could no longer graze their cattle on the fallow land, as had been their tradition.

The consequence of the drive to grow even more grain led to increased enclosures, while new methods of rotation of crops involving turnips and grasses for fodder

meant less and less fallow land. The combination of these factors gradually led to access to common grazing becoming restricted.

In this period, when diets became very basic and access to a previous variety of foods within their diet diminished because of the consequences of enclosures, and while wages failed to rise with the cost of bread, work patterns changed for labourers. However, the fertility of the lower classes, at least at a national level, was not checked. This has been a difficult area for historians to understand as, for many of the poorest people, they were less likely to be able to keep their animals and supplement their diet from their gardens, the fields and hedgerows.

The Reverend Brereton commented (p.1) that in the latter period of the eighteenth century onwards and at the time of his writing in 1825 *'the peasantry'* were depressed and had lost to a considerable degree their ancient reputation for freedom, independence and moral deportment. He was also concerned by the rise in the number of poor people and the need for increased poor rates (p. 25).

National recognition of the changes in agriculture resulting in the lowering of the living standards of the poor from 1765 onwards

Just how bad the diet and life style of the labourers and cottagers became needs to be explored in order to show that, while actual famine was not a feature of their lives at this time, they certainly began to feel the consequences of the changes in agriculture as enclosures began to bite. It is also necessary to emphasise in some detail in the following discussion the resulting fall in living standards of agricultural workers over this period from 1765.

By 1801, Riches (1967, p.15) maintained that *'relatively fewer people were engaged in feeding themselves'*. Most now had to buy grain rather than growing or gleaning it. Few were given grain in lieu of wages or fed at the farmers' table. While the number of farm servants began to decline rapidly, as they were seen as a drain on the farmers' resources and a distancing occurred between farmer and servant or labourer, subsistence farming declined.

Kent made his views known by writing a pamphlet *Hints to Gentleman of Landed Property* (1775, p. 261) where he suggested that farmers and landlords in Norfolk should take responsibility for those who worked for them in terms of increasing wages and also by considering the state of their homes, which were not being maintained but turning into hovels. The roofs of their houses leaked, as cottagers and labourers were without access to thatch, bracken and straw to repair holes. Reflecting the guilt of many landlords and reformers, Kent produced plans for model homes for the labourers and cottagers.

Davies (1795, Preface) stated that *'the mischief is universally felt'* and was so concerned about the labourers in his own Berkshire parish that in his report of *The case of labourers in husbandry* he put in a plea of redress for the labourers to the Board of Agriculture to listen to Kent and give more attention to:

> *a case of widespread and increasing distress; and be instrumental in procuring for the numerous class of people in question that redress, to which they seem to have just claim.*

Even Arthur Young (1808, pp. 32-3) who supported the enclosures and the agricultural changes was moved to comment:

> *there is however, one class of farmers which have undoubtedly suffered by enclosures; for they have been greatly lessened in number: these are the little farmer... it is a great hardship, suddenly to turn several, perhaps many of these poor men, out of their business, and reduce them to be day-labourers, would be idle to deny, it is an evil to them, which is to be repelled.*

It was difficult to make ends meet on such low wages, with high bread prices and high rents. Kent, (1775, p. 262) estimated that, within the second fifty years of the eighteenth century, wages rose 25%, but the average price of wheat the labourer had to buy had increased by 60%. He stated that, as conditions were, it was impossible for the labourers to live by their labour. His calculations for weekly bread for a family of seven left them with only 3s 3d for all other expenditure. Wages remained entirely *'too stable'* during the century and failed to reflect the gradual rise of the cost of food after 1760, or the sharp rise during the last 10 years of the century. Rogers gave six shillings per week as the average wage for agricultural labourers for

all of England in 1708, and eight shillings in 1790 (1902, pp. 494 and 527). Eden (1797) made the point that the harvest wages were actually lower in 1796 than 1771, while even in the workhouse it cost 1s.6d per day per person to feed, house and clothe the inmates (1794a, p.163). Kent had already made the case for the Norfolk labourers; he (1775, p. 261) estimated a family of seven required 42 pounds of bread a week, the almost sole article of food. In 1794 the country experienced one of the worst harvests ever recorded. The price of a loaf of bread jumped from 7d to 12 ¼d in 1795, in 1799 to 13d, in 1801 to 15 ¾d, and in 1812 17d. Wages remained at 7s.or 8s. Bread remained a constant item of the budget, but meat followed milk and consumption practically ceased. Meat in 1789 accounted for 12% of income, whilst in 1795 it was only 0.08% (Salaman 1989, p. 497).

However, not all landowners disregarded the needs of poorer people (Beresford 1924, pp.198-201).

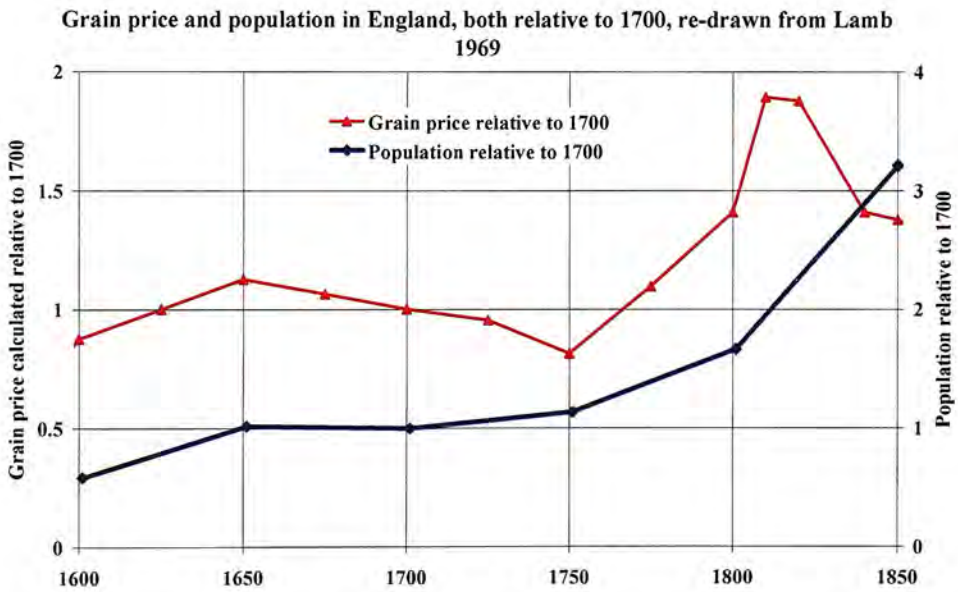


Figure 6.8 Population and grain price in England relative to their levels in 1700

Modern analysis of wages and food show the extent of the low standard of living of the poor. Overton (1996, p. 68) presented the changes, linking population and prices

with a wheat-wage index that showed that real agricultural wages fell from 1500 to the early seventeenth century, and then a hesitant rise occurred in the 1740s, but after that there was a continued fall in real wages as prices rose once again (Overton, 1996, pp. 68-69). Figure 6.8 illustrates the relative price of grain to wages.

Overton contended that the agricultural revolution consisted of two related transformations; firstly a transformation in output and productivity brought about by a complex set of changes in farming practice, which allowed England to avoid a *'Malthusian trap'* in the eighteenth century; secondly a transformation of the agrarian economy and society including a series of related developments in marketing, landholding, field systems, property rights, enclosures and social relations.

Of the above ingredients of the agrarian revolution there were certain features which had a domino-like effect on the lives of poorer sections of the agricultural population, as landowners and tenant farmers responded to the needs of the wider markets. Overton felt that the explanation for the rise in labour productivity was due more to institutional factors. Most of the paternalism was gone to be replaced by a farmer and waged labourer relationship subject to the conditions of weather and seasons for work and increasingly no other source of income for the labourers. The labourers were now waged workers dependent only on that wage, and very little other resources.

The effects of the agricultural revolution led to the separation of poor farmers, cottagers and labourers from their traditional social and economic ties and the consequences of the social changes became very conspicuous to contemporary writers, reformers and those with a social conscience.

Fertility of women

Great emphasis has been made in this chapter on the consequences of agricultural change and the effect on the standards of living of rural workers, which resulted in a change of diet to wheat but with little else. Yet in spite of low wages and the

distancing of landlords from labourers so that labourers were now waged and could only work in one employment and were increasingly unable to produce food from other sources, generally the fertility of women was stable and the population figures remained high.

Habakkuk (1965, p. 283) had already suggested that there was a view that in England, even the bad harvests, for example 1793-5 and 1798-1801, did not have so severe an effect on the population as those of earlier periods. He considered that improved nutrition, whatever its origin, was clearly a possibility for the increase in population. However, he thought that it was difficult to assess this conclusively as the surviving examples of labourer's diet hardly suggested that any improvement could have been substantial. It has been shown that since 1965 more information on the condition of agricultural workers and their diet has been forthcoming, substantiating his claim.

However, the main argument which lies at the heart of this thesis is that one of the factors affecting the improvement in fertility at a time of low standard of living and occasional short term harvest crises was the reduction in the amount of rye being grown together with the decrease in the contaminating ergot, in favour of wheat.

The decline of rye and a potential lessening of ergot

The initial decline of rye has already been highlighted, but that is not to say that rye was not grown at all. Ashley (1928, p.7), using the Corn Tracts of 1764, reported that in East Anglia the proportion of rye for bread was 8.8% compared with barley 1.9% and wheat 89.3%. Many liked bread made with one quarter rye to wheat, as it kept its moisture better and had improved storage properties. There were also differences in the North and South of the country.

However, what was important was that the widening of the markets signalled the ending of subsistence farming (Overton, p.140) and rye became mostly used as a fodder crop as well as being exported. This resulted in less rye being eaten after about 1750.

This can be clearly shown, as has already been discussed, when problems were created when the Speenhamland system was introduced in Berkshire, and when related systems were adopted in other parishes in the south and east of England (Overton, 1996, p.187). The labourers rejected rye as the staple grain and insisted that the parish benefits had to be based on the price of wheat bread (Eden, 1797, vol. 1 pp. 576-577), as this was now their staple food and often with little else.

The potato

Salaman's (1989) history of the potato detailed its development as an important crop in the diet of the British people towards the end of the eighteenth century, which eventually became widespread across England in the nineteenth century. The general health of the people would have improved through eating potatoes that contained Vitamin C, but could it also have been a contributory factor in maintaining or increasing fertility as the rye decreased? The vitamins available within potatoes, especially vitamin C, would have helped to improve the general health of the labourers but would not have increased their fertility *per se*, as they lack other important vitamins such as Vitamin A, D and E, which help reproduction (p. 123).

Conclusions

Within this chapter, the links between weather, agricultural change and the quality of the life and income of the rural labourers within three distinct periods covering the Little Ice-Age, The Golden Age of the Peasant and the period from the 1760s onwards has been presented, with some supporting evidence from Norfolk.

Table 6.1 summarizes these findings and supports the conclusions presented below.

Table 6.1 The effect of weather, the agricultural revolution and ergot contamination on the life of the Norfolk labourer, 1675-1800.

Factors	1st phase 'Little Ice Age'	2nd phase 'Golden age of the peasant'	3rd phase Agricultural Revolution
Rye Bread	√	X	X
Barley and Wheat	X	√	√
Old plough	√	↓	X
New plough	X	↑	√
Weather bad in ..			
Winter	√	X	√
Summer	√	X	√
Fields gleaned	√	↓	↓
Enclosures	X	↑	√
Access to ...			
Berries, fruits and nuts	√	↓	↓
Garden produce	√	↓	↓
Common lands	√	↓	↓
4th year fallow grazing	√	↓	↓
Rabbits and deer	√	↓	↓
Firewood	√	↓	↓
Turves	√	↓	↓
Thatch	√	↓	↓
Bracken	√	↓	↓
Threshing at home	√	↓	X
Eating with the farmer	√	↓	X
Cooking at home	√	↓	X
Cost of bread-high	√	X	√
Real Wages High	√	↓	X
Population Checked	√	↓	X
Climatic Conditions for Ergot Growth Favourable	√	X	√
Farming Conditions for Ergot Growth Favourable	√	↓	X

Key High = √, Changing = ↑↓, Low = X

Table 6.1 The effect of weather, the agricultural revolution and ergot contamination, on the life of the labourer 1675-1800

In summary, increasingly over the eighteenth century, rye, even if grown and consumed, would not have suffered as much from ergot contamination as previously. A combination of events and agricultural changes could have reduced ergot contamination and interfered with its life cycle: enclosures and larger fields increased the hygiene of fields, the burying of ergot deeper with the use of new ploughs, the gradual reduction of rye as a subsistence crop and the introduction of wheat and barley which were less likely to be contaminated.

While the hypothesis that rye and ergot ingestion had a role to play in depressing fertility in the late seventeenth and early eighteenth centuries, later, the reduction in growing rye in favour of wheat and barley, was accompanied by an increase in fertility. The most important point arising from the decline of rye was that while poorer women once again in times of bad harvests were hungry in the late eighteenth century, the fact that most had changed to wheat, even though it was in short supply for them, meant their fertility was maintained or increased. This fertility outcome is in stark contrast with harvest crises in the late seventeenth and early eighteenth centuries, when poor rye was the main diet, and, it is argued that, this was linked to a fall in fertility. Also from the mid-eighteenth century, until the mid-nineteenth century, gleaning was prohibited in some areas and women would not have had the opportunity to gather any ergotised rye from the fields and so grain or flour would have had to be purchased. The consequence would have been that women would have eaten less rye from the mid-eighteenth century onwards.

Supporting modern and independent evidence for this hypothesis can be found in Overton's conclusions on the factors involved in agricultural change, where he divided his findings into two main periods before 1750 and after 1750; the design of the new plough, the decline of rye, early enclosures and a response to widening markets seem to be the key features of the first stage, while the rise of the landowners, the new capitalist market for grain, the effect of enclosures and the decreasing interaction between landowners and workers seem to be the main features of the second stage. These are all in line with the arguments presented in this thesis affecting the change from rye to wheat, the potential decrease in ergot and the link to the demographic trends from the Cambridge Group's research.

In Overton's first period up until 1750 and starting towards the end of the second decade of the eighteenth century it has been shown that the introductions of new farming techniques helped farmers increase their output of grain. Coincidentally, these changes occurred during unusually dry weather (Figure 6.3) and good harvests and were driven by the development of new dependable markets for the wheat and barley. These factors can be credited with causing the main changes in farming in

this period, particularly in the south, in turn leading to other economic and social changes that had a significant effect on the diet of the agricultural labourers and their way of life.

The result would have been a decrease in the amount of ergot on rye crops which in turn would have resulted in a less contaminated diet. The release of the control arising from small doses of ergot in the diet should have meant that the contraceptive effect would have lessened and women would have had a more normal chance to conceive. This was demonstrated by the rise in fertility identified in the Cambridge Group study.

In the seventeenth century, if the hypothesis suggested above is considered, ergot could have acted as a contraceptive as it probably heavily contaminated rye diets in times of bad harvests (Figure 6.3). Population figures demonstrate a check on population in the last quarter of the seventeenth century.

To turn the hypothesis around, if contaminated rye was not a factor, then it could be argued that in the later period of the eighteenth century, punctuated by food riots, bad harvests, starvation conditions, little access to their previous resources of food, fertility should have been even more vulnerable to a check than before. However, this did not happen. From 1760 onwards, while financial success for the farmers as a result of the new markets continued to increase, and was obvious for all to see, this was at the expense of the quality of life of the labourers. However, the diet of the mass of the people was now firmly wheat, with little variations possible in the diet because of the high cost of food and static wages. This standardisation of the diet had consequent effects on female fertility. A wheat diet would have maintained fertility, even in bad years and during a period of rising cost of living. Large families could continue to be produced, as the contraceptive effect of ergot would have been gradually removed through ingesting less ergot along with the rye.

This chapter has helped to substantiate the first part of the hypothesis concerning the role of ergot; namely that rye bread, which was a major part of the staple diet of most

people at the beginning of the long eighteenth century, and could have been contaminated with ergot, though supplemented with produce from their gardens and livestock, suppressed fertility. When the staple diet was replaced by wheat and little else, these contaminating effects would have been removed. The hypothesis suggests that as rye use declined, it could have released women from the contraceptive and abortive action of any ergot ingestion and, with the move towards eating wheat, the fertility of women was allowed to occur normally from about mid-century onwards.

However, the next important issue to address is whether there is any evidence that ergot featured as an epidemic of ergotism in the period under study and whether ergot was recognized within agriculture in England. This will be addressed in the next chapter, Chapter 7.

Chapter 7

Evidence to determine whether ergot was a problem within English agriculture that could have contaminated the staple diet and the potential consequences of its presence

It was established in the previous chapters that rye was grown and used for food extensively during the seventeenth and early eighteenth centuries in England and that, by the end of the century, there was a change to mostly wheat usage, especially among the poor rural labourers and their families. These changes were shown to parallel the rise in population.

This chapter will establish whether the ingestion of ergot, present as a fungal parasite on rye in particular, but sometimes on other poor grains, could have been a contributory factor in affecting fertility. It will investigate the views of historians as to whether symptoms consistent with ergot ingestion occurred in England and also whether the ergot contamination of rye was known to be a problem to be avoided within agriculture. A two-pronged approach will therefore be taken: searching for evidence of ergotism and ergot-like symptoms; and examining agricultural records to establish whether farmers recognized ergot as a problem. An assessment of whether ergot could have affected fertility can then be presented.

Epidemics and symptoms of ergot contamination

The most important points that arose from Chapter 3 were the extent of ergotism in Europe, while the evidence gathered seemed to portray England as having largely avoided the problem. Overall, in terms of rye infected by ergot, Drummond and Wilbraham (1958), in trying to understand the picture across Europe, were forced to consider whether English rye could have been less heavily infected than the Continental variety. They discounted this as unlikely, as, before the change in farming methods '*the practice of growing cereals was just as primitive in England at that date as it was in Germany or France* (p. 87)'. They also pointed to the lack of any outbreak of ergotism following the purchase of large quantities of rye from other European countries for use by the poor in times of scarcity of corn. They further

suggested that *'no satisfactory explanation has yet been offered to account for the rarity, indeed non-existence, of ergotism in England'* (p. 87).

Certainly, Drummond and Wilbraham were looking for full blown epidemics, and had probably supposed that any small amounts were harmless. They concluded that, because people were at no time wholly dependent on contaminated rye for a sufficient length of time, the disease did not manifest itself. It is important to establish what reasons there could have been for this so called *'rarity'* of full-blown ergotism in England, particularly in the seventeenth and eighteenth centuries, and to determine whether Drummond and Wilbraham's view was correct.

As has already been discussed within Chapter 3, there were a number of factors that could have accounted for the lack of ergotism in England compared to Europe. These would have included any differences in the growing conditions for grain, the effect of weather on agriculture, and significant differences in the diet of the mass of the population in England compared to Europe. Conversely, the presence of ergot could have been a problem but was not recognized as such, and this needs to be investigated, as a poor recognition and understanding of the fungus and its action, together with poor communications, could have led to a failure to diagnose and understand local illnesses and incidences of ergotism and its consequences. Another argument could be that only small amounts of ergot occurred in the diet at a sub-clinical level that did not readily or obviously manifest itself as being harmful.

Charles Creighton, in *A History of Epidemics in Britain* (1894, p. 58), was also puzzled that there were no epidemics of ergotism in England and thought that these had been overlooked or misunderstood. In order to discover incidences of ergotism in England he suggested that:

> *the types of ergotism can be so varied that the task is, not to search the records for the name of ergotism, but to scrutinize any anomalous outbreak of disease, or any outbreak distinguished ... by some unusual mark, with a view to discovering whether it suits the hypothesis of ergotism.*

These are important directions and need to be explored further.

While Creighton's approach suggested a direction in which to proceed and a useful tool for this study, and he was aware of the main convulsive (involving the neuro-system) and the gangrenous form (involving the circulatory system) of ergotism, he himself could not have known all the symptoms of ergot ingestion or its effects that have emerged through modern investigations and discoveries. He would have been unaware of the many other clinical and sub-clinical effects that are now associated with ergot and the various drugs discovered within ergot - ergot has been referred to as a *'treasure house for drugs'* (Stoll, 1965). In particular, the action of ergot on the uterus, now well understood, is the effect that is the most important with respect to the hypothesis presented in this thesis. Therefore, in order to proceed, first of all it is necessary to determine whether there was ergotism in England.

Re-visiting various historical epidemics and features of particular and widespread illnesses may therefore lead to the discovery that ergot contamination and consequent disease was present in England in the long eighteenth century. There are, however, dangers in this approach, as Matossian found after publishing her article in1985 (p. 76-79, 84). The vast number of symptoms that can be produced by ergot can lead to over-emphasis and misinterpretation, due to selectivity, and not enough direct or circumstantial evidence and references on which to base a definite conclusion. In Matossian's case, this led to critical reviews of her publication by other historians (Hardy, 1988, pp. 387-401, Estes, 1990, pp. 624-625 and Wilkinson, 1990, pp. 446-447).

Creighton applied his approach by scrutinizing any anomalous outbreaks that could be ergotism and referred to a number of epidemics in England that he thought were due to ergot. He took as one of his examples an outbreak in Lancashire and Cheshire in 1702, which *'was clearly not a psychopath (sic) or hysterical outbreak, and yet had a seemingly hysterical element in it'*.

An account of the epidemic was sent to the Royal Society by Dr Charles Leigh of Lancashire (Creighton, p. 58-61 and the *Philosophical Transactions,* 1702, pp. 1174-1176). Leigh stated that *'we have this year had an epidemical fever'*. The particular

case he described was of a young boy of 13 years, John Pownel, who lived in Lymm in Cheshire, who had signs of a disease that Creighton interpreted as the convulsive form of ergotism. The convulsive fits were accompanied with spasms of the chest which affected his ability to breathe and speak and in these spasms he '*barked and snarled like a dog*'. Leigh made the following statement about the young man. *'The remarkable case of the boy, certified by several witnesses, is expressly given as one belonging to the general epidemic of the locality, others having been affected much after the same manner.* ' Dr Leigh had to dissuade local people that the boy was not *'possessed'*. Importantly, Dr Leigh had stated *'there have been other persons in this country (sic) much after the same manner'*.

Creighton (1891-1894, pp. 61-62) also referred to another case of what he thought was convulsive ergotism in Oxfordshire in 1700, reported by Nichols in his *History of Leicestershire* and investigated by a Dr Freind in the town of Blackthorn. In this outbreak a number of girls in two close-knit families had signs of convulsive fits and chest spasms that also caused them to bark like dogs. Diagnoses of *'St Vitus Dance'* and hysteria were eliminated. A report was sent and published in Latin in the *Philosophical Transactions*, dated 1700-1701.

The third case that Creighton highlighted occurred in 1762 in Wattisham in Suffolk, where a family of eight were affected by ergot which produced full blown symptoms of the gangrenous type of ergotism (Wollaston, 1762, Bones, 1762) and was eventually recognized as such at the time.

A full investigation of this case took place and was once again reported in the *Philosophical Transactions*. Interestingly, in this instance, the ergot was found on poor rivet wheat (sometimes called clog wheat or bearded wheat) and not rye. While it would have been more relevant to the argument presented in this thesis to discover that the growth was on rye, it does prove that ergot was still in the soil even in 1762 and could contaminate any potential host, even though great improvements in agriculture were taking place in much of this region of England.

The previous chapter on rye growth in England in the long eighteenth century, showed that in times of dearth poor people relied on very poor grain. Those affected in Wattisham had used very poor grain that had been *'set aside'* and then used in a crisis to make bread and puddings and also used to brew two bushels of malt. Another labourer, who lived in the village, also ate the flour from this batch and had milder symptoms of ergotism with numbness of his hand, loss of nails and peeling of the fingers, for about four weeks during the same period.

The father of the affected family, John Downing, was *'so pre-possessed with notions of witchcraft, and so obstinate in his opinion, that I cannot excite in him even a desire of attributing this disease to any other cause'* reported Wollaston (1762, p.531). This is the second reference to being *'possessed'* in these three cases, which suggests that there may have been a folklore about this disease. Other historians have subsequently shown that cases of witchcraft persecutions were often associated with outbreaks of ergotism (Caporael, 1976, Matossian, 1989). MacFarlane (1970) suggested that witch persecutions were evident across the country in the fifteenth and sixteenth centuries in England, and, in these cases, the symptoms usually included hallucinations, fits, trances and gangrene and were often associated with death of cattle. However, he did not appear to make the connection to ergot.

The Wattisham case caused a lot of public concern because all the family affected lost limbs that had eventually separated without pain, sometimes at the ankle and others at the knee or hip. All recovered except one, but obviously without certain parts of their limbs. The only member of the family who succumbed was the 2 month old baby who, although taken off the breast at the start of the mother's illness and put out to a wet nurse, died with blackened limbs two months later. One of the most important features of this case was that the baby must have been affected by the mother's breast milk, a consequence highlighted by the WHO (1990) two hundred and thirty years later, and an area that still needed to be further investigated, as shown in Chapter 3.

In the debate that followed the final letter and report to the Royal Society, it was stated that, *'the gentlemen of the academy were of the opinion that the disease was produced by bad nourishment, particularly of bread, in which there was a quantity of ergot'* (p. 533) and they also added,

> *although we undoubtedly excel the antients (sic) in the knowledge of poisons, yet a great deal of that subject still remains unknown to us. It will therefore be very difficult for us to discover, to what cause, or to what combination of causes, so uncommon a malady is to be attributed* (p. 533).

Those in the academy, while having some knowledge of the disease, appeared not to be familiar with it or were unaware of other instances of this rural illness or the nature of ergotism.

The cases above also refer to epidemics across counties and the country, so an assumption could be made that at times it was spatially distributed, but obviously not widespread enough to warrant government action. While these epidemics came to the attention of certain intellectuals, there does not seem to be any evidence that it came to the notice of the authorities in such a way that the problem was addressed nationally, as was the case in some other European countries. However, it may be that officials were aware of certain illnesses and addressed the problems pertaining to them without knowing what they were dealing with, as during that period many diseases were called *'plague'* or *'fever'* when their cause was unknown and routes for dissemination of observations and treatments were limited.

However, even if there were only three confirmed outbreaks that came to the attention of the Royal Society, this does mean that ergot outbreaks did occur in England in the long eighteenth century and were therefore not unknown in England. Also, it was not known how many more outbreaks occurred that were not recognized as such.

Cases of diseases which may or may not have been caused by ergot

To justify the above statement, another case is presented of an unknown epidemic that could easily have been ergotism and could have linked back to the problem of

ergot affecting breastfeeding and infant mortality, already highlighted above in the Wattisham case, due to ingestion of poor contaminated grain by the mother and transferred in the breast milk.

Maitland (1756, p. 623), in a *History and the Survey of London* described an outbreak of illness in 1741. He reported that;

> *the City and places around were carried off in great numbers... the immediate cause of the fever was said to be a coagulation of the blood or a stagnation thereof in the capillary arteries. It was difficult to treat and the most successful remedy was 30 grains of the powder of the American Senekka Rattle-Snake-Root, given to the patient in warm milk*[1] *every six hours.*

Maitland noted that this *'distemper'* spread over the whole nation and was also felt in Ireland. He recounted (p.623) that a judicious author (this was John Attree, 1741, p. 610 in the *London Magazine*) had written;

> *from several circumstances, it seems improbable that it should rise from the communication of infectious matter, from the body of one person to another; and, therefore, we are led to suspect it must arise from the unwholesomeness of the diet, that the people afflicted with it lived upon. In the late scarcity and dearness of provisions, tis well known (especially in parts of the Kingdom) that the millers and bakers bought, and consumed vast quantities of horsebeans, pease and unsound barley etc.*

There was a high mortality among babies in London at this time, much occurring either in the first month of life or at the time of *'teething'* (Creighton 1894, p. 749 and Lander, 1993, p. 209). The diagnosis of convulsions in these babies was not linked with fever, but the convulsions were linked with *'griping in the guts'*. It could have been gripe, but gripe or colic would not cause death, unless it too was linked with mesenteric gangrene, another symptom of ergot contamination.

Landers (1993, pp. 208 and 228), whose research for *Death and the Metropolis* analysed the London Bills of Mortality for the period, listed four main trends. One of these was the disappearance of the summer burial peak between the late seventeenth and early eighteenth centuries of babies, which apparently reflected an absolute

[1] It was quite probable, if this was caused by ergot, that the milk itself would have been the best antidote that could have been given.

reduction in July and August mortality and corresponded to the virtual disappearance of *'griping in the guts'* as a recorded cause of death.

Of the figures for infant mortality before 1700, 76% were for *'griping of the guts'* deaths and the others were under the heading of '*infants, chrisomes* and *teething'*. Landers also highlights that, in the period after 1728, the number of burials at young ages is dominated by the single category of convulsions.

Lander assumed that the widespread vulnerability among young infants leading to their deaths, and the expectation that breastfeeding generally gave babies a degree of immunity from infection, therefore, implied a prevalence of early artificial feeding. Lander (p.152) admitted that he had no direct evidence as to infant feeding methods among the study population. However, he did not consider whether the mother's milk, either because it was limited or contaminated, could have been another reason or a different interpretation of the cause of high infant mortality in this period. As has already been mentioned, ergot can both dry up the mothers' milk production and be transmitted to the babies gut or alimentary system through the mother's milk, leading to death. Transference to the baby could have occurred from the mother or a wet nurse, which was a common way of feeding babies when mothers were having difficulties.

The possibility that the transfer of ergot to the baby can also happen during birth must also be considered, both from the mothers' ingestion of ergot and alcohol during labour and by the prescribing of ergot by midwives to help with the pain during birth. This view is to be fully explored in Chapter 9.

Interestingly, in the nineteenth century, Ramsbottom, in an article in the *London Medical Gazette* in 1839 (p. 252), suggested that in four of his cases the children delivered by the aid of ergot died of convulsions a few hours after birth. He attributed their deaths to the *'deleterious properties'* of ergot being conveyed to the infant and acting injuriously on its tender *'organisation'*, although it did not affect the mother, and he added *'convulsive seizure being one of the prominent features of*

ergotism'. In these cases the ergot was prescribed, but even if it was ingested in the diet, the outcome would have been the same. Of course, breastfed babies would have suffered if the mother or wet nurse was affected by ingested ergot at even small doses. Ergot could have affected the baby's alimentary tract causing restriction of the blood to the gut, leading to gangrene of the intestines and of the mesenteric tissue due to its spasmodic actions.

Convulsions are not linked to colic either. Recently, Bangh et al. (2005, pp. 239 and 242) reported cyanosis, convulsions (47%) and respiratory distress in neonates who had been accidentally administered an injection of ergot.

The discussion on the use of the London Bills of Mortality and the term convulsions in babies has been one of the sources of controversy between Matossian (1985) and Hardy (1988). The above remarks introduce a possible understanding of the reason for the prevalence of *'gripe'* and its role in causing death based on the presence of ergot. The use of ergot as a prescriptive drug in labour may also unknowingly have contributed to this problem.

It is also interesting to observe that Wrigley et al. (using the work of Dobson, 1989) linked much of the high infant mortality at this time to those areas of coastland and marshes in England and this is exactly where the local poor or sandy soil would have been used to grow rye. This period of time coincided with two seasons of very poor harvests due to bad weather in 1741-1742 (Creighton, 1894, p. 78). This is of particular interest because at that time in London the infant mortality rate was at its peak, at 450 deaths per 1,000 live births (Wrigley et al., 1997,. p. 218 quoting Landers, 1993, and Laxton and Williams, 1989). The only other place with such a high rate was the East Anglian Fens, from where grain for London was often received, confirmed in this case in 1741, as Maitland specifically stated that much of the grain eaten had arrived from East Anglia. With soil conditions there so poor and the weather so bad, the grain may well have been contaminated with ergot. As will be shown in Chapter 9, new laws also allowed for the poorest grain to be shipped to the capital for the brewing of gin and, in a time of shortage, might have been sold on

instead of being used for gin. However, the diagnosis remains difficult. It could also have been due to malaria or typhus, as both Short and Creighton gathered together many contemporary references but found the interpretation of hazy symptoms *'severe'* in many fevers and diseases (Wrigley et al., 1989, p. 668).

Coincidently, evidence from a recent historian has suggested that many babies in the year 1741 were in poor condition. Levene, in 2005, investigated the mortality in London and the Foundling Hospital from 1741 - 99, and concluded that the high mortality in 1741 was due to the condition of the foundlings on entry, rather than their experience of hospital life, which corresponds to the above direct evidence and the time period. Interestingly, also, two of the three conclusions suggested by Levene as to why the infant mortality improved after 1760, included the improved nutrition of the mother and a decrease in gin drinking in the capital (Levene, 2005, p. 96), both potentially linked to ergot. These last two points will be raised and discussed further in Chapter 9.

However, even if the events discussed above could have been caused by ergot, it is difficult to be definite, as many diseases were poorly diagnosed and misunderstood (Hardy, 1988). This can be further demonstrated by a few other possible or doubtful diagnoses.

Problems with diagnoses of diseases

Contemporary and later historians seemed to have recognized that there were problems in diagnosing ergotism as the symptoms were similar to other diseases, and because disease mechanisms were poorly understood. Porter (1992, p. 6) highlighted the point that the only regular topical medical literature being published in the seventeenth century was in the *Philosophical Transactions* and the *Gentleman's Magazine*, which were used as a forum for medical correspondence. As has already been shown, a number of references to ergot-like symptoms were published by the Royal Society in the eighteenth century.

Attention has already been drawn to the difficulty that Creighton highlighted with the diagnosis of ergotism. This muddle was evident from the few pieces of published medical literature. George Cheyne (1733, p. 93) made a reference to *'St Anthony's Fire'* among a list of other diseases in his book *The English Malady* about nervous diseases, but no detail of symptoms were given. A few further examples of this dilemma follow.

Creighton (p. 63) appeared not to link infant mortality with ergot poisoning in this period under discussion but did link ergot with the diagnosis of typhus. He stated:

> *it has not been easy, in an epidemic among peasantry after a bad harvest to distinguish the cases of ergotism from the cases of typhus, the contractures of the limbs, which seem so special to ergotism, having been described also for undoubted cases of typhus.*

It has already been demonstrated that during the eighteenth century the main diet of the population in England gradually changed from rye to mostly wheat. Other writers had views as to the effect of changes in the diet of the poorer people and their subsequent health. Gilbert White in 1778 stated that the change in diet bought about health. He suggested that one of the possible reasons for the disappearance of leprosy was due to *'the plenty of good wheaten bread that now is found among all ranks of people in the south instead of that miserable sort which used in old days to be made of barley and beans'.*

When the symptoms of leprosy (now called Hansen's disease) are considered it is easy to see how that diagnosis could have been muddled with other illnesses, as so little was known about the disease at that time. The BBC Health Medical Notes on Line (2008) notes on leprosy states:

> *The disease is difficult to diagnose accurately even today, but is characterized by cuts on the body coupled with loss of sensation.*
> *Lepromatous leprosy symptoms are a chronically stuffy nose and many skin lesions and nodules on the front and back of the body.*
> *Sensation loss starts at the fingers and toes and may only affect a small patch of skin to begin with. The loss of sensation can lead to unnoticed injuries which may in turn become infected. In advanced cases, gangrene will set in and flesh will rot on the patient.*

Today leprosy is still not clearly understood and it is only since the 1930s that drugs started to become available to treat it. In light of this research, one further possibility is that the diagnosis of cases of leprosy in England may at times have been confused with ergotism, as both diseases caused parts of the extremities to eventually separate, as was shown in the Wattisham case. The evidence for the mechanisms by which leprosy was thought to be transmitted is still not considered conclusive and, like ergotism, leprosy can occur amongst family members or groups of close knit people.

Continuing the theme of misdiagnosis, or lack of knowledge of diseases, Morgan, even in 1930 (p. 57), when he reported on the cases of ergotism in Manchester at that time in the *Journal of Hygiene*, commented that some of the characteristics of ergotism closely resembled Raynaud disease. This is a disease where occasional spasms of the digital arteries occurs, causing paleness and numbness of the fingers and toes, which can result in dry gangrene, but it does not occur in epidemics or among any close groups of people, only as individual cases.

The above examples of suspected ergotism relate to situations where direct and circumstantial evidence can be put together to interpret events for a particular outcome and both could be researched in depth to determine whether the suggested diagnosis is valid.

Health of the population

It is also necessary to consider the state of health of the mass of the population, as this appears not to have been of national concern and any local illnesses may only have been seen as that, a local issue. There is a proviso, however, about the health of this group. Most of the lower classes or the poor did not have access to a doctor or physician. They tended to put up with their lot and it may still be that ergotism in England was more widespread, but not recognized, than suggested by those outbreaks and the medical references already discussed. As the health of the labourer was not considered important by most of the élite, knowledge of the diseases they suffered was not easily communicated other than locally and usually by the clergy.

It was only in the late eighteenth century that any literature could be found addressing the medical conditions of the poor for their own self-care, and that was due to Buchan, an Edinburgh GP, who in 1769, thought it wrong to keep secret medical knowledge and published his *Domestic medicine*. He was heavily criticized by a great many of his colleagues for revealing medical information to the general public. However, the information that was published was only the best available locally and was not very accurate. For instance Buchan refers to *'St Anthony's Fire'*, another old name for ergotism, as another name for erysipelas (which is inflammation of the skin and is contagious) and then muddles the symptoms of the two diseases. This remained a common medical inaccuracy for many decades. In another section he appeared to recognize the symptoms of ergot in labourers but diagnosed those as due to careless living and not caring for themselves in cold weather (Buchan, 1772, pp. 50-51).

> *Diseases of the extremeties (sic) are very common amongst those who labour out of doors. Thees (sic) diseases are often attributed to venom, or some kind of poison.' ... 'labourers come from the field, cold or wet, they run to the fire, and often plunge their hands in warm water...a strangulation happens, and an inflammation or mortification ensues.*

Here it is not obvious whether the disease could have been frost bite or perhaps ergotism as both can lead to gangrene.

Recognition of ergot as a problem in agriculture in the eighteenth century

The precise amount of ergot found on rye and other grains in England is of course difficult to estimate and therefore an assessment of what effect ergot had in the diet, and on the health of the poor in particular over a longer period of time, is inevitably somewhat problematic. This can however be examined from another perspective, by investigating whether there is evidence that ergot was noticed in the fields or in agriculture generally. Documents have been found that refer to problems with rye growth within agriculture that both support and confirm the presence of ergot.

Ergot poisoning of cattle

Various kinds of evidence linked with the modern knowledge of ergotism can be used to support the view that ergot was a problem in England. Ergot affected cattle as well as people and the incidence of symptoms in both can be a helpful indicator. As shown in Chapter 3, cases of witchcraft, now accepted as probably linked to ergot, were found across the country and 'suspicions' were often triggered by the death of cattle. The gangrenous form of ergotism can affect cattle and they are wary of eating infected fodder (Mantle, 1969). Henslow recorded that *'ducks, fowls, turkeys and pigs... preferred starvation to voluntarily partaking of the rye, even when it was mixed in small proportions only with good flour'* (1841, p. 15).

The importance of not feeding animals with any ergot residue from the sifted rye from the mills was highlighted in Chapter 3, together with the importance of preventing animals from grazing in infected rye fields or being given rye grass that had been allowed to flower instead of being cut early for hay. Henry (1771, p. 223) reported a discussion at the Royal Society where farmers were cautioned against ergot's pernicious effects and warned that it was also hurtful to animals and added that the Society thought that rye *'was much in disgrace among the farmers of this country'*.

Interestingly, Foot and Mouth in cattle was also recorded in 1712, which would have made the antidote to ergotism, i.e. milk and dairy produce, more difficult and expensive for most people to drink or obtain. In a diet that contained mostly rye and most probably ergot, the effects of the ergot in producing obvious symptoms of ergotism in England, although sometimes very evident, could well have been ameliorated by the ingestion of milk, meat and other dairy produce that was probably available to many labourers at the end of the seventeenth century. For those affected at a sub-clinical level, the lack of milk and dairy produce would have made infertility more probable if rye was contaminated with ergot. Indeed, in Buchan's *Domestic Medicine,* he offered a milk and vegetable diet to all those women who were barren or infertile, a diet which two of his doctor colleagues also used and found successful (Buchan, 1772, p. 66). This would have effectively lessened any widespread

incidences of ergotism. On the other hand, a lack of milk and dairy produce would have had the opposite effect and the symptoms of ergotism, especially sub-clinical ergotism, would have been more prevalent.

Interestingly, Michell (1828) when disputing that the death of babies occurred because of the too early administration of ergot during labour, and presenting a number of cases to prove this from his own practice, raised the issue of giving ergot with milk. He wondered whether his practices were slightly different to others in that he gave the ergot with milk and thought it might have worked as an antidote. '*Milk is said to be its antidote. I merely mention this as it may suggest a reason why the ergot has been so mild in my practice, as I always add one third milk to the infusion*' (p.126) [2].

The dangers inherent in sowing and processing of rye

One of the other sources of evidence that ergot was a problem in agriculture was from warnings about its presence in agricultural writings. While Ashley wrote extensively on the amount of rye consumed in England, he did not refer to any ergot on rye, but there was one reference in his publication to *'clean rye seed'* in a list by Henry Best. *'Clean rye seed'* could be interpreted as either meaning free of other seeds or free of contamination by ergot.

John Mortimer, in his *The whole art of husbandry* (1721), in sections on corn growing, referred to methods for preventing *'smut'* on wheat and *'blasted'* corn. *'Smuts'* were probably types of mildew, but the word *'blasted'* usually referred to ergot. He stated (p. 307) that '*if corn is blasted, I am told that if you set up in ricks three or four years, that the blasted ears will consume and rot away*'. This is suggestive of ergot being the causal fungus as it tended to lose its potency after a year or so while, conversely, if any other mildewed corn was left in ricks for that period of time, it would have made all the rest of the rick rot. It would have been

[2] As has already been discussed milk was used by others to increase fertility and as an antidote to ergot during epidemics.

unlikely that this information was shared except among the élite or the leaders among the farmers.

Further searches revealed that the word *'blasted'* was confirmed as meaning ergot by Henry, in 1771 (p. 231), when he referred to rye as being:

> *addicted to a disease called blast, and under that circumstance if ground into meal and eaten constantly, is of all poisons the most pernicious, for it has been known to kill whole families by piece-meal by rotting off their limbs, and then leaving them to linger out their lives in extreme misery.*

In addition, any reasons why ergot could have gone unnoticed in preparing rye for use need to be identified. The process by which rye was sown, grown, harvested and prepared for food by labourers was fully described in Chapter 5. There were particular points raised from this description that can demonstrate how ergot, when present, could easily have entered the labourers' food chain. It has been shown that women and children ate more of the grain in the home as the men folk often ate at the farmers' table during the day. The food that the poor ate and the manner of its preparation all need to be considered to determine the likelihood of ergot contamination of their diet.

Women gathered the leftover grain as part of the harvest gleaning and it represented a large part of the grain available in the home. One point worth noting is that gleaned grain came especially from the hedges and edges of fields where field hygiene would be at its worst and ergot would be most plentiful and from stalks and grain scattered in the process of harvesting. Once the rye was contaminated ergot could be recognized as black ears within the rye head. However, during the process of harvesting and grinding to flour, when the outer black shell of the ergot could have been accidentally damaged or removed by raking, it would have then become impossible to see and would not have been noticed, thus preventing its extraction. Furthermore the increasing problem of a lack of free fuel, which worsened as the reduction of common rights and the effect of an increasing number of enclosures began to bite, would have prevented thorough cooking of gruel and bread. The loss of potency of ergot due to intensive cooking, described in Chapter 4, would not then have occurred.

Those grains of ergot not harvested would over-winter in the soil. It is useful therefore to compare modern standards of deep ploughing and constant field hygiene to prevent contamination of the rye with ergot, with the farming methods of the late seventeenth and early eighteenth centuries. As outlined in Chapter 3, extremes of weather and poor maintenance exacerbate contamination of the rye crop. If it was a cold and wet year and the edges of fields or strips were not weeded the ergot could remain in the soil and be ready to contaminate the next crop. Until the introduction of a deeper ploughing system, described in Chapter 6, the soil containing ergot spores could not be turned over deeply enough to render these spores ineffective.

Sub-clinical amounts of ergot in the diet and its implication for the women that consumed it

The cases of ergotism in England described above were evidence of spasmodic incidences due to short term heavy ingestion of ergot. However, Chapter 3 showed that ergot could also be a problem when small amounts were taken over a long period, especially if people had a sensitivity to ergot. It could mean that small amounts of ergot acting sub-clinically may also have been present without necessarily causing obvious problems to those eating it or recognized as the source of symptoms of an illness that did not display the degree of symptoms that full blown ergotism would achieve.

At the end of the seventeenth century and during the early eighteenth century, a daily intake of a few grains of ergot would have acted as a contraceptive and would have had an effect on the woman's fertility. The outcome of this would have been difficulty in conceiving and could result in fewer pre-nuptial conceptions and later marriages, fewer children during marriages, wider spacing between children and a decreased fertility span, while conception outside of marriage would also have been checked. When women did become pregnant, they could become vulnerable to having a stillbirth in the third trimester. This was because progesterone, acting as a protector during previous months, fell to a level where ergot could potentially overcome the role of the hormone, thereby allowing the uterus to contract.

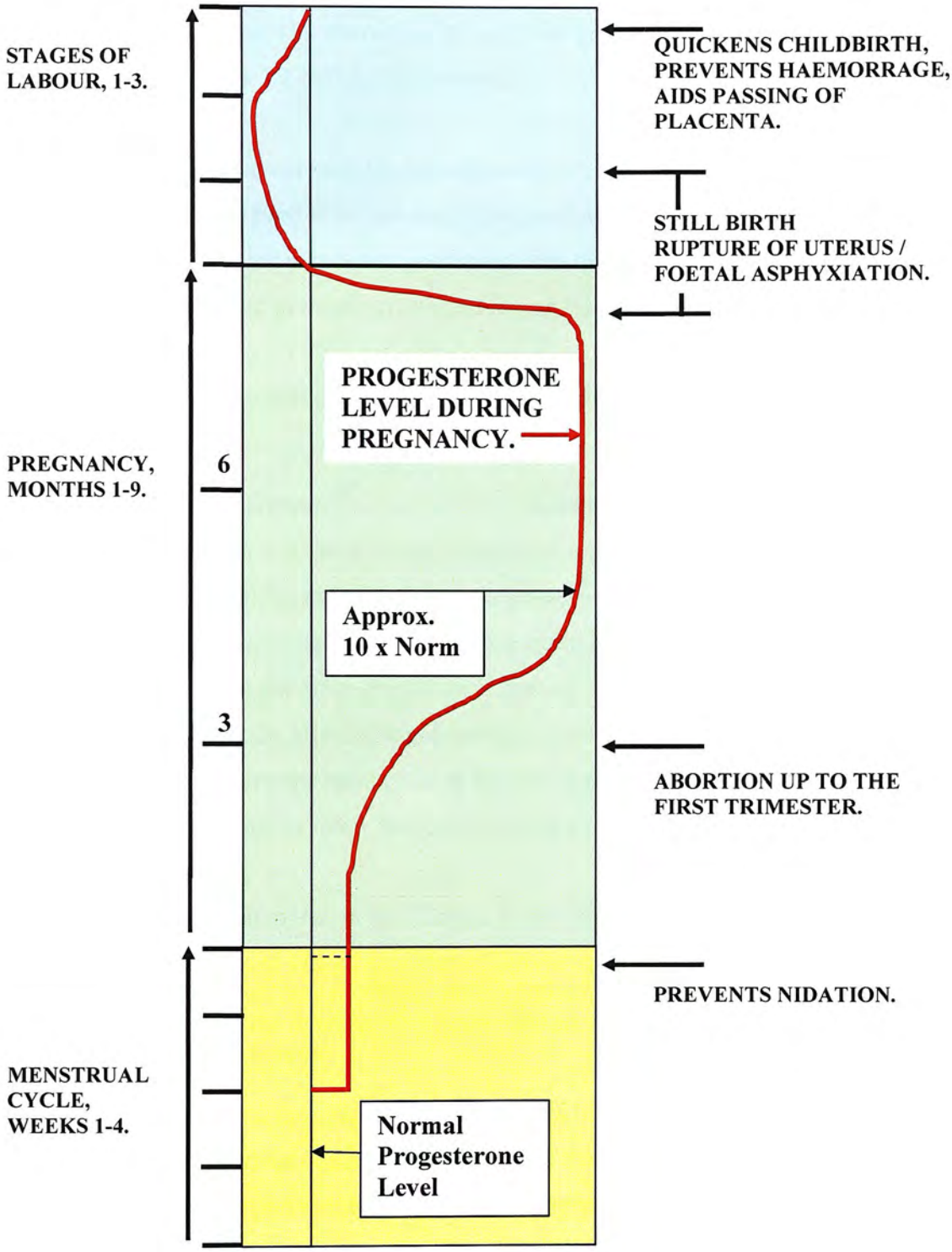


Figure 7.1 The variation of progesterone levels during the menstrual cycle, pregnancy, labour and post partum, indicating the periods when ergot has the potential to overcome its protection and predominate

The effect of this could be to kill the baby through extended contractions and cause the death of the mother through rupture of the uterus, as the cervix was not in a prepared state for labour. The interaction of ergot and progesterone is fully explained in Chapter 9 and Figure 7.1 outlines the actions.

The questions identified and raised to be addressed, at the end of Chapter 1 from the Cambridge Study, now need to be considered as possibly being, at least in some part, due to ergot ingestion that may have contributed both to infertility through its contraceptive effects and as an abortive agent during the last trimester of pregnancy.

The lessening of the effect of ergot after the middle of the eighteenth century in England

While this chapter has presented evidence of the likelihood that ergotism occurred in England and has shown that the differing amounts of ergot could have had an effect on the population's health and fertility, there is a need to show why the effect lessened after 1750, even when the weather once again became a problem for growing and harvesting the grain crops. The important point to make here is that during this later period the effect of ergot contamination would have markedly lessened as wheat became the main grain in the diet of the poor and the art of home baking was also soon lost by many housewives, with a move towards buying bread.

By 1821 (p. 82) Cobbett wrote, in his *Cottage Economy:*

> *How wasteful, and indeed how shameful for a labourer's wife to go to the baker's shop; and how negligent, how criminally careless of the welfare of his family must the labourer be who permits so scandalous a use of the proceeds of his labour.*

He obviously recognized the change in the labourer's life style but did not appreciate the difficulty that the wives of the poorer sections of the population had, after about 1750, in retaining their previous diet due to the emergence of economic market expansion, with a low waged income and little access to the variety of food produced from the previous use of common land and gleanings. By the time Cobbett wrote, businessmen had profited from the shortages during the Napoleonic wars and their wish to gain even more profits resulted in enclosures reaching a higher intensity

(Turner, 1984), making access to firewood and other materials difficult for the poor to obtain.

The poor had, however, much earlier turned to mostly wheat for their main diet and while, after 1750, they experienced hardships due to harvest crisis or lack of work due to the economy, on this occasion, their health and fertility remained the same or improved. One distinct possibility that this thesis raises, is that this was due to ergot having been removed from their diet, together with its contraceptive effect on the women and the loss of babies due to stillbirths.

Conclusions

This chapter set out to determine the evidence as to whether ergot contamination was a problem within English agriculture and whether ergotism affected the population in the long eighteenth century.

It has already been shown in Chapters 5 and 6 that all the conditions were present at the end of the seventeenth century for ergot to flourish, while, in the latter half of the eighteenth century, ergot contamination would have been much less of a problem in England because wheat became the grain of choice and even in times of hardship the poor tried to maintain this *'higher diet'*.

Evidence has been produced to show that epidemics of ergotism were present in 1700, 1702 and 1762, substantiated by papers and discussions in the Royal Society reported in their *Philosophical Transactions*. Other sources that referred to plagues and fever could also have been misdiagnosed and actually have been ergotism, but the dangers of interpreting these as such were fully explored. However, contemporary agricultural records of 1721 and 1771 confirmed that the references to *'blasted'* corn were ergot and some farmers recognized it as a problem.

The evidence presented has shown that the way that grain was sown, harvested and the flour produced offered opportunities for ergot to be incorporated into the labourers' main food supply and for the contamination to become unidentifiable.

However, as already shown in previous chapters, dairy products were often given in other countries as an antidote to full blown ergotism, and milk was more available in England in the late seventeenth century and first decade of the eighteenth century, than later, potentially mitigating somewhat the adverse effects of ergot ingestion.

While ergotism was shown to have occurred in epidemics in England, a case can certainly be made that ergot may also have acted at a sub-clinical level, especially in the late seventeenth and early eighteenth centuries. As has already been stated in the preface, Matossian (1985 and 1989) attempted to address the population question in England, but she headlined ideas rather than fully exploring the evidence and any relevant research. The consequential lack of referenced statements was highlighted by a number of reviewers of her publications who were critical of her approach to historical research (Hardy, 1988, 1991 and Wilkinson, 1990). Hardy (1991, p. 510) stated that, superficially Matossian's arguments seemed 'not implausible', but she considered her work insubstantial and deeply unscholarly. In particular, Hardy argued that Matossian did not define her claim that ergot acted as a fertility suppressant, variously implying that it was due to infant mortality, miscarriage, or temporary female infertility. This thesis has now offered evidence that ergot occurred on English rye in the Little Ice-Age, when it was the staple diet, and can be linked with modern research that found that ergot acted as a contraceptive, as well as an abortive agent.

Coutinho's trial of ergot as a contraceptive, already discussed in Chapter 3 and reported in his 1975 paper, investigating the prescription of ergonovine maleate (ergometrine in UK) at a daily dose of 0.20mg orally, indicated that the compound had an active contraceptive effect. This provides direct proof that ergot given in small and regular doses could act as a contraceptive. The inference of this research, related back to the period of the Little Ice-Age, when there was evidence of the presence of ergot in agriculture as well as cases of ergotism, is that ergot could have acted as a contributory factor, acting as a contraceptive, in the fertility changes being considered even although people would not have been aware of the effect. If the conditions are examined further the inference seems even more justified.

Rye was eaten in large quantities but because of the range of diet, particularly dairy produce, full blown ergotism was rarely found among the labourers, or at least reported, as other parts of their diet would have acted to some extent as an antidote. However, small doses would have acted sub-clinically and probably have had a contraceptive effect. As women were most often the recipients of damaged rye, they would have been vulnerable to the contraceptive effects of ergot contamination. A sub-clinical amount of ergot could well have been present to affect the fertility of women, especially in seasons of poor Spring weather that facilitated ergot growth on the rye or if there were harvest crises or hardship, when the poor would resort to poorer and coarser grains. Not only would it have caused infertility, it also had the potential to cause stillbirths in the third trimester as progesterone levels dropped in preparation for labour.

However, when periods of dearth occurred after 1750, when the poorer classes were poorly paid and unable to vary their mostly bread and potato diet, it might have been expected that the population would have experienced the same kind of check as in previous crises, but this did not re-occur. Even though they experienced hardship and difficulty in feeding the family, as similar groups before them had in England in times of crisis, and although many were also without the previous resources from common land and gleanings that they had enjoyed at the end of the Little Ice-Age, their fertility was not checked but was maintained.

When ergot contamination that affected fertility in women was removed, it also removed the potential to cause stillbirths in the third trimester, so that this would have occurred simultaneously in the same period.

Some evidence to substantiate the view that ergot affected the food of the poor and limited women's fertility in the long eighteenth century until the major inclusion of wheat changed their diet maintaining their fertility in times of hardship, and allowed pregnancies to proceed to full term, has been identified. It is therefore argued that one of the contributory factors for the changes in population over the long eighteenth

century could have been ergot contamination in the staple diet, which acted as a contraceptive and as a cause of stillbirths, until wheat became popular and replaced rye, thereby markedly reducing ergot contamination from the diet. This finding could be considered as one of the answers to why there were changes in fertility within the long eighteenth century, especially those concerning illegitimacy, prenuptial pregnancy, spacing of children, fecundity and changes in the rates of pregnancy occurring later and longer in the reproductive span. On the one hand, ergot could have helped to hold back these events during the Little Ice-Age; on the other hand, when ergot began to be removed from the diet, around the middle of the eighteenth century onwards, it released this check.

While the above conclusion may contribute an answer to some of the main questions concerning fertility and its effect on nuptiality arising out of the Cambridge Study highlighted at the end of the Chapter 1, it does not necessarily answer the other points that were raised there. While the number of stillbirths may show why some of the endogenous infant mortality rates changed, together with the maternal mortality rates, it may not fully answer the questions raised concerning all the other possible improvements in maternal care.

Wrigley et al. maintained that improvements in midwifery care also led to more live births and fewer deaths in childbirth. A discussion on the changes in midwifery and child birth practices during the long eighteenth century will follow in Chapter 8, and then in Chapter 9 the question to be investigated is whether ergot could have also affected women and children when taken or used during pregnancy and labour. It will be argued that, while the staple diet could have been unknowingly contaminated by ergot, its use in labour may have been premeditated, even though an understanding of its exact mechanism of action was lacking. In addressing these issues during pregnancy and labour some of the difficult questions and interpretations raised by the Cambridge Study concerning stillbirth, maternal and infant death and illegitimacy, highlighted at the end of Chapter 1, will be explored further.

Chapter 8

The extent to which delivery skills and childbed practises changed and affected the rate of endogenous infant and maternal deaths in the seventeenth and eighteenth centuries in England

Among the suggestions put forward by the Cambridge Group to explain the increase in population in the eighteenth century was that an improvement in the midwifery care of women led to more live births and fewer deaths of women in childbirth (Wrigley et al., 1997, pp. 236-8, 242, 306, 313).

As can be seen in Figure 8.1, adapted from Tables 1.1a and 1.1b, total infant mortality figures seem to have been substantially higher in the second half of the seventeenth century and the first half of the eighteenth century and from about 1740 they began to fall. It was at this point that life expectancy at birth also rose.

During the period from 1625-49, when the overall infant mortality was low, (estimated by Wrigley et al. as 153 per 1000) to 1725-49 when overall infant mortality was at its peak (191 per 1000), exogenous[1] mortality rose by 51% from 73 to 110 per 1000, while the endogenous[2] rate was almost identical for the period at 80 and 81 per 1000. Although the two definitions are not exact, this could imply that infections or invasion of the body by external agents were particularly prevalent in the mid-eighteenth century. By contrast, when the major fall in the overall infant mortality rate took place after 1740, the fall was concentrated exclusively in the endogenous rate, which tumbled from 81 per 1000 in 1725-49 to 33 per 1000 by 1825-37. This implies a marked decrease in infant deaths during pregnancy, birth trauma or inherited genetic defects.

Figure 8.1 shows that, over the same period, as endogenous infant mortality was falling, maternal mortality was also falling and in much the same proportion. This suggests that there was steady improvement in maternal health and childbirth from the late seventeenth century onwards.

---

[1] *Exogenous mortality-caused by the invasion of the body by external agents e.g. infections

[2] *Endogenous mortality- infant deaths due to maternity, birth trauma or inherited genetic defects. Wrigley et al., suggest that the distinction may be arbitrary, but has proved illuminating at times.

The questions that arise from these changes are, why was the endogenous birth rate so high, even if it mirrored the decrease in maternal deaths, in the late seventeenth century and why did these rates begin to fall and continue to decrease throughout the eighteenth century?

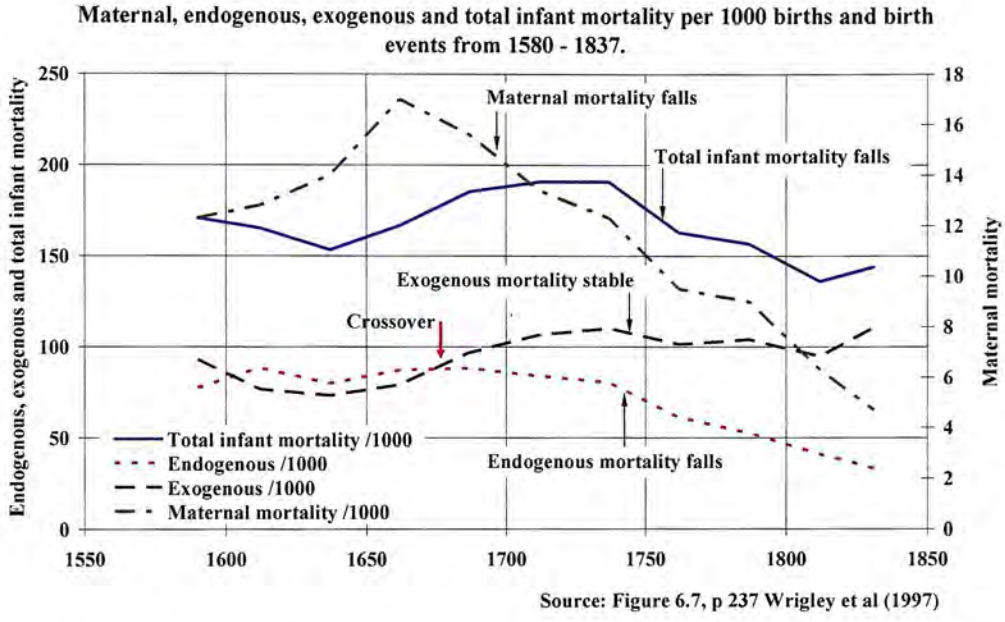


Figure 8.1 Maternal, endogenous, exogenous and total infant mortality per 1,000 births from 1580 - 1837

The Cambridge Group suggested that improvements in childbirth practices could offer an explanation for both of these changes. Therefore, the areas of health care development to be examined further in this thesis, are aspects of personal care in childbirth and changes in culture and professional practice during labour. The consequences of these changes will then be considered to see if they could have influenced the endogenous mortality and maternal death rates.

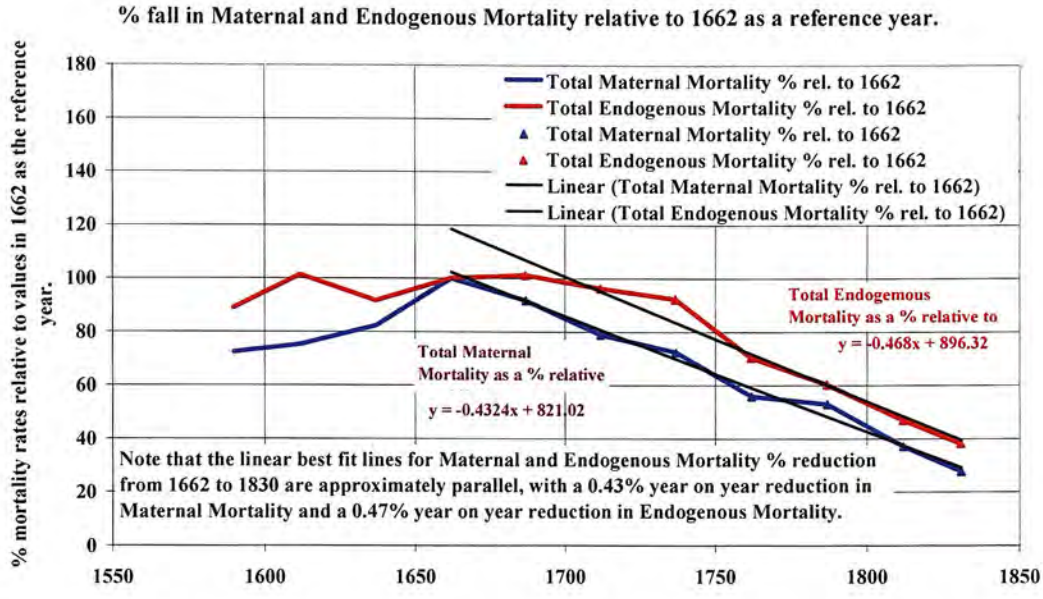


Figure 8.2 % fall in maternal and endogenous mortality relative to 1662 as a reference year

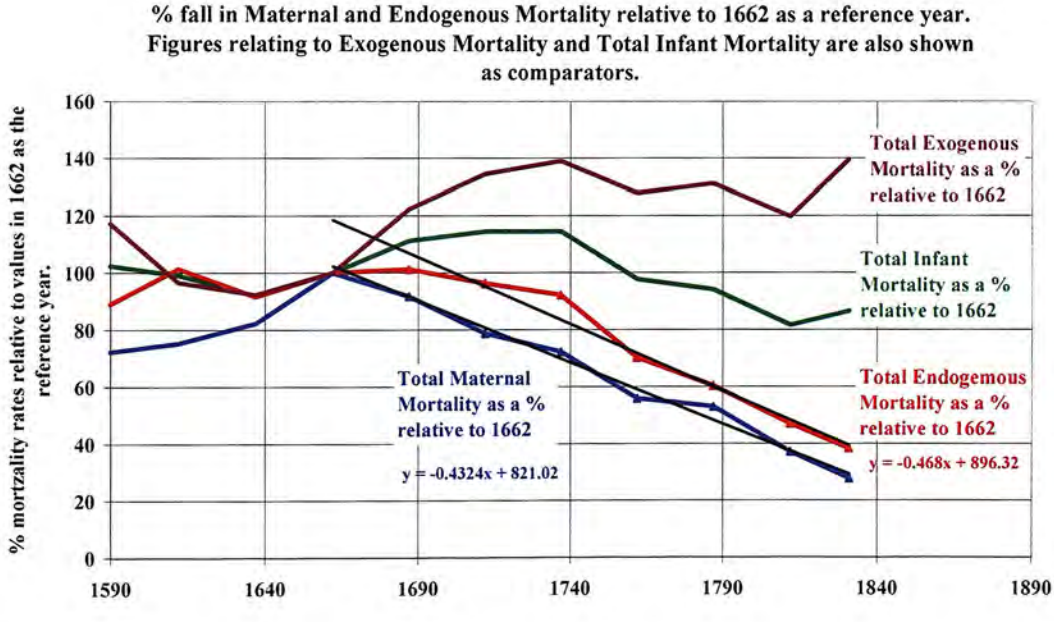


Figure 8.3 % fall in maternal and endogenous mortality relative to 1662 as a reference year with figures relating to exogenous mortality and total infant mortality shown as comparators

Figures 8.2 and 8.3 show the annual year on year percentage reduction of maternal and endogenous mortality from 1662 to 1830. The graphs are parallel with around

0.4% reduction per year, so whatever was happening was affecting both groups at about the same extent, while the start of the downturn, around 1700, is clearly shown in Figure 8.1.

The data for total infant mortality and exogenous mortality do not display the same effect (Figure 8.2); they continue to swing up and down over this period as shown in Figure 8.3.

Loudon (1992. p.160), in his book *Death in Childbirth*, while examining the statistics of maternal mortality in England, concluded that there was broad agreement between sources and that there was a continuous and substantial decline in maternal mortality during the second half of the seventeenth century to the first half of the nineteenth century (see Figure 8.1). While the rates were higher in London than the provinces, the pattern of decline occurred in both town and country. He was concerned, however, that the timing of the decrease did not match with the later increased involvement of medical practitioners in childbirth. Loudon offered three alternative theories as to why the decline happened but two of them he discounted, namely rickets, because this was a disease of both seventeenth and eighteenth centuries, and a fall in the virulence of Streptococcus pyogenes, as he found little evidence for this.

More importantly, Loudon argued, because the fall in maternal mortality was not matched by a similar fall in total mortality, the maternal mortality change had to be explained largely in terms of factors specific to childbirth rather than in terms of factors likely to have impinged on mortality from all causes. He therefore deduced that it was unlikely that such a fall in maternal mortality was solely or largely due to improved economic conditions and better nutrition. He agreed with Wrigley's point that '*in the eighteenth century, there is scant evidence of any link between living standards and mortality*' (1987, p. 234), so that the idea that any nutritional improvements could have just affected women was discounted. Loudon, therefore, considered that it was probably the significant rise in the number, status, skill, and efficiency of English midwives that made the difference.

In order to assess whether Loudon is likely to have been right, an attempt will be made in this chapter to establish the impact of any changes in medical, surgical and midwifery practice in the period under study by examining contemporaneous medical and midwifery documents. However, most care during childbirth was delivered by midwives with the help of friends and relatives and this will be addressed first.

Childbirth customs in the seventeenth and eighteenth centuries

Wilson (1995, p.1) in his *The Making of Man-midwifery: Childbirth in England 1660-1770*, described childbirth in the seventeenth century as a social occasion, emphatically under the control of women. A rather ribald contemporary description making similar points is contained in *The Whole Pleasures of Matrimony* written by Edward Ward around 1710-1714, but the exact date is not known.

The midwife ran the birth, helped by several female '*gossips*' who were friends or close relatives; men were excluded from both the delivery and from the mother in the subsequent month of lying-in. In the seventeenth century and early eighteenth century, medical men were only called in to help in difficult deliveries and as a last resort; they had no place in the management of normal childbirth.

The delivery room was darkened and airless and the lying-in associated with various customs. One of the customs was the drinking of *'caudle'* by the mother and her guests; another was the swaddling of the baby. The mother was also excused her usual chores and the sexual demands of her husband for a month of *'lying-in'*, policed by her gossips. Within the month, the child was taken to the church for the christening led by the midwife, the godparents or sponsors and the gossips. When the month was completed, the mother went to church for *'churching'*, originally for purification but from 1552 *'the thanksgiving of women after birth'* in the Reformed Church of England (Wilson, pp. 25-27). Wilson's research suggested that the christening, though it was meant to take place on the first Sunday after the birth, was often delayed for a month so that the mother could attend, and other researchers

found that this was sometimes extended to much longer periods, at varying parishes in England, in the seventeenth and eighteenth centuries (Berry and Schofield, 1971). These customs at childbirth appeared to be almost universal across England, although they would have been adapted according to income and the environment of the woman's home.

The eighteenth century was a time of significant change in professional practice as well as a period when the older social customs for women in labour gradually declined, through a trickle-down effect from the fashion of the rich to the middle classes, but also through changes in the location of labour for some of the urban poor. However, Wilson suggested that generally, among the rural poor, the traditional rituals of childbirth were still observed throughout the eighteenth century. He used the agricultural budgets, collected by the Anglican minister David Davies in 1790, to substantiate this. Davies (1795, p. 16) reckoned the expenses of lying-in at 20s.0d and assumed that this happened once in two years, and so concluded that 10s.0d a year was required, out of a total of annual outgoings of £7 (2s.8¼d a week) which needed to be added to the current weekly expenses of 7s.8d, leaving a deficit from wages of 9s.0d of 1s 4¾d. The lying-in expenses included the midwife's fees, *'attendance of a nurse for a few days', 'a bottle of gin or brandy always upon this occasion'* and *'half a bushel of malt brewed and hops'*. Wilson used the fact that these expenses were standard among the poorest families, even in a time of extreme hardship in the1790s, to confirm the continued use and popularity of the lying-in rituals. What was of particular note was the use of a variety of alcohol during and after the birth.

However, surgeons and physicians, towards the end of the eighteenth century, were also beginning to have their say concerning traditions and new practices. Buchan, a medical practitioner particularly interested in the health of the poorest people, in 1772 (pp. 661-2) stated:

> *we cannot help taking notice of that ridiculous custom which still prevails in some parts of the country, of collecting a number of women together upon such occasions, who serve only to crowd the house, and obstruct the necessary attendants. Besides, they hurt the patient with their noise; and often, by their untimely and impertinent advice, do much mischief.*

Changes in professional practices and skills

Other changes started to take place in the seventeenth and eighteenth centuries, which showed that new professional practices developed and knowledge improved. The potential impact and timing of these, needs to be examined. One of the new developments was the use by surgeons, and later men-midwives, of instruments in difficult childbirths.

A member of the Chamberlen family invented the midwifery forceps. In London, from 1560-1728, altogether five generations of the Chamberlen family used the obstetric forceps and kept it a secret from other practitioners and patients. As Dunn (1999) outlined, the use of the forceps was particularly timely in that rickets was becoming widespread and with it dystocia (difficult, slow, or abnormal labour or delivery) due to pelvic deformity. The Chamberlen family tried to keep the forceps secret within their family over the generations, which included seven male members who practised midwifery and surgery (Dunn, 1999, and Wilson, 1995). Before the last of the male family died, Hugh the younger allowed the family secret to be shared during the last years of his life. This then led to Chapman's famous essay on the improvement of midwifery and the publication of his forceps design in 1733.

The release of the description of the forceps appeared to coincide with the increase in man-midwives. Wilson argued that it enabled the male practitioners to deliver a living child, where previously he could only deliver a dead one. However, it is important to note that, in general, in the seventeenth century and early eighteenth century, surgeons and medical practitioners were only called in when there were difficulties and emergencies, such as an obstruction, slow births, haemorrhages, or where the baby had died and remained in the womb or where the placenta was not delivered. The timing of the increase and numbers of these new men-midwives was later than the improvements in maternity mortality that began in the late seventeenth century.

In the eighteenth century where this new practitioner, the man-midwife, came into practice, he began to act instead of a midwife. He became a medical man who

delivered normal births. This was unique to Britain and Britain's American colonies (Wilson, p. 5). Wilson also argued that men-midwives had achieved a permanent place in the management of childbirth, chiefly among the wealthy and the urban sections of the population, but also among poorer women who entered the newly set up lying-in hospitals and those used by the new teachers of midwifery, as a source of clinical practises and teaching in their homes, in lieu of a payment.

While at the beginning of the eighteenth century translations of standard treatises on childbirth from France and the Netherlands were widely read in England, Loudon (1992, Chapter 23) suggested that from around 1750, the centre for the publication of texts on midwifery moved from Paris to London. There was also a great deal of movement and exchange of information between professionals, both male and female during this period between the capitals. In the seventy years from 1730 onwards, Loudon considered that midwifery knowledge had advanced so quickly in England that it could reasonably claim to be an academic discipline on a par with physic and surgery: a claim that was resisted by leading physicians and surgeons. The contemporary publications examined during the research for this thesis, all clearly showed that the knowledge and understanding of the female anatomy and the changes during pregnancy and birth, increased during this period.

However, there was controversy between male and female midwives over which cases they undertook and especially who should have responsibility for difficult births and normal births. There were also disputes between male practitioners in particular about how cases should be handled. Forceps practitioners argued with those using the Dutch Deventerian's method, who preferred to enlarge the diameter of the vaginal passage by forcing the coccyx to bend backwards. Some midwives, both male and female, for instance Willughby (1863), Stone (1737) and Smellie (1794), were skilled at turning a child by hand and delivering it by the feet, when there were problems with presentation. There were also tensions between the relevant skills of experienced practical midwives and *'men-midwives'* who were perceived to have learnt mostly from textbooks.

In a move to devalue female midwives, the Incorporation of Surgeons of Edinburgh (later the Royal College of Surgeons of Edinburgh) put on record in 1726 *'their appreciation of the very great danger to women in childbirth and to their children through the ignorance and unskillfulness of midwives'* (Johnstone, 1952, p. 31).

As Wilson (1995, pp.1-2) stated:

> *female, traditional midwives were criticized for their management of childbirth, while man-midwives were criticized by midwives as being immodest, interventionist, and a trespass on the work of midwives.*

Men-midwives and surgeons wrote many contemporary essays and books specifically to help guide female midwives to improve their practice. These included Willughby (1630-1670, but only published in1863), Culpeper (1701), Gifford (1734) Chapman (1735), Dawkes (1736), Ould (1742), Manningham (1744), Counsell (1752), Hunter (1770), Leake (1772), Hamilton (1781), Smellie (1794), and others. There were also a number written by female midwives. These included Sharp, (1725), Stone (1737) and Nihell (1760).

Johnstone (1952), who produced a biography of William Smellie, one of the prominent medical teachers of the period, argued that the *'monopolistic grip'* (p. 31) of the midwives upon the whole practice of midwifery throughout the country and the continent was quite perceptively beginning to slacken, by the time Smellie settled in London in 1739. There were prominent midwives, like Mrs Celhier and Mrs Nihell, but no proper organisation or control over their practices. The Bishops of the Church of England remained the licensing authorities in England, under a de facto extension of their power to licence physicians and surgeons, conferred by Parliament in 1512 (Wilson p. 32). Johnstone suggested (p. 31) that, in their largely nominal examination of the midwife, they were often more interested in evidence of moral character than of any knowledge, skill or experience in the matter of childbirth. However, they must also have been aware of good and bad practices if the following *'certificate'* is taken into account. Schofield (1970) discovered a midwife's *'certificate'* which was drawn up in the county of Middlesex for Ellen Perkins in 1686 (p. 57) which stated:

item, you shall not give Counsel, nor Minister any herb, medicine, potion, or any other thing to any women being with Child, thereby to destroy or cast out what she goeth withal before her time.

However, the cost of the licence was high and licensing was only patchily implemented and with limited success and then usually ratified after women had practised midwifery over a number of years, rather than women being selected as midwives or to be trained.

Wilson therefore saw 1733 as a watershed between the old and new ways with the publication by Chapman of his paper '*Essay towards the improvement of midwifery*' on the use of forceps. Loudon (1992) was also in no doubt that the eighteenth century was a period of phenomenal growth in obstetric knowledge, teaching and practice. He highlighted a number of famous men whom he thought contributed most to this change - William Smellie, William Hunter, John Leake, Thomas Denman, William Osborn, Charles White of Manchester and Alexander Gordon of Aberdeen whom he considered were outstanding (p. 171).

William Smellie (1697-1763) was, in later generations, considered the *'master of British midwifery'*, a term coined by Prof Herbert Spencer in a Fitzpatrick lecture in 1927, and quoted by Johnstone (1952, p.1). He was an innovative teacher and carried out his clinical work accompanied by his students in the homes of the poor in London from 1739 onwards. He carefully recorded his cases in a great deal of detail and included his mistakes as well as successes. Johnstone saw Smellie's life work as moving from the days of crude, blundering medieval midwifery to the beginning of the science and art of obstetrics (p.1).

Smellie's approach to childbirth was active treatment by digital stretching of the os (ring of the cervix), rupturing the membranes, and, if necessary, delivering by the method of *'accouchement force'*, using instruments. Inevitably, in Smellie's cases and those of others, much butchery of the baby took place in difficult births as he used the forceps and the crochet to pull off arms, legs and even heads. Mrs Nihell *'a professed midwife'* was very scathing about the methods and teachings of the men-

midwives and other 'accouchers'. In her book *A treatise on the art of midwifery* (1760), she argued that:

> *many out of distrust inspired them of midwives, have thrown themselves into the hands of men, who have promised them infinitely more than they were able to perform, and who behind all the tender alluring words, of superior skill and safety in employing of them, conceal the ideas with which they are full of cutting, hacking, plucking out piece meal, or tearing limb from limb* (p.4).

George Counsell (1752) a surgeon and practitioner in *'midwifry'* defended his practice:

> *...no instruments are wanted, except on some few extraordinary occasions; nor should they be ever so much thought of, but in cases of the utmost extremity* (p. xvi).

Smellie (1794, Chapter iii-Laborious labours) had the same view but argued that in his work, the use of instrumental interference was sometimes necessary:

> *a general outcry hath been raised against gentleman of the profession, as if they delighted in using instruments and violent methods of their practice... every judicious practitioner will do everything for the safety of patients before he has recourse to any violent method... for my own part I have always avoided them as far as I thought consistent with the safety of my patients, and strongly inculcated the same maxim upon those who have submitted to my instructions.*

The impact of professional changes nationally

However, while undoubtedly the fashion around childbirth began to change, the impact of men and the use of forceps, even at this time, may not have had a huge effect on the live birth rate and maternal death rate throughout the country. Counsell's contemporary view in 1752 was that '*there being scarce any city, or very large town, in which a practitioner in midwifery of some eminence does not now reside'* (p. xv), but Versluysen observed (1981, p. 31), that the forceps were useful in only a tiny minority of deliveries, they were disliked by mothers, their misuse were one of the main themes of the opponents of man-midwifery, and they were even opposed by some of the leading men-midwives.

While Wilson suggested that historians held two traditional reasons for the changes that followed, fashion and the forceps (1995, p. 3), he meticulously detailed the

reasons for the changes, and concluded that between 1720 and 1770 improvements happened because childbirth became part of medicine. However, Grundy (1995, p.128) thought that Wilson '*takes it for granted that a man would succeed where a woman would fail*'.

Undoubtedly, the increase in knowledge of midwifery would have somewhat helped professionally to improve practice and it may be this actual impact which may have continued to have an effect on the continuing decrease of the maternal mortality rates.

Loudon substantiates this view and considered that the female midwives would have continued to have improved their practice. He suggested that it was probably the significant rise in the number, status, skill, and efficiency of English midwives that made the difference that led to the decrease in mortality of mother and child (1992, p.161).

A body of research has now developed which has moved away from the concept that midwives were ignorant and involved in poor practices in problematic cases, as described by the men-midwives and surgeons at the time. Contemporary female midwives such as Nihell, Sharp, and Stone clearly demonstrated their knowledge and skills and their views in their publications. While a few historians had even thought some midwives were considered at the time to be witches, which was contested by Harley (1990), recent research now considers that many midwives of the seventeenth and eighteenth centuries had a raised status in the communities where they lived. Some were highly educated and involved in decisions of the courts regarding '*bastardy*' as well as involvement in who should have parish social benefits and their distribution. Many campaigned for professional registration for their practice and for more midwifery education. To ensure quality of care and practice, Quaker midwives were even supervised by local women's meetings and used each other as consultants in difficult cases (Harley, 1994, Hess, 1994, Evenden, 2000).

The dangers to women in childbirth and the ability of professionals to deal with them

Another way of ascertaining the impact of any changes in midwifery practice would be to establish what the main dangers were at the time for women in childbirth and whether any of the clinical and cultural changes identified could have contributed to any improvements that eradicated or lessened these dangers.

Leake, a member of the College of Physicians in London and physician to the Westminster Lying-in Hospital stated in 1792, in his *Practical observations on the child birth fever*, that *'haemorrhages and convulsions are the two most dangerous and alarming maladies which can happen to pregnant women'* (p. 243). Terminology was problematic at this time and toxaemia of pregnancy and eclampsia with convulsions, little understood. This acute condition, characterized by convulsions and coma, is a more advanced stage of serious pre-eclampsia and can arise during pregnancy, labour or during the puerperium. Only recently in 1995 was the best treatment, magnesium sulphate, finally determined from a world wide *Magpie* research study, that was then audited for the introduction of the findings in 2004. So it can be argued that changes in the practice of men-midwives would not have altered the treatment. The only anomaly was in the numbers of women who appeared to suffer from convulsions and so called toxaemia, conditions which were very commonly reported.

Much of the puerperal fever due to streptococcus infection, and probably some of the so-called convulsions associated with it, occurred because of the lack of understanding of hygiene. The setting up of the lying-in hospitals for poor women was a recent introduction in the eighteenth century practice of midwifery that involved prolonged medical interventions by the practitioner and his students, which would have contributed to the spread of the disease. Altogether, six maternity foundations were created in London, from 1739-1765, with private capital (Versluysen, 1981, p. 36). Wilson made the point that puerperal infection was certainly increased by difficulty in the birth itself, especially by prolonged obstructive labour (1995, p. 15). While the proximity of patients in a lying-in

hospital would have spread puerperal disease, the practice of examination by doctors and students in the home for teaching purposes, could also have had the same effect. The practitioners discredited themselves and rather than improving childbirth introduced a new iatrogenic disease, the incidence of which increased mortality for women and babies.

With regard to infection, a contemporary report from Leake stated that:

> *in the year 1746, during the winter season, a disease of the epidemical kind was observed to prevail with great violence among lying-in women. Poor women who were delivered in hospitals, were observed to be the most subject to the disease* (p. 26).

He thought it was mostly due to the weather and the quality of the air (pp. 24, 31).

Haemorrhaging was different. Johnstone (1952) suggested that in Smellie's time there was no true understanding of the nature or the varieties of haemorrhage, especially that due to the premature separation of the placenta. However, if a physician was called early enough, a quick delivery by the feet was a possible lifesaver for the mother and the child. It appeared that some surgeons were able to help women if called in early enough in those cases of placenta praevia, but this was not always possible. Today a placenta praevia is dealt with immediately and the baby delivered as quickly as possible by caesarean section.

Practitioners appeared not to have known how to deal with haemorrhage after delivery either and many theories of how to deal with the placenta and when, were put forward in contemporary texts.

Currently, during normal delivery, the placenta is either delivered naturally, within a short period after the birth or a dose of syntometrine is given intramuscularly and the placenta is produced within 20 minutes and with little blood loss. Previously, up to the 1970s, ergometrine, an injection of a form of ergot, was given in the same way and for the same effect.

Overall, Versluysen (1981, p. 21) deduced that medicine, during the period under discussion in the seventeenth and eighteenth centuries, was virtually powerless in the face of the principal complications, which caused maternal death; toxaemias of pregnancy, sepsis and haemorrhage. It can be deduced from this that the introduction of men-midwives almost certainly had only a limited effect, if any, on maternal mortality rates.

Conclusions

In conclusion, this chapter has set out to assess the impact of changes in the practice of midwifery during the seventeenth and eighteenth centuries in the context of the demographic changes presented by the Cambridge Group. An examination of contemporary records, undertaken for this thesis, showed that in this period there were undoubtedly improvements in practice as well as theory, but it is not known how widely knowledge was communicated into rural areas. Overall the knowledge base of midwifery can certainly be seen to have moved forward.

However, as Versluysen argued, the introduction of men-midwives and their forceps, because of their limited numbers across the country and the limited number of cases that they used them in, would not have had a huge impact in improving live birth and maternal death rates, except perhaps in some urban areas. In fact new problems that arose in the towns, such as puerperal fever, contributed a further cause of maternal deaths.

Overall, Loudon argued that the improvements occurred not just in the towns but across the country and this must therefore be the key to understanding the improvements in midwifery practice during the period under study. It is necessary therefore to look further at other areas of midwifery practice to assess whether other cases that midwives managed could have been a greater source of midwifery improvement and that these potential changes could have contributed to the noticeable health of mothers and babies, presented in the demography.

Chapter 9 will refer to a number of problems for women in childbirth that were not fully addressed in this chapter, as the obvious changes in practice in the period under discussion appeared not to cover these types of cases. While some other more common causes of death that had to be dealt with, for example the problem of obstruction, including women suffering from rickets and who had physical deformities of the pelvis, have already been addressed, others did not feature in this discussion. Cases of women who became tired and exhausted during a long labour and cases where women's labour pains faded altogether, all of which could cause the death of the mother and baby, were not fully discussed. As these would have been the more common experiences that midwives dealt with, these cases will be examined and addressed separately in Chapter 9 of this thesis.

Linked with normal labour are the remedies offered by midwives and their gossips to help the woman through the pain and difficulties of giving birth. In the next chapter an in-depth investigation of the effect of the ingestion of caudle and alcohol during labour, which were part of the customs of the gossips, and the role of medication given specifically in childbirth, will also be considered. This will be addressed in order to discover whether these factors could have contributed to infant mortality, and in particular endogenous mortality, which eventually decreased by around 50% from 1743 to 1800, along with maternal mortality.

Chapter 9

An examination of the customs of normal childbirth and the midwife's medicines for intervening in difficult cases

'Ergot the problem child of the medical textbooks' (Wasicky, Vienna 1913).

At the end of Chapter 8, a number of problems for women in normal childbirth were highlighted but not examined as the changes in medical childbirth management practises discussed did not appear to address these problems. These areas included cases of women who became tired and exhausted during protracted labour and cases where women's labour pains faded altogether, both potential causes of death for the mother and baby. Midwives would have been expected to take responsibility in these cases, even if eventually medical assistance was required.

This chapter will examine and address these cases, together with the role of the substances given specifically in childbirth, in order to consider whether such medication could have been a contributory factor in the improvement of maternity care and infant mortality, which was cut by half from about 1743 to 1800. One particular concern is to establish whether ergot was implicated as a medicine in childbirth at this time and whether the ingestion of *'caudle'* and alcohol, which were part of the customs of the *'gossips'*, could also have been accidental vehicles for either contamination by ergot, or through deliberate ingestion, as a strategy to help the mother deal with pain and other problems in labour.

In order to address these issues, many relevant documents published in the seventeenth and eighteenth centuries were examined to establish whether ergot was a feature and whether there was any evidence that the caudle or alcohol consumed could have contained ergot. These are discussed below.

As a preparation for understanding this chapter, it is important to reiterate the main features concerning the negative effects of the ingestion of ergot, identified in Chapter 3, namely that ergot could cause ergotism by either high intakes over a short period of time or a low intake over a long period of time or when ingested by people

who were sensitive to the fungus. Up to this point this thesis has concentrated on sudden large intakes that could cause ergotism and small amounts in the food that could cause sub-clinical effects causing infertility through its action as a contraceptive. The discovery that administering ergot in large medicinal doses could also cause abortion has also been addressed. However, attention was also drawn to modern discoveries, using ergot as a potential modern contraceptive and as an aid in labour, and it is this information that needs to be examined retrospectively for its action in the period under discussion in this thesis.

In this chapter the role of ergot as an aid in labour during the seventeenth and eighteenth centuries will be addressed. In order to provide a background to this discussion it is important to detail the mechanisms involved in pregnancy in order to understand why ergot could have had such an effect on the uterus and hence on the process of labour. This addresses some of the further important points raised by Hardy when she reviewed the work of Matossian (1985 and 1989). Hardy ((1991, p. 510) not only argued that Matossian did not define, with research and evidence, her claim that ergot acted as a fertility suppressant, but that she also variously implied that ergot affected infant mortality as well as miscarriage. This chapter addresses this lack of evidence and offers modern research findings concerning the effect of ergot on the hormone progesterone as the mechanism that affects female reproduction.

The role of progesterone in nidation and on the uterus during pregnancy and labour and the consequences of ergot ingestion

In Chapters 3 and 7 the modern understanding of the action of ergot on the uterus was described. One outcome of further research work that appeared in 1964, (Kraicer and Shelesnyak, 1964) was a clear relationship between the structure of the alkaloids and their ability to upset the hormone balance of progestation. The ergot mechanism related to conception is not entirely understood, but is thought to be either an enzyme block mediated by the pituitary via the hypothalamus or that ergot alkaloids set off a trigger effect, in which, as part of a chain of events, the progesterone level is decreased. The resulting lack of action by progesterone prevents nidation (ovum implantation). The result would be that any sustained contraction of the uterus caused

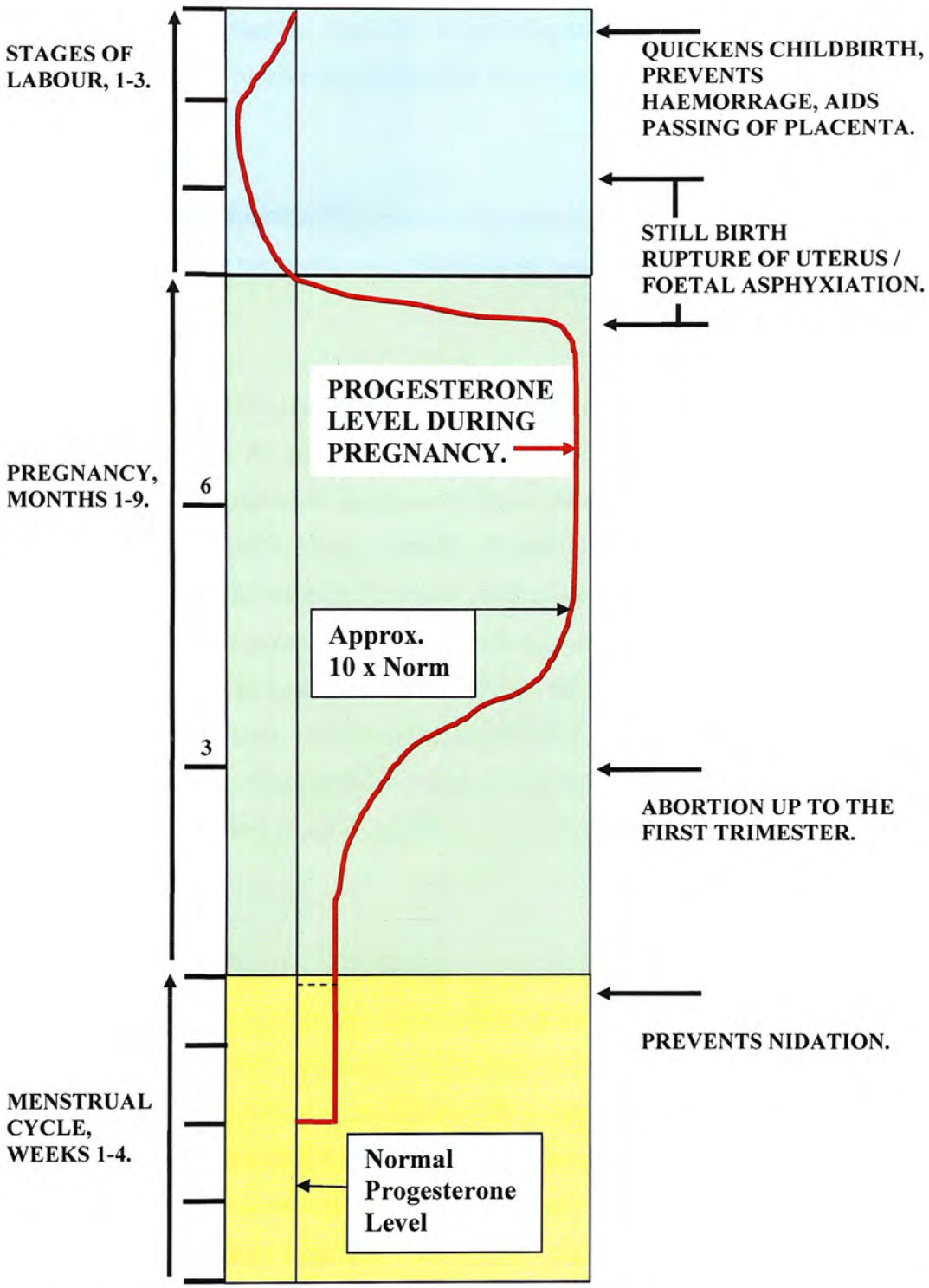


Figure 9.1. The variation of progesterone levels during the menstrual cycle, pregnancy, labour and post partum, indicating the periods when ergot has the potential to overcome its protection and predominate

by the ergot would have prevented the fertilized egg from implanting itself into the lining of the endometrium. In addition, the blocking of the action of progesterone would also have meant that the condition of the lining of the uterus would not have been in a ready state to receive the ovum. This would have produced a contraceptive effect.

A diagrammatic representation (Figure 9.1) of the potential action during the menstrual cycle, during pregnancy and childbirth is repeated from Chapter 7 for ease of access.

Progesterone, the female hormone, also plays an important role during pregnancy; produced in the ovaries, the placenta and the adrenal glands, it keeps the uterus from contracting. Its level in the body continues to rise at the start of pregnancy to keep the foetus safe. After the first trimester, when the placenta has grown, the placenta itself begins to produce high levels of progesterone throughout the pregnancy until, towards the end, a decrease in progesterone occurs which triggers the onset of labour. During pregnancy the levels of progesterone are usually ten times higher than those for a woman who is not pregnant. It is important to note, that, currently women who have spontaneous abortions or frequent miscarriages have been found to have low levels of progesterone and are often or subsequently treated with the hormone to obtain a successful pregnancy.

As can been seen from the above description, and Figure 9.1, a woman could, therefore, be vulnerable to ergot ingestion in the first few weeks of pregnancy, and again towards the end of the pregnancy, when progesterone levels decrease. If ergot was ingested, for whatever reason, at either of these times of vulnerability, it could cause problems by overcoming the action of the progesterone and forcing the uterus to contract and attempt to expel its contents. In the early months of pregnancy this negative action could cause a spontaneous abortion, and in the period before labour it could cause stillbirth and also problems for the mother through the rupture of the uterus, as the uterus could strongly contract when the cervix was not open or ready.

Conversely, if ergot was administered at the third stage of labour, when the baby's shoulder had passed through the cervix, these contractions could aid and quicken the birth and prevent haemorrhages during the passage of the placenta, resulting in a positive outcome.

The consequence of giving ergot at the wrong time can therefore be determined: small amounts of ergot seem not to have much impact on the uterus once pregnancy is in progress. However, if given or ingested in very large doses, it can overcome the natural effect of the progesterone. A few grains of ergot could also cause contractions of the uterus to start off labour towards the end of the third trimester which would cause great dangers for the baby. During long sustained contractions of the uterus the baby could be asphyxiated and stillborn or born in a poor physical state.

Following a birth, ergot alkaloids were shown to have markedly reduced the serum concentration of prolactin during lactation, which is essential for normal membrane secretions of milk. This has been demonstrated to have occurred in animals, but little research has been forthcoming on its effect on humans, though, as already indicated in Chapter 3, there was a commitment in the World Health Organisation programme of 2002.

Relating the above information to the long eighteenth century would mean that, if women managed to become pregnant and then ingested small amounts of ergot in their diet during most of the pregnancy, it may not have had any effect. However, if ergot was in the diet during the last few weeks of pregnancy it had the potential to cause fatalities both for the mother but mostly for the baby.

Conversely, the beneficial effects of the ergot given at the right stage in the process of labour would have been helpful to the mother. It would have helped to quicken any failing contractions, prevented haemorrhages, and hastened the passing of the placenta with little loss of blood. However, this mechanism, as will be shown, was first of all little understood and not used to its full potential until a much later date.

Following this presentation of the mechanisms by which ergot could be either a problem or an aid to mothers, an understanding of the problems that midwives and other practitioners had in dealing with labour and the use of the best knowledge they had in the long eighteenth century, can now be addressed.

Practices and medicines used in normal labour in the long eighteenth century

Midwives are thought to have used ergot in their practice during the long eighteenth century, and some hard evidence has been produced to substantiate this, drawn from mostly later published work. One of the problems was that most midwives rarely recorded their practices and skills until well into the eighteenth century, as often their expertise and experience was only passed on by word of mouth or later by mostly male practitioners who would have had access to the evolving professional dissemination routes. There is also a problem with determining the ingredients of the midwives preparations, particularly ergot. These preparations could have been labelled with generic titles or particular ingredients incorporated in a cocktail of medicines.

In order to address this problem, a number of seventeenth and eighteenth century contemporary documents were searched for any references to medicines used in labour and these are explored for their action and content. Important evidence concerning these medicines was found and is discussed below.

The most important find was the writings of Percival Willughby who practised midwifery in Derby, Stafford and London at different periods, from 1620-1670. He wrote original works on midwifery, but these were not published in his lifetime (1596-1685), only becoming available in 1863. This meant his *Observations in midwifery*, a series of his case studies, was not available to his contemporaries, although it is obvious from reading these case studies that he took every opportunity to instruct any of the midwives that he met at a birth, as well as his daughter, whom he was training.

As has already been stated in Chapter 3, Willughby was the first practitioner so far discovered to mention in print the use of *'a dose pulvis parturiens'* or ergot, *'to a woman with a dying countenance, and she was speedily delivered of a dead child'* (1863, p. 71). Although the drug was only mentioned once by name in his publication, the way he referred to it in this particular case history, without further comment, suggested that he often used the substance for quickening the birth, and was not surprised by its action.

However, on further examination of his publication, which consisted mostly of advice to midwives, he appeared to be very concerned with the point at which female midwives should intervene in a labour and when not. In one of his *'standards'* (p. 20) he suggested *'the midwife's office, or duty, in a naturall* (sic) *birth, is no more, but to receive the child, and, afterwards, to fetch the afterbirth, if need require'*. He also taught others his skills.

> *Therefore, let me perswade* (sic) *all midwives, not to do anything hastily, or by force, to enlarge the passages, in hopes of a speedy delivery, much lesse* (sic) *to let forth the waters, by breaking, or tearing the membrane. Such doings bee hurtfull* (sic) *to both the mother and child, for the midwife ought to bee quiet, and, with patience, to wait on nature until they do break, or crack, of themselves.*

He suggested that the midwife should intervene when things did not proceed normally and offered remedies that could be suggestive of the inclusion of ergot. He stated in another of his standards (p. 306) when a *'midwife's powder'* should be used at delivery. He summed up his observations and advice by stating *'and I would have no medicines given to force throwes* (contractions), *unless nature faint, and that towards the end of the travaile'*.

He suggested that, in cases where

> *labour begins to flag, and the throws decrease, towards the latter end of the woman's travaile, it would bee (sic) convenient to give a dose of the midwife's powder, to quicken the child's expulsion, and it will much advance the woman's delivery* (p. 25).

While he did not describe the contents of this powder, he did, however, mention the action of this and a number of other powders in his case notes. In one particular case

Willughby records that the *'midwife's powder'* did not work (pp. 60-61). The quote could suggest that he was surprised by it failure.

> *I gave her the midwife's powder, but it did little good, to which I added, afterwards, some borax, with some oile of amber, and the balsam of charity, the which opened her body. Then it pleased God to suffer the child's head to slide into the world.*

Forcing medicines and midwife's powders

It was important to try to discover what these *'forcing medicines'* were and the content of the *'midwife's powder'*. A search of contemporary dispensatories did not reveal any reference to midwifery powders. However, in an Harveian prize essay written by Samuel Wright, Senior President of the Royal Medical, Royal Physical and Hunterian Societies of Edinburgh in the *Medical and Surgical Journal* in 1840 (p. 22), reference is made to ergot being in use in England for many years and also being called *'poudre obstetricale'*.

> *For more than two centuries, ergot of rye has been known to possess the property of expediting the process of labour when given after the commencement of uterine contractions; and with such intention it has been extensively used by matrons, empirics and legitimate practitioners. From this property it has been distinguished by the names pulvis parturiens, pulvis partum accelerans, and poudre obstetricale and powder ocyotique.*

Barger (1931, p.175) referenced *'poudre obstetricale'* as a name for ergot, back to Desgranges, a young physician at Lyon, who in 1777 met a midwife who was in the habit of using ergot, and he afterwards used it in his practice and eventually published his observations, in French, in 1818.

Previously, Rathlauw (1747), a Dutch accoucheur claimed to be using a secret medicine that when given as a second dose had never failed to excite true labour pains and terminated the most difficult labour without instruments. He practised midwifery in Freisland until 1741 when he moved to Amsterdam and often visited Paris and met with Levret, a famous French obstetrician (cited by Barger, 1931, pp. 12-13). Barger thought this secret medicine was probably ergot.

Another two powders, also mentioned by Willughby, again without listing the contents, and which worked effectively to speed delivery, were the *'Earle of Chesterfield's powder'* and the *'Countesse of Kent's powder'*.

> *To facilitate her labour a decoction of germander, pennyroyal and calamint, boiled in posset drink, the which I tinctured with saffron; and to a draught I added a spoonful of the Earle of Chesterfield's powder, and two spoonfuls of oile of sweet almonds. This quickened her throws, and at last brought forth the child* (p. 59).

Again,

> *her labour being long, and tedious, I entreated her to take the Earle of Chesterfield's powder, to move the birth, in posset drink, in which was boiled calamint and pennyroyal, and afterwards tinctured with saffron. Some two hours after ... I did get her to take it again...then she had some through throws ...the child was still born* (pp. 65-66).

In the margin of page 176, Willughby makes a note about *'Remember the Countesse of Chesterfield'* and suggested,

> *two or three graines of pil. Pacifica hora somn... it comforteth a weake* (sic), *consumptive body, and keepeth the woman from miscarrying; but when labour approacheth, it then doth not hinder, or put off labour, but helpeth the woman to bee more easily delivered.*

It is not clear if this was the same powder as above or whether the Earl and '*Countesse*' of Chesterfield are the same family and whether the *'Countesse'* of Kent below who was also mentioned was someone different. This was not ascertained in spite of further research and discussions with the archivist at the Royal Pharmaceutical Society.

In the documents that referred to the '*Countesse*' of Kent's powder, Willughby was called to a woman whose placenta was retained three or four days after the birth.

> *The same day. That I came, an Honourable Lady had sent her the Countesse of Kent's powder, the which shee* (sic) *took, and it helped her, and had driven forth the after-burden before my comin* (sic) (p. 117).

She died that night.

Researching this remedy further, it was found that Thompson (1929, pp. 223-224) described the *'Countesse of Kent's powder'* as one of the most popular remedies of the late seventeenth century in which crab claws formed an important ingredient. He

gave the full ingredients and the way it was prepared based on the work of Schroeder in 1669. The powder was

> *famous and in high request in England against epidemic distempers, particularly against small-pox and measles. It is also highly commended for plague, for it strengthens the heart and all noble parts.*

It is not surprising, therefore, that it did not work for these women in labour. A reference to its ingredients was also to be found in *Bates Dispensatory* in 1713 (p. 625), with a further name of *'pulvis cantianus'*.

Willughby (p. 161) made reference to other unnamed medicines. In a case where *'having no throws on her'* and *'finding the child to come in a right posture'* he rested the woman and *'afterwards, I gave her medicines to move her labour. Some two or three houres after that .. finding her throws increasing she was speedily delivered'*.

All of the above powders or *'pils'* were given to help the *'throws'* or contractions, except the Countess of Kent's powder, which appears to have helped deliver the placenta, even if the women died.

Throughout the section on *'Fluxes of blood too frequently prove fatall'* (*sic*) (pp. 187-202), Willughby did not appear to clinically link any of the powders described above as useful in the treatment of haemorrhages or *'flouding'* or *'violent flux of blood'* after the birth. In fact, the advice he gave to the midwives concerning the placenta, was to deliver it immediately; neither pulling too hard on it or waiting too long to deliver it (pp. 26,117 and 236). He did, however, comment on the midwives' approaches to delivering the placenta (p.118).

> *There bee(sic) some midwives that will fetch the after burden, but leave the expulsion to nature, and their women have done well, and recovered their former health. There bee others, that, by their too much searching, and endeavour to get it, do much mischief in their women's bodies. I like not either of their ways.*

He advocated gentle traction on the chord.

He also wrote a great deal about haemorrhage and the associated dangers but then added,

> *If possible, I heartily wish that some worthy practicer would bee (sic) pleased to direct some powerfull wayes (sic), or medicines, to bridle this raging, destroying evil. Women would have causes to acknowledge his worth, and succeeding ages would give him thanks* (p. 201).

He attempted to use other types of medication to stop bleeding. He used filipendula root powdered, with other ingredients, for haemorrhages, but this medicine did little good (p.178). Willughby did not appear to recognize and understand that he could have used ergot to stem haemorrhages.

The reference in Willughby's work to forcing medicines suggested other keywords to investigate in other contemporary writings. These were examined for any further mention of *'midwife's powders'* or *'forcing medicines'*. An anonymous publication of 1682, *The English midwife enlarged*, featured a fictitious discussion between a surgeon and a midwife that offered a great deal of information on all types of births and presentations with 30 illustrated copper plates, but did not mention powders or any quickening of labour. Many other publications did not refer to or use this terminology either. It was only in 1734 that any further mention was found of such medicines. William Giffard in his *Cases of midwifery*, published in 1734, was very specific in his view that *'... where the pains were irregular or weak, and the labour was lingering; ...that forcing medicines did more harm than good...'* (p. 333 and repeated again on p. 287, in another case).

Thomas Dawkes, a surgeon, in 1736 (p. 75, Aphorism, p. xviii) stated in his *The midwife rightly instructed* that

> *medicine which force delivery, should not be administered but by a midwife of good knowledge, and large experience; for the maladministration of these, is sometimes the cause of bad, and difficult labours.*

William Buchan (1772, p. 666) also had something to say about forcing medicines. *'When the labour is coming on, it is not to be hastened with forcing medicines, which inflame the blood and humours, or put them into unnatural commotions.'* His answer to tedious and difficult labour was to bleed the patient (p. 661).

Leake, a member of the College of Physicians in London and physician to the Westminster Lying-in Hospital detailed his own use of drugs for uterine haemorrhage and convulsions but ergot was not one of the medicines mentioned (1772, pp. 237 and 312).

In summary, there was a strong suggestion in the contemporary literature that forcing medicines were used, but most of the literature did not specify the name or contents, except in Willughby's tract. The action of the drugs used in forcing contractions is highly suggestive of the action of ergot and Wright (1840), reviewing the papers that had been written in the eighteenth and nineteenth centuries on the subject, stated that ergot was used in England for two centuries.

Caution seemed to be the main characteristic of its usage unless the midwife was very experienced. However, internationally there was a great deal of interaction and debate and it is possible that the secret remedy that Rathlauw claimed he used, as well as Levret, was ergot and that eventually this became common knowledge across Europe. It can be seen, therefore, that in the seventeenth and eighteenth centuries, ergot could well have been used to quicken delivery, mostly by midwives, while probably not recognized for all its actions; quick delivery of the placenta and to stop post partum haemorrhages.

While Willughby stands out as the first surgeon in England to mention the use of ergot in labour in his writings, his publication was not available in print until 1863. However, as stated already, his tract indicated that he taught midwives about improving their practices and knowledge at every opportunity when he was called to help them with difficult cases. It is possible that he discussed the use of ergot as well, as he made reference to *'forcing medicines and midwife's powders'*.

However, in the nineteenth century, references were found that stated that *'midwife's powder'* and *'poudre obstetricale'* were ergot. It is, therefore, probable that the use of ergot was common among midwives but not necessarily widely recorded before

the profuse publication of literature on childbirth began from about the nineteenth century onwards. As already indicated in Chapter 3, it was really only much later in the nineteenth century that the action of ergot was recognized and understood for all its uses as a medicine in labour. At that time there grew a gradual understanding of its true effects in delivery, on the afterbirth and to stem haemorrhage, highlighted in particular by Stearns (1808), Prescott (1813) and Hosack (1822 and 1824), in the USA, and Merriman (1820), Hamilton (1822), Davies (1825), Neale (1828), Michell ((1828) Etherington (1839) and Wright (1840) in England, and Beatty (1834 and 1844) in Dublin.

It seemed from reading the contemporary literature that two groups of professional practitioners developed; those that used forceps and those that used ergot. A quote from the early nineteenth century revealed the strong regard for the use of ergot and opposition to forceps:

Neale (1828, in his advertisement at the beginning of his book) stated:

> *having strong grounds for believing that the mischievous employment of obstetrical instruments is a source of much misery and of increasing frequency, and being persuaded that an intimate knowledge of the efficiency and virtues of the spurred rye would tend very much to put an end to this evil practice.*

In 1828, (p. 123) Michell clearly repeated and reaffirmed this opinion and, in his publication on managing difficult cases using ergot during parturition in England, he drew attention to the problems with using ergot in labour and indicated its potential for the later stages of labour.

> *I consider the ergot as such an acquisition to my midwifery practice that I never go without it. I have never once regretted its use, and I invariably find that women recover much better after it than they had done before. If the woman has been subject to flooding, on former labours, I have given the ergot with a view to prevent it, with very good success. It also mitigates the severity of the after-pains, so as nearly to subdue them altogether. Its virtues are not confined to the acceleration of the uterus during labour, it also causes it to contract immediately, and detaches the placenta from the body of the uterus, so that you have never to wait five minutes for its separation. I have never known an instance of adhesion when ergot has been given. I would, however, caution those who are strangers to its properties, to take away the placenta directly, otherwise they will find the uterus contracting all*

around it, and will experience some trouble in the dilatation of the os uteri, I have several times found the os uteri contracting so firmly, as to oblige me to introduce the finger through it.

Both doctors, writing and publishing at this point in their careers, (Michell died a few years later), would have practised the art of midwifery over a period that included the late eighteenth and early nineteenth centuries.

Supply and usage of ergot

One of the possible ways to substantiate the use of ergot in England would be to determine the source of supply in the long eighteenth century, so this was researched further. There appeared to be no evidence of where and when ergot was available, unless it was taken from the fields of rye. Stearns in the USA in 1808 had been advised to go to the nearest granary and select the ergot from the rye.

The first English record so far traced is from Adam Neale (1828, p. viii) M.D., who was then *'Physician to His Majesty's forces and to His late Royal Highness the Duke of Kent'*, who suggested:

> *to such persons as may be desirous of administering the spurred rye, it may be useful to know, that it may be obtained of the best quality, at Morson's operative chemist 19 Southampton Row and James Butler Herbalist at Convent Garden Market.*

Searches have been undertaken to find records that exist for these companies. Mention is made of the records of Thomas Morson and Sons Ltd in the *Records of Pharmaceutical Businesses* (Richmond, Stevenson and Turton 2003, p.259) which stated that the archive material is available at the Wellcome Library. These were searched to see whether records of their stocks were available to discover the source and amount of supply of the ergot. However, while various letters, journals and institutional records were available at the Wellcome special collection (SA/ MOR) however only one reference to secale (ergot) was found. This was a recipe in Morson's journal for making up liquid secale in spirit and was not dated, but the previous entry was on December 28th, 1853 (SA/MOR/ G.1 p.12).

The only reference to James Butler that was found was an article in the *Pharmaceutical Journal* of 1973 (anon), where it referred to him as one of the first tenants of Covent Garden. He was an herbalist, seeds man and importer of leeches. His knowledge of herbs was such that Theophilus Redwood paid tribute to Butler's help in his revision of Gray's supplement to the *Pharmacopoeia* (1847) particularly in the compilation of the Pharmaceutical calendar in the book, setting out the herbs, berries and roots to be collected each month. On examination of the text, no reference was found concerning ergot or any information on where it could have been collected.

However, the difficulty of supply and problems with ergot quality was also mentioned by Michell, much later, probably when rye was no longer widely grown. He was a member of the Royal College of Surgeons and, in 1828 (p.128), he referred to his practice in Bodmin, Cornwall and stated:

> I *have great reason to suppose, as only one druggist, I believe, in the county of Cornwall keeps it among his medicines, and that one at first ordered it, and at present keeps it, principally for my use*.

Beatty in Dublin, in 1828 (p. 175), who used ergot, suggested *'that every man engaged in midwifery practice should carry in his pocket case, sixty grains of carefully prepared powdered ergot of rye'*, as obtaining a supply in an emergency was difficult and would, therefore, have been too late for use if a source had to be found.

However, while no eighteenth century source for obtaining ergot has been identified, the publications of the nineteenth century referred to above were almost certainly drawing on practices that must have developed no later than the eighteenth century, and, therefore, it may be assumed to have been in use earlier than stated by these publication dates.

It is important to note that most midwives would not have been in a position to record their practices and share their experiences except by word of mouth or by being trained by other older midwives. This was probably the way that they passed on their

knowledge of ergot. It can, therefore, be reasonably suggested that ergot was seen as beneficial in childbirth significantly earlier, although its full potential was not recognized until late in the eighteenth century and would have improved the survival rates of mothers.

Relating this information back to the demography and the maternal and endogenous mortality rates, it can be argued that the deliberate use of ergot, given by midwives during birth, gradually benefited the mother from the late seventeenth century. Experience of using ergot in their practice during childbirth probably meant that midwives eventually learnt when and why it was best to administer the substance which in turn would have had beneficial effects for the babies as well from around the start of the eighteenth century.

The ingredients of other drinks and customs associated with labour

However, there were other ways that ergot may have been given during childbirth and its consequent actions accepted as a helpful practice, without a basis of knowledge and real understanding of how it worked. As already stated, throughout the seventeenth and eighteenth centuries, the custom and common practices during the lying-in month remained strong. Davies suggested as late as 1795, in his *Estimations of Labourers' Outgoings*, that the ritual of childbirth and cost of lying-in should be added into the calculations, as it was still a common ritual. Davies' calculation of 10s 0d a year for the lying-in expenses, besides the *'the midwife's fees'* and *'attendance of a nurse for a few days'*, included *'a bottle of gin or brandy always upon this occasion'* and *'half a bushel of malt brewed and hops'* (1795, p. 16). Alcohol was, therefore, seen as useful to the mother during labour and confinement.

Wilson (1995, pp. 26-27) also suggested from his research that a *'caudle'* was prepared for the mother and was also drunk by the gossips as well as the other visitors during the lying-in period. A modern definition of caudle states that it was a warm drink based on gruel, mixed with ale or wine to which spices, sugar or honey were added and it was commonly given to the sick and especially to women in childbirth

and afterwards (*World wide words* and *Oxford English dictionary and thesaurus, 1987*), but as will be shown the content of the liquor or spirit varied with its availability.

The mother drank caudle during delivery and it was often shared as part of the feast among the gossips after the birth for up to a month. The drinking of caudle by the mother and her guests was also a continuing ritual observed by royalty. *The Ipswich Journal,* in 1802, recorded the christening of the Earl of Chesterfield's daughter Georgiana, with the king and queen as sponsors. *'After the baptism, a cup of caudle was presented by the earl, on one knee, to his majesty, on a large gold waiter, placed on a crimson velvet cushion.'*

Considering that rye, as has already been detailed, was the main food for English labourers in the seventeenth and the eighteenth centuries, although in decreasing amounts as wheat became popular, what is critical to note for the present discussion is that the gruel especially in the earlier period would have been frequently, if not normally, made with rye, and in bad harvest years it would undoubtedly have sometimes contained ergot.

A number of issues concerning the use of ergot, both accidentally and as a prescription, were highlighted in Chapter 3. For the mother, the ritual of drinking caudle and alcohol appeared to help her during the birth and with the afterbirth pains and was commonly used. The mechanism and outcome by which this helped, needs to be examined further. If the caudle did contain ergot then, depending on how much was ingested and at what stage, it could have had either good or bad effects during the birth. Good scenarios would have occurred if the caudle happened to be taken at later stages in the birth, according to the symptoms, which would mean it could quicken labour when the contractions failed; but it would only be successful if there was no obstruction, as well as helping the passage of the placenta and also to prevent or stem haemorrhages. Bad scenarios could include: the death of the child if taken or given too early on in the delivery, especially with first time mothers, even causing rupture of the uterus if there was an obstruction; death of the baby due to intense sustained

contractions at an early stage in the birth; failure to deliver the placenta because the contractions were too fierce and sustained; failure of milk production and the birth of a child who could not be fed by his mother due to the ergot drying up the mother's milk.

The effect of the caudle, when contaminated or even laced with ergot, on the gossips when they drank it, is not recorded. It is interesting to note that, in a paper by Harley (1990, p.16) on the myth of the midwife-witch, he referred to a local belief in Scotland concerning the *'potentially murderous transfer of pain in childbirth'*. It may also be relevant to note that there were superstitions about it being unlucky for pregnant visitors to enter the room during the lying-in period. One possibility is that this could have been because drinking a contaminated caudle could have had the potential to cause an abortion or end the visitor's pregnancy prematurely, resulting in a possible stillbirth.

In essence, the effect of any ergot in the caudle could have been a hit and miss affair, unless the popular culture built up by the female gossips and midwives through experience, recognized the effects of ergot so that it was deliberately given with the understanding of when its action was most suitable at each stage of the birth and in the post-natal period. The continuity of the custom could also have been based on the general effect on the mothers during a normal birth, who felt it helped them safely through the process of labour, without too much delay, with little bleeding and no afterbirth problems. Some evidence has been found that midwives were aware that caudle affected the course of labour.

Midwives and their use of caudle

Of the contemporary midwives seen as progressive, it appears that they differed in their use of caudles. Jane Sharp (1725), who described herself as a practitioner in the art of midwifery, suggested in her publication *The compleat (sic) midwife's companion or the art of midwifery improved, 'that women are in great danger, if not more, after the young is born'* (p.135) and *'to not let her sleep till (sic) about four hours after she is delivered, but first give her some nourishing broth or caudle to*

comfort her' (p. 132). While she mentions a number of herbs and medicines and other concoctions that she made up and gave to women in labour, she did not mention ergot.

It is interesting to note the use of caudle here for comfort after the birth. This could mean it was used to help the mother with the afterbirth pains and contracting down (involution) of the uterus. While the contemporary writings seemed to show that caudle was mainly used to ease the pain of childbirth and to quicken the contractions, some gave it just after the birth. Willughby (p. 128) also stated *'I gave her afterwards, the white and yolk of an egg mixed in caudle, with nutmeg and sugar'*. It is possible that the action of the caudle was recognized as affecting the afterbirth pains in a way that ergot's action was not. The gossips continued to make this and celebrate with this, with the mother and other visitors, throughout the lying-in period.

In contrast, the work of Sarah Stone (1737), a midwife who supported the use of instruments and who practised in Devon, Somerset, Bristol and London, does not contain any reference to caudle. She also stated that she did not give any medicine either to quicken the birth.

It is interesting to consider what William Hunter, the anatomist, who lectured on midwifery in London around the 1760s, (p. 91), said about caudles, in the light of the above discussion concerning the afterbirth pains. In his lectures, he proposed that caudle should be drunk during lying-in, but strongly opposed its use to assist delivery.

> *It is very wrong... to suffer the gossips to give her hot stimulating liquors when the labour proceeds slow and painful, such as crude or burnt wine, saffron, castor, drams or any spirituous liquors, and you should take care they do not make too free with spices etc. as they may produce the most terrible consequences, and not withstanding the notion imbibed by them of promoting delivery* (Quoted by Wilson, p. 181).

Some surgeons favoured the use of caudles. In *The Rise of the Egalitarian Family*, Trumbach (1972, pp. 184-185) summarized evidence that seems to confirm that caudle was usually used to ease the pains of childbirth, but by 1750, it was mostly frowned on by physicians, and, by 1770, doctors began to outlaw caudle and

thereafter its social importance lessened. William Buchan was an example of a doctor who criticized the use of caudle in 1769 (p. 571 referenced as p. 569).

George Counsell, a surgeon and practitioner in *'Midwfry'* (*sic*), who published a book on *The art of midwifery: or the midwife's sure guide* (1752) suggested that if the women should faint the midwife may give her some broths, jellies or caudles. He also offered a number of suggestions for medicines that he could offer the women in labour but none at first sight seemed to contain ergot, at least by intention. However, he suggested that she may be given a glass of *'good juniper water'* and he preferred to give *'Holland Geneva'* (p. 47). His instruction for use (p. 69) was:

> *wait a while with patiente* (*sic*), *and give the women some comforting nourishment, and a little Holland Geneva in some warm mild beer, or in a white caudle, or in any agreeable liquor, while her strength remains in full vigor* (*sic*).

Again after delivery and when the woman was fatigued, he ordered

> *or instead of broth, she may take a little white caudle, made by adding a spoonful or two of good white wine, to half a pint of the common gruel, with nutmeg and sugar in it* (p. 172).

The use of gin in caudle or as an additional aid in the late seventeenth and eighteenth centuries

The Holland Geneva or gin was an additional ingredient that seems to have been introduced into caudle towards the turn of the seventeenth and eighteenth centuries, occurring at the time of the gin craze, and appeared to have been widespread and very popular. Dillon (2005, p. 285), stated that in 1745 spirits had sold at £23 a ton. After the Act of 1760, the spirit duty alone came to more than that. While cheap gin was a halfpenny a dram, a pint of porter was three halfpence in 1736 (the *Daily Post* 1st April, 1736). However, by 1758 good porter gained popularity again and gin became very expensive.

Holland Geneva did contain Juniper flavour, but it was in fact gin originally made in Holland. Importantly, this particular gin was made from a cereal base; often rye, and

when copied and made in England in the eighteenth century, the coarse spirits were often mixed with beer.

Barger (1931, p. 72) reported that the small epidemic of ergotism near Potsdam in the eighteenth century *'was ascribed to ergot, even the spirit made (distilled?) from ergotised rye was harmful'*. The included brackets were his.

Dillon in his research for *'The much – lamented death of Madam Geneva - the century gin craze'* (2002), discovered that so called distilling was not often pure (p. 9). During William and Mary's reign, in 1690, an act to encourage the distilling of brandy and spirits from corn was passed, in order that a new British distilling industry would lead to *'the greater consumption of corn, and the advantage of tillage in this kingdom'*. The distilling industry in London meant a new market for English grain and the English farmers were the main beneficiaries. To encourage distilling from corn, Dillon stated that they used four grain crops – wheat, barley, rye or oats. William's Act, as it was popularly known, took advantage of the manufacturing process for raw spirits. Dillon described the method (p. 9). When the weakly alcoholic base was put into the still and heated for the first time, it was not proof spirit that condensed out of the spout. The first run-off produced coarse spirits, known as *'low wines, which were well below proof strength'* (p. 9).

Dillon (p.12) made the point that not only did farmers benefit from new markets for their corn, distillers made use of damaged corn which not even the brewers would buy.' *Great quantities of the worst sort of malted corn, not useful to the brewers, a later Act affirmed, trumpeted the success of the new policy hath been yearly consumed by those who set up works for that purpose'*.

Within a year further abuses had taken place, causing another Act to be passed *'for the better... ordering the duties on low wines ... and preventing the abuses therein'*. Distillers were supposed to use only malted grain, but it turned out to cut costs the distillers mixed raw corn into their wash alongside the malt.

Compound distillers, who bought the raw spirits from the malt distillers and added the flavours to them, became ever more inventive in their search for new products (Dillon, p. 12).

From 1720 almost 90% of English spirits were distilled in London. When an end was suggested to the abuses in 1743, questions were asked about what would become of the corn injured by bad harvests and during a House of Lords debate in March 1743 (cited by Dillon p. 84), this problem was raised because previously *'it had opened to the farmers a market for spoilt and coarse sorts of corn, which they never before could make anything of'*.

The result of drinking poor quality gin used in caudle

The outcome of the above discussion is that any of the poor quality gin that was used in the caudle, could also, because of the adulteration of the distilling process, have contained ergot from the *'worst sort'* of rye and other cereals used. This means that the caudle could have potentially contained ergot from the rye gruel and also from the *'gin'*, as well as any other brew made from rye they would have made themselves locally for the occasion and probably in quite large amounts.

Henry Bracken, a doctor who worked in the North Lancashire area, appeared to recognize the danger of drinking this gin after the birth. In order to prevent addiction through constant usage he preferred to give a dose of opiate (1737, p. 181). However, the quote below suggested that usually a lot of alcohol would have been imbibed during birth and lying-in, particularly for griping pains which again suggested that the ergot in the drink might have been considered useful, but probably indistinguishable within the drink, to help the involution (decrease in size) of the uterus following birth. Here the gin can be considered as being given deliberately for its effect, but what is not known is whether it was recognized that it contained ergot or whether the gin was just used because of its good effect without knowledge of its content.

Bracken (p. 181) suggested that, after a woman was newly delivered, she should be given

chicken, white meats, Broths or such like... but I forbid the use of strong spirituous liquors, such as aniseed, or Juniper waters, which are (through a mistaken notion) often drunk by lying-in women to hinder windy griping pains, as I think a great many women get a habit of tippling these sort of drams when they lie-in, so it is hard for them to refrain the ill custom afterwards. Indeed I often prescribe a moderate warm opiate, if the after pains be excessive, and that no symptoms contra-indicate.

And again (p. 176),

that she refrain drinking strong and spirituous liquors, tho (sic) I consent to the use of a generous cordial; especially to those women who have been accustomed to a glass of wine and good living, for such require cordials: But for the poorer sort who often drink Geneva, aniseed waters, and such like (by order of the midwife or old women about her) for a cure for griping or after-pains, I think they endanger their lives by such practices; for in this weak state of the body the blood and spirits are easily put into a hurry, when on the contrary all ought to be kept as sedate and calm as possible.

What is interesting about this comment is that although gin drinking was mostly a London or big town craze, its influence extended across the country. Bracken stated that gin (Geneva) was common among the general population and the 'poorer sort', who were the majority of the population, and would not be able to afford the best products, but only the worst kind.

The quantity and effect of gin consumed during and after labour and the problems of subsequent addiction

It is difficult to assess exactly how much was imbibed by the mother in the home, although the contemporary survey reports noted the continuing importance of the custom, even at the end of the eighteenth century. Certainly there is evidence from a number of sources concerning the amount and custom of drinking during confinement and the lying in period. In a number of accounts of poverty and the expenses of the poor during this period, essential items included alcohol and grain for brewing beer for the birth (Eden, 1797 and Davies, 1795), while publications were found that referred to riotous celebrations at the birth (Ward, 1710-1714) and condemnations of such behaviour by doctors (Buchan, 1772).

First of all it is important to note that gin was sold by the pint. Eden reported in his *Bill of Fare for the Poor in the Work-house of St Martin's in the Fields* (1797) that, even when gin had gone out of fashion, being replaced by porter , *'each married lying-in woman received, one pot of porter for caudle the first 9 days, and a pint for 7 days after'*. Dillon reports that a pot of porter was equal to a quart and was a very strong draught beer that replaced gin after the act of 1760 when it became a cheaper commodity (2002, p. 58). The important points arising from this evidence are the continuing custom of using alcohol even at the end of the eighteenth century and the strength and quantity of this replacement for gin, which probably reflected the amount of gin that was consumed previously.

Stephen Hales, (1734, p. 18), a campaigner against gin and brandy intoxication, referred to the state of many of the newborn babies:

> *Where the unhappy mothers habituate themselves to these distilled liquors, whose children, when first born, are either of a diminutive, pigmy size, or look withered and old, when they have, as yet, alas! attained* (sic) *to the evening of the first day.*

This seemed to be an accurate description of babies with foetal alcohol syndrome (FAS).

Difficulty in determining what was foetal alcohol syndrome and what was the effect of too much ergot

A contemporary source, referred to, but not clearly referenced by Dillon (2002, p. 217), stated that eighteenth century campaigners, were not surprised *' that the child of a gin-drinker should have half-dried bones ...a skin all shrivelled and black ... nor that such a baby should come out half burnt and shrivelled into the world'*. This may have referred to babies with FAS or those who were blackened by death in the womb, due to long and sustained contractions of the uterus from the effect of ergot. A later reference, from Dr Beatty, who practised in Dublin in 1844, on the effect of ergot given over two and a half hours before the women gave birth, referred to babies who were, by the force of the contractions, turned a deep blue colour. Also, babies might

not always die during the labour but be born with ergot toxicity in their bodies. The effect would have been to cause convulsions, respiratory distress and cyanosis.

Discussion on the use of ergot as a medicine or as a constituent of both caudle and alcohol

In this chapter ergot administered deliberately or accidentally, or at least as a custom in caudle, was discussed. Good and bad outcomes could have resulted from its ingestion. In the seventeenth century and early eighteenth century, ergot was not given for haemorrhages and the delivery of the placenta, but for hastening childbirth and this prescription would, therefore, have meant that the mother would have benefited somewhat from the intake of ergot during labour. However, ergot, given unmonitored, at the first signs of labour, would have been detrimental to the baby who, during a long birth and sustained birth contractions, would eventually have been stillborn. As Huston (1829, p. 183) later stated in the North American literature, the drug called *'pulvis ad partum'* (ergot) in recognition of its effect in hastening labour, also, because of its action of compression through the violent contraction of the womb, impeded the circulation of the blood to the baby and caused compression of the baby's brain, and, therefore, became labelled as *'pulvis ad mortem'*. Any baby surviving the birth could also have been born having convulsions and feeding problems and, if this poor practice was not recognized as such and the giving of ergot in this way was common practice, this would have resulted in a high endogenous infant mortality rate at the time, and particularly in the late seventeenth century.

If the caudle was contaminated with ergotised rye and given in the later stages of labour, it would have accidentally and probably through custom, based on a recognition of its good effects, helped the mother by hastening the birth, encouraging the rapid production of the afterbirth and helped ease painful afterbirth contractions.

However, conversely, from the middle of the eighteenth century, as the use of rye only bread started to become less common, and wheat, with only a little rye to keep the bread moist, became more usual, ergot would have had less effect within the caudle so that caudle became just a food or form of nourishment. This also coincided

with the decrease in gin drinking around the 1750s so that the baby would also have benefited from these changes: not only from less ergot in the gin, as controls were implemented on the standards for gin production, but also from the lack or decrease of alcohol and ergot in the mother's body during labour. The decrease in infant mortality, especially endogenous infant mortality, would, therefore, have become evident during the later part of the eighteenth century. This decrease in endogenous infant mortality is shown in Chapter 8, Figure 8.1. This period also coincides with a decrease in stillbirths and the increase in life expectancy generally in the population and a decrease in maternal deaths.

Conclusions

This chapter set out to address the customs during normal childbirth and the medicines used in difficult labours in the late seventeenth and the eighteenth centuries, particularly by midwives and helpers. The ingredients of *'forcing medicines'* and *'midwife's powders'* were investigated together with caudle and alcohol, drawing upon references to their use in a number of contemporary publications.

There appeared to be some evidence of usage of ergot by name, especially by Willughby, and contemporary female midwives, especially when *'forcing medicines'* and the *'midwife's powder'* were found to mean ergot. Willughby and others recognized and acknowledged that midwives used ergot in their practice.

It was likely that the customary caudle may also at times have been a vehicle for the transmission of ergot to some woman in labour and to her visitors and gossips. If contaminated rye was the base of gruel and when ergot was accidentally added within the adulterated gin, this could have affected the maternal and endogenous mortality rates among the labouring classes who made up the majority of the population. Whether this was deliberately included or found to be helpful by custom and practice was not actually discovered, but the probability is that it was accidentally found to be helpful and was, therefore, extensively used across England.

In summary it is necessary to revisit the statement that improved nutrition could have in some way affected pregnant women in particular as well as the population generally. It has already been shown in Chapter 5 that there was a shift in women's diet from rye to wheat during the eighteenth century and this could have contributed to the increase in fertility due to the removal of the contraceptive effect of low level ingestion over a long period of time. In addition, if ergot was gradually removed from the diet of even a proportion of women during pregnancy and labour from the 1740s onwards, this change could certainly have contributed towards decreased maternal and endogenous mortality.

As discussed at the beginning of this chapter, any ergot in the main diet would have been more dangerous in its action during the first trimester and at the end of the last trimester at the end of the pregnancy, as the level of progesterone in the body would have greatly decreased and the uterus would be vulnerable to the effect of the contractions initiated by the ergot. Therefore, when ergot was then used, either deliberately as a medicine, or found in the caudle or the alcohol, this would have had a perceptible impact on the maternal and infant mortality rate.

Its effect could have led to both good and bad possible outcomes; the result being dependent on the quantity used or its time of use and the level of understanding of its effects by those using it. On balance, it probably helped improve the safety and health of the mother when given during the later stages of labour and in the post-natal period. If this was so it could also have had some impact on maternal and endogenous infant mortality during the late seventeenth century and which continued through the eighteenth century.

As a better understanding of the role of ergot in all the stages of labour was gradually gained from the latter part of the eighteenth century, giving ergot during the later stages of childbirth meant that the lives of mothers were less at risk while the babies would have benefited from its use at the later stages of birth and were born alive. Thus the question of ergot usage had two effects; general reduction improving fertility as the contraceptive aspect was removed, while its application through

education and experience by midwives improved labour survival rates for both mother and baby.

Addressing some of the questions arising from the Cambridge Group's research

The questions arising from the demographic trends, from the Cambridge Group's research, discussed in Chapter 1 that needed to be addressed, are why was there:

- A decrease in infant mortality, especially endogenous, rather than exogenous, that commenced gradually from the start of the eighteenth century. Endogenous infant mortality, while peaking in the final quarter of the seventeenth century and falling gently thereafter, descended sharply from 1740 onwards. It raises questions about whether delivery skills and childbed practices changed and affected the rate of endogenous infant mortality and maternal deaths. Conversely could it also be related to better nutritional benefits for mothers and their babies, or to both factors?

- A marked decrease in the death of women during childbirth after 1750. Was this linked to the point above or were there quite separate mechanisms at work?

- A reduction in the rate of stillbirths that occurred between the end of the seventeenth century and early nineteenth century (1680-1820).

While it was found in Chapter 8 that any changes that took place as a result of the introduction of men-midwives and their tools, although innovative, did not essentially alter the rates of maternal or infant mortality, it has been shown in this chapter that a gradual understanding of how ergot could be successfully used in the later stages of labour both helped the mother and produced more live births and, therefore, must have made an impact on decreasing the maternal and endogenous mortality rates. The correct use and timing of giving ergot during birth could have been that factor in the eighteenth century that helped make the real change in

midwifery practices. This is supported by the fact that ergot is still used safely across the world today as an accepted part of the management of labour.

While the decreasing use of rye in its contaminated form, during the middle decades of the eighteenth century, could well have been the major factor that released women from its contraceptive effects and thereby increased fertility and the possibility that its action could cause stillbirth, it may now be possible to conclude that, when the effect of ergot specifically in the diet of mothers was lessened, one consequence was likely to be some reduction in early abortions and later stillbirths as well as maternal mortality in the last half of the eighteenth century.

This chapter has addressed each of the questions presented above. It is quite likely that the skills of the female midwives were increased by the publication of educational material on good midwifery practices and by increased discussion and dissemination of good practice. This chapter has also raised the distinct possibility that ergot was a significant factor in the improvement of midwifery skills during the eighteenth century, due to the increasing expertise and experience by midwives of its use in labour, which led to a decrease in maternal mortality and a reduction of stillbirths. The timely and considered use of ergot in labour, its deliberate or accidental presence in the gruel of some of the caudles, as well as in the poorly distilled gin, and also its use as a medicine, would have helped the mother. Ergot would have been particularly effective at the latter end of childbirth, preventing mortality in cases where the labour pains had failed, or when the afterbirth had not been passed, as well as a means to soothe post-natal pains.

However, the accidental and customary use of caudle in labour, which could have contained ergot in both the gruel and the gin, may have provided further contributory factors, both unfavourable and favourable, depending on strength and timing, and could also have affected the endogenous infant mortality rate, and the reduction of post-natal haemorrhaging. Any factors affecting the improvement or otherwise of the mortality rates of mothers from the customary use of caudle could have substantially affected the rates across the country.

Chapter 10

Hawkshead Parish

Introduction

The Cambridge Study indicated that Hawkshead Parish appeared to have had, in the late seventeenth century, an unusually large number of stillbirths and infertile married women. There was also some indication that fertility increased from the middle of the eighteenth century. These findings will be examined in the context of the questions related to fertility, raised in Chapter 1, in a context where it seems quite possible that Hawkshead was also an area with high levels of ergot contamination.

The geography and history of Hawkshead Parish suggests it was within a rye growing area, and, as it lies in a high rainfall area, locally grown rye could have been infected with ergot. Hawkshead is within the area served by the markets of Kendal, Carlisle and Appleby, where Ashley showed rye was sold in the period 1692-1703, as well as next to the county of Northumberland, which was one of the main rye growing areas of England within the period under study. An assessment as to whether it was possible that Hawkshead women could have been affected by sub-clinical amounts of ergot on rye within the food they ate and whether this corresponded with the fertility data available is necessary as part of this analysis.

Compared to other parishes, Hawkshead has some useful registration data for the period under study, together with midwifery records from nearby Kendal and other local contemporary information available for analysis. Cowper's two historical publications, specifically on Hawkshead and the Hawkshead early parish register (1897 and 1899), are a helpful resource, as well as more modern analyses of the second register for the eighteenth century.

In considering the evidence available from the Hawkshead Parish resources, the aim of this chapter is to explore whether any links may have existed between the fertility and demographic data available and midwifery practices. Of particular interest are the early years of the long eighteenth century. It will also be important to investigate

whether it was possible that the effect of eating rye within the staple diet could have had a significant effect on fertility in the Parish of Hawkshead. Any medical knowledge of ergot usage which could have played a part in fertility changes in the period under study will also be addressed.

While the data relating to fertility for Hawkshead are unfortunately not complete, there are data for age at marriage, illegitimacy and prenuptial pregnancy as well as stillbirths and perinatal mortality. Other sources can help to fill the gaps, especially an understanding of the midwifery care and social history of Hawkshead during the long eighteenth century. However, data concerning fertility, such as birth intervals and the percentage never marrying, have not been found in any publication, while a family reconstitution proved to be too difficult for the volunteers, including Kathleen Leonard, the author of the second register of Hawkshead (1968), because of the limited common names within the area; therefore, the exploration here will be limited to the data published.

Wrigley's view (1998, p. 440) on the cause of the national decrease in endogenous infant mortality was that *'the health and nutritional status of the mother were of crucial importance, though circumstances such as delivery skill and childbed practice may also have been impor*tant'. This will be assessed alongside the hypothesis in this thesis that ergot could have had a contraceptive effect on the childlessness and high stillbirth rate of women in Hawkshead.

In order to understand the agricultural environment and diet, a number of sources are used: in particular the agricultural reports produced for the Board of Agriculture for Lancaster, Northumberland, Westmorland and Cumberland, which were based on surveys that recorded the type of grain grown in the last decade of the eighteenth century. The justification for using these, which were produced around one hundred years later than the period under consideration, is that the reports covered the agricultural changes in England and also focused on both past trends and potential future changes introduced in order to achieve increased yields of grain. The returns of rye from local markets and the Tracts on the Corn Trade, from Ashley's seminal

work of 1928, will also be reported. The main approach will be to determine whether:

- rye that was grown or bought locally was consumed by the residents, and in times of dearth whether there were established routes to other sources and markets; other issues concerning soil, markets, rainfall and cooking methods will be important here as well as any evidence of the use of rye for thatching,
- there was any evidence of ergotism,
- there was any correlation between poor and good harvest seasons in the late seventeenth century and an increase or decrease in maternal deaths, stillbirths, and childlessness,
- there was any evidence from local contemporary midwifery practice to suggest that changes in midwifery through poor or good practice may have also involved the use of ergot.

The overall format of this chapter, after a brief introduction to Hawkshead, will therefore include: evidence from the parish registers of fertility and perinatal rates, midwifery practice and the likelihood of contaminated rye being ingested in the diet.

The Parish of Hawkshead

The parish of Hawkshead, now in Cumbria, is 13 miles long and 6 miles wide and was formerly administered as the northernmost part of Lancashire until 1777. Figure 10.1 shows its connection with the rest of Lancashire and its boundaries of Cumberland and Westmorland, from Holt drawn in 1793.

The inhabitants of Hawkshead were shepherds rather than agriculturists. Cowper (1897, p. xxvii), a historian of the town, described their life:

> *Each little farmer landowner tilled his little holding and shepherded his flocks, with the aid of his sons and his herd and on market day he met his fellow daleman on an equal footing to haggle with him.*

Figure 10.1 Holt's map of Lancashire, showing Hawkshead and environs, 1793

Evidence from the parish registers

In this chapter the evidence from Hawkshead registers, particularly relating to foetal deaths and a low rate of fertility among married women, will be assessed and related to any evidence of rye in their diet. In the wider national context a link between an increase in infertility and stillborn rates was apparent in the late seventeenth century,

with some evidence of this being reversed from the middle of the eighteenth century, when the staple diet changed to wheat.

However, compared with the South of England and counties such as Norfolk, the North of England probably made slower progress in making the change to wheat.

In order to compare the detail of any changes between Hawkshead Parish and national data, there are three main sources available: The first Hawkshead register, 1568-1705 as presented by Cowper, the second register 1705-1797, published by Kathleen Leonard, and the Cambridge Group's study (Cowper, 1897, Leonard, 1968, and Wrigley and Schofield, 1989).

While Hawkshead was one of the 404 parishes included in the Cambridge Group's study on population (Wrigley and Schofield, 1989), it was one of three parishes rejected for inclusion in the final study on family reconstitution by the Cambridge Group (Wrigley et al., 1997) because of the large incidence of childlessness among married women, which was considered suspiciously high. Among women marrying under the age of 25, and after twenty years of marriage, the childlessness was 11 or 12 per cent, a substantially higher figure than in other parishes (Wrigley et al., 1997 p. 29). While no dates or further information was given at publication, members of the team and other associates wrote a number of articles referring to discoveries within the Hawkshead registers, which illuminate a number of other variables.

The Hawkshead registers start at 1572, with registration remaining poor for 15 years. The reconstitution of *'bastardy'* records of Hawkshead (Oosterveen and Smith, 1982, Chapter 2) start at 1586 and cover a period of 250 years. The analysis of the registers and their reconstitution by researchers included age at marriage, prenuptial pregnancy and illegitimacy. Importantly for this thesis, Schofield also found the Hawkshead registers were unusual in that they recorded the death of newly and abortively born babies consistently over a period of 130 years from 1581- 1710.

The link between mean age at marriage, illegitimacy and prenuptial pregnancy

This section sets out to demonstrate that Hawkshead women's fertility was curtailed in the late seventeenth century and appeared to increase in the middle of the eighteenth century, following national trends already discussed.

The mean ages of first marriage in Hawkshead in fifty year periods from 1600 to 1849 were as follows:

	Females	Males	Female median of 15 other parishes
1600-49	24.8	27.8	24.5
1650-99	27.1	31.0	26.7
1700-49	27.4	31.9	26.8
1750-99	25.6	28.8	25.3
1800-49	27.2	30.6	24.2

(Originating from Laslett 1980, p. 21)

The mean age at marriage for females rises to 27.4 by 1749, but decreases in the fifty year period from 1750 but does not again reach the low of 24.8 recorded in 1649. Except for the years after 1800 the Hawkshead trend is similar to the national one. However, the mean age is always slightly higher than the median age at marriage in 15 other parishes that were analysed.

Illegitimacy

The changes in the rates for illegitimacy in Hawkshead are more dramatic (Oosterveen and Smith, 1980, p. 95):

Date	%
1591-1640	3.2
1641-1690	1.8
1691-1740	3.0
1741-1790	6.0
1791-1840	8.1

Illegitimacy rose steeply during the fifty year period 1741-1790 to reach more than 8.1% by 1840. Leonard (1968, p. vii) in her analysis and editing of the registers

from 1705-1787 stated that the rise in illegitimacy in Hawkshead began in 1760, but the figures from Laslett suggest an earlier rise, beginning from around 1725. These Hawkshead trends also parallel the national ones.

Prenuptial pregnancy

Both Smith and Laslett (in Laslett, 1980, p. 109) documented the frequency and percentage of first live births less than nine months after marriage in a number of English parishes from 1550-1849. Laslett showed that across English parishes there was a decline in the late seventeenth and early eighteenth centuries. The percentage rates for Hawkshead were always a little higher in this period compared to the percentage rates from 16 parishes, and when the prenuptial rates rose nationally from 1750, there was a marked increase in the percentage rates of prenuptial pregnancy for Hawkshead to a figure well above the average of the 16 parishes.

Prenuptial pregnancy in select English parishes by 50 year periods:

	Hawkshead			From 16 parishes
Date	**Frequency Prenuptial Pregnancy**	**Total First Born**	**%**	**%**
1600-1649	25	116	22	23
1650-1699	19	95	20	16
1700-1749	16	70	23	22
1750-1799	44	97	45	33
1800-1849	44	95	46	37

(Laslett, 1980, p. 23 and Oosterveen and Smith et al., 1980, p. 109 based on data from the reconstitution tabulations of the Cambridge Group)

In the above data there is a striking difference between the number and percentages of prenuptial pregnancies in 1650-1699 and 1750-99 and 1800-49 of 25 points or approximately 130%.

Figure 10.2 summarises the data on the age at marriage, illegitimacy and prenuptial pregnancy in Hawkshead parish.

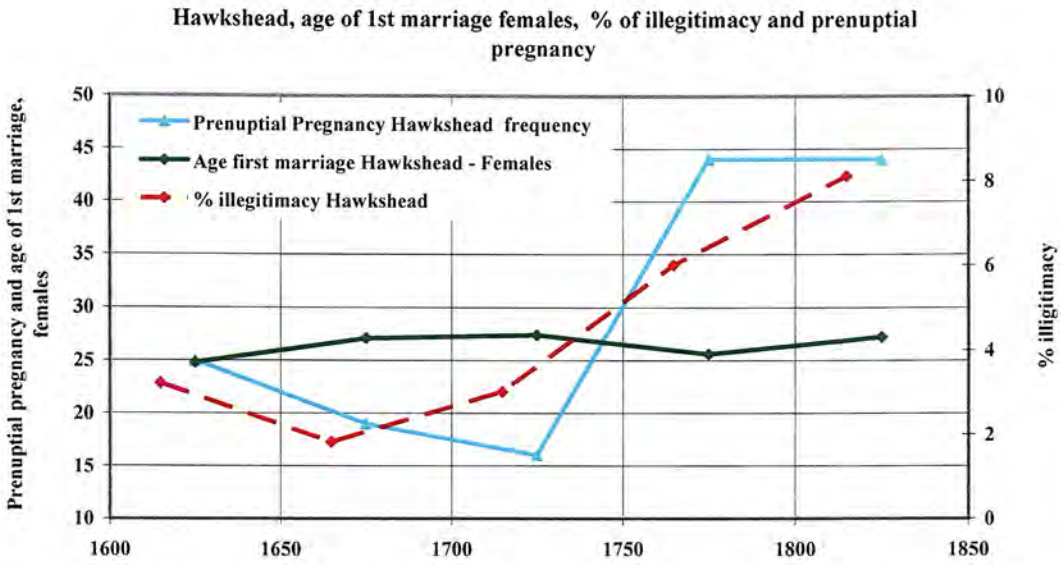


Figure 10.2 Hawkshead - age at female first marriages, and percentage of prenuptial pregnancy and illegitimacy data illustrating earlier marriage as prenuptial pregnancy and illegitimacy rises

The question that these very marked shifts in Hawkshead data in particular then raises for this thesis is whether at least some part of the changes result not just from changes in behavioural or sexual norms, but also because it had become easier to get pregnant. Also, if the latter was significant, might ergot have played some part in this?

The key point about Hawkshead raised in the Cambridge Group study, and used as one of the justifications for not using the parish in the reconstitution study, was that there were an unusual number of childless married women in the late seventeenth and early eighteenth centuries. This was thought by the Cambridge Group to be an anomaly in the records. However, there is another possible explanation. If the records were in fact correct it could imply that the marked low fertility of Hawkshead's women was caused by a sub-clinical amount of ergot eaten in the diet acting as a contraceptive. The infertility trend before and during marriage at the end of the seventeenth and during the early eighteenth centuries could, therefore, in part at least have been connected to a diet which included ergot.

Stillbirths

Nationally, another factor that affected fertility rates involved childlessness within marriage, due to primary sterility or failure to produce a live baby. It has already been established that eating small amounts of ergot over a regular period of time could lead to sterility due to its contraceptive effects. While it cannot be judged without detailed data how many Hawkshead married woman were in fact sterile or had miscarriages, Hawkshead does, almost uniquely, have data which allow the calculation of stillbirths and any infant deaths in the first week or month, which often have an association (Wrigley, 1998, p. 442).

Hawkshead appears to have had an unusually high number of stillbirths in the late seventeenth century. The figures for perinatal death in Hawkshead, consisting of foetal deaths and first week infant mortality are available from 1581-1710 (Schofield, 1970, p. 15). Schofield found that, unusually, the burial registers of Hawkshead recorded the deaths of newly and abortively born babies consistently over a period of 130 years. He reported that, from 1581-1620, the registers were kept almost entirely in Latin and the death of the newly born is recorded with *'stark simplicity'* as *'Puer (filius)* or *Puella (filia)) of...'* the father's name. The child was given no name and the presumption is that it died soon after birth or before it could be baptized. Similarly, the death of the abortive baby is recorded as *'Puer abortivus'* or *'Puella abotiva of...'* the father's name. From 1620, English phrases creep in *'a child of'*, although *'filius'* and *'filia'* remained the usual form of entry.

Unfortunately, a problem occurred in the recording of stillbirths from 1710 onwards so attention is restricted here to the years up to 1710. The result for 1601-1710 are summarized in Table 10.1

DEATHS OF UNNAMED AND STILLBORN CHILDREN IN HAWKSHEAD, LANCASHIRE, 1601-1710

Dates	Baptisms	Burials of unnamed	Burials of abortives	Total 'live births'	Foetal death ratio
				(1)+(2)	(3)/(4) x1000
	(1)	(2)	(3)	(4)	(5)
1601-1610	316	6	10	322	31
1611-1620	444	8	18	452	40
1621-1630	428	5	18	433	42
1631-1640	481	2	30	483	62
1641-1650	412	0	12	412	29
1651-1660	315	1	14	316	44
1661-1670	320	5	25	325	77
1671-1680	229	6	15	235	64
1681-1690	263	5	18	268	67
1691-1700	273	9	27	282	96
1701-1710	256	1	18	257	70
1601-1710	3737	48	205	3785	57

1601-1710 Three mothers were recorded as having died in child birth.

Source Adapted from Schofield (1970, p.13)

Table 10.1 Deaths of unnamed and stillborn children in Hawkshead 1601-1710

In analysing the deaths of unnamed and stillborn children in Hawkshead from 1601 – 1710 Schofield (1970, p. 15) suggested that there appeared to be three distinct periods, each with different levels of foetal mortality: in 1601-10 it was 31 per 1,000. It rose towards the end of the seventeenth century until in 1691-1700 it was 96 per 1,000 and in 1701- 1710 it was 70 per 1,000. Schofield commented (p. 15) that:

> *The 1690s were an outstandingly bad decade. These late seventeenth ratios are above those usually recorded for developing countries today. The question of the causes of these high ratios in Hawkshead, and the problem of how far the recorded stillbirths may include the victims of induced abortion or even infanticide cannot at present be answered.*

Problems and controversy concerning the method of classifying stillbirths and early infant deaths

There is however, some disagreement over the best method for calculating stillbirths and early infant deaths from the Hawkshead data. Schofield's figures have been used by several authors (Wrigley, 1998, p. 452 and Woods, 2005, p. 150) to calculate the following different measures:

1. Foetal Death Rate (Schofield, 1970) = Column 3 / (Columns 1 + 2) x1000
2. Stillbirth Rate (Woods, 2005) = Column 3 / (Columns 1+2+3) x1000
3. Perinatal Rate = (Columns 2+3) / (Columns 1+2+3) x1000.

In practice, however, methods yield very similar results (Figure 10.3).

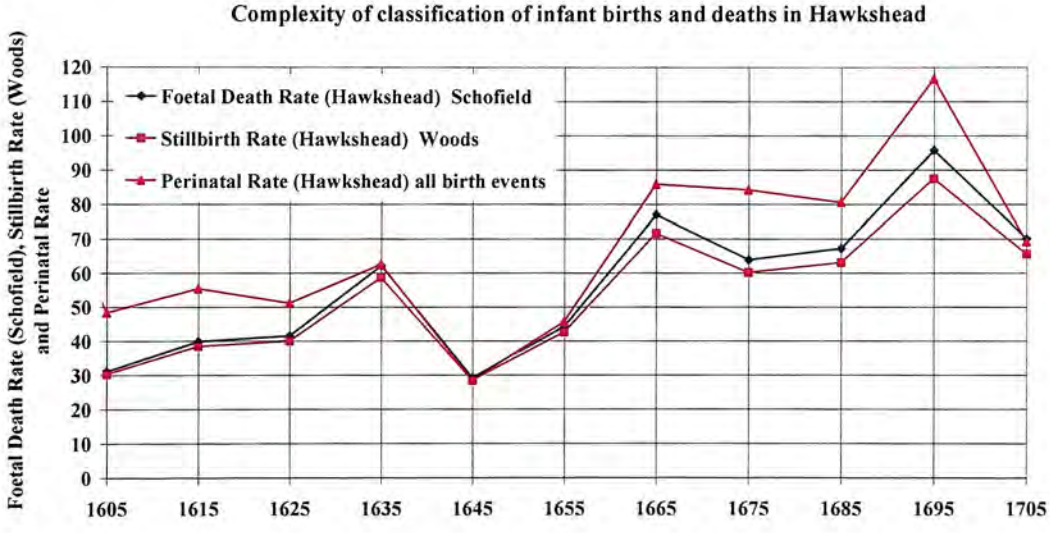
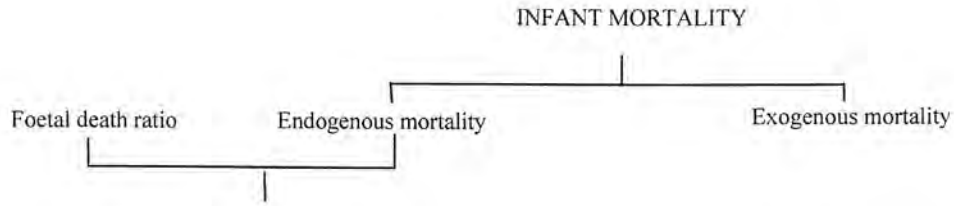


Figure 10.3 Data derived from Schofield illustrating the application of differing methods of classifying the foetal death rate, stillbirth rate and perinatal rate to Hawkshead

Schofield (p. 12) offered the following diagram to summarise the different measures of infant mortality that can be used.



Source : Schofield 1970, p. 12

However, even though the Hawkshead records were seen as one of the best parish records that Schofield found, in that they appear to have recorded stillborn and abortive children carefully and consistently, since his paper was published others have also contested his faith in the accuracy of the registers. In particular, in 1980, Finlay challenged Schofield's figures suggesting that problems of transport, geography and weather could have caused under-registration, or that some of the abortive deaths were really infant deaths.

Finlay's suggested that due to the size of the parish *'the abortives'* recorded in the burial register at Hawkshead may in fact have been the record of children who had been born live but died shortly afterwards and had been too weak to have been taken for christening in church (1980, p. 35). He therefore maintained that:

> *the suggestion that some, but not all, of the abortives contained in the Hawkshead burial register from 1691- 1709 were born alive but died very shortly afterwards is consistent with most known features of registration.*

However, one way of dealing with the problem as to whether deaths were recorded as stillbirths or early deaths would be to use the perinatal rate which would include in the total the unnamed and the abortives, not just the live births. And as Figure 10.3 shows, this makes little difference to the overall pattern of a relatively high level throughout the seventeenth century.

Moreover, there is supporting evidence that suggests that the churchwardens were meticulous in keeping the registers up to date and this casts considerable doubt on the premise that there was much under-registration. From the registers it was found that George Rigg was made a lay registrar from 1656, following an Act of 1653 relating to

the introduction of lay registrars, and the handwriting remained the same until 1697. His wife Dorothy died in 1696 and his health must have started to deteriorate, as, in September 1697, there was an entry for two marriages in different handwriting with a memorandum *'Geo Rigg forgot these'* and three corrections where *'licence'* was inserted. The new writing continued after this, and George's death was recorded in the second register of Hawkshead, dying on 11 March 1706 with a note *'ye old Clark (sic) died'*.

During the period when he acted as registrar, a number of Acts were introduced requiring him to keep a list of those buried in woollen (Act, 1679); this he faithfully carried out and the names were entered in the back of the register. Another Act (1694) required him to impose a scale of dues to be paid for five years on all births, deaths and marriages *'for carrying on the war against France with vigour'*. Cowper referred to both of these lists (p. lxiv) and stated that they were bound in the register.

Harley, in his chapter on *Provincial midwives in England: Lancashire and Cheshire, 1660-1760* (Marland, 1994), named the two Quaker midwives who were practising in the Hawkshead parish in the period 1680-1700, as Dorothy Beck and Dorothy Satterthwaite. While they were both intermittently cited by the churchwarden for unlicensed practice during this period, their status was probably quite high within the community as they also acted as poor relief agents for the parish and their Quaker women's meeting (p. 36).

It seems, therefore, that there were a number of checks on the registrar George Rigg: his records were supervised and checked, he harried midwives who had not been registered with a bishop's licence, and he implemented and fulfilled the requirements of government acts. The new registrar, in 1697, also checked the entries for the period prior to his taking over from Mr Rigg and made some adjustments.

However, in terms of how the births and deaths of babies were actually recorded, an examination of Elizabeth Thompson's diary 1669-1675, *The diary of a Kendal midwife* (WD/Cr/11/60 Cumbria record Kendal Archives and also reproduced by

Curwen Archives Trust, 2001), may be helpful here. Kendal is only 18 miles from Hawkshead and the largest accessible market town.

Elizabeth Thompson kept a meticulous record of her deliveries from 1669-1675. The births are listed on the right hand page of the diary while she used the left hand page to record the children who were born dead or died shortly after birth and were not baptized. Rather than naming them as she does for live births she calls them the sons or daughters of the father. In one case of twins she recorded them on the opposite side of the page, which was usually blank, and she recorded that they were born and buried on the same day. 1 June 1671, number 14 in the list, reads *'the sons of Crisophar Shaw Shoomaker in Stricklandgatte borne and buryed June the 1 being hallow Thursday'* (*sic*). In the case of an abortive baby, number 29 in the list for the same year, she also recorded this on the left hand side of the page as *'the son of John Hucke Smith in Kirkland born the 13th of agust'* (*sic*). It seems that this midwife classed stillbirth or abortive babies and those born and dying soon after birth in the same way within her records. The format she used mirrors those used by the clerk in the parish of Hawkshead. Mrs Thompson always listed her cases in date order and always named those children that lived, which most probably meant that she attended the christenings.

As to Finlay's suggestion that travel was a problem, it is worth noting that the two Quaker midwives from Hawkshead, (who will be discussed further below), were present at nearly all the Quaker women's monthly meetings in this period, whether held in Ulverston (approximately 24 miles from Hawkshead) or Cartmel (18 miles), (recorded in the Swarthmore Women's meeting book), which must have meant that, in spite of some bad weather, the roads were passable and communications possible most of the year.

In conclusion, Schofield's data in Table 10.1 has been used in various publications over more than thirty years, and to ensure that the data has subsequently not been corrected it was important to consult its originator. In personal correspondence with

Professor Anderson, Dr Schofield re-examined this research and judged that the Hawkshead stillbirth and perinatal data was still relevant.

While Woods concluded from further examination of Wrigley's work that it may be unsafe to conclude from the stillbirth rate in Hawkshead, as Wrigley does *'that this scrap of empirical evidence, therefore lends support to the view that stillbirth rates were higher in the seventeenth century than in Victorian times'*, the social history of Hawkshead may help to substantiate Schofield's faith in the registers for the parish and may also suggest that Hawkshead may have been unusual in its stillbirth pattern. Moreover, there could have been a direct and further linkage between having a high stillbirth and high rates of childlessness.

Midwifery practice

Within Hawkshead in the eighteenth century there was a system of four overseers of the poor within the parish, who were elected every Easter. Their duties were to provide relief for the poor in the shape of clothing, clogs and sometimes meat. Lying in and midwife expenses were also stated in the parish accounts, which commenced in 1696, but Cowper found no mention of a doctor prior to 1743 (1899, p. 427). The fact that the care given to the poor by midwives was recorded suggested that this was normal in the area and midwives were of a high status in the parish.

The area of Westmorland was one of the early birthplaces of Quakerism. Increasingly in Britain a number of Quaker women became midwives. Hess, in her chapter on *Midwifery practice among Quakers* (Marland, 1994), recorded the way that Quakers were officially under siege by ecclesiastical and state authorities until the Toleration Act of 1689 (p. 52). She suggested that even some local churchwardens were at daggers drawn with Quaker midwives and harassed them by repeated presentations for unlicensed practice and refusal to attend church, and this has been shown to have happened in Hawkshead.

Attitudes to Quakers generally changed after the Toleration Act of 1689. There were challenges however for practising Quaker midwives as they did not conform to the

old customs of generations associated with childbirth and lying-in, outlined in Chapters 7 and 8, and they eventually had their own system for registration of births for their own members (Penn, 1694, p. 870).

However, from an examination of the registers for Hawkshead, it seems unlikely, due to the diligence of the clerk and the churchwardens, that the babies delivered by the two Quaker midwives, whether born alive or dead, went unrecorded in the Hawkshead records. Indeed, Berry and Schofield (1971, p. 455) stated that, from 1695 -1705, a tax was placed on births, deaths and marriages and all parishes should have recorded births in this period as *'either baptism or birth'* through an Act of Parliament (7 and 8 of William III c 35, s.4) and as already discussed there is evidence that this was carried out in Hawkshead.

Hess (1994) suggested that Quaker midwives fell short in terms of the social niceties required. Quaker midwives could not participate in the baptism, churching or the gossips' party. Also they would have disapproved of laced linens and frivolous gossip (p.62) and would not have accepted the usual tips from godparents (p. 55). However, conversely, the Quaker midwife may have been very skilled, as well as honest, plain in her dealings and be unlikely to be a gossipy women who would spread tales from the home of her employer. She was likely to be educated and probably well read in contemporary midwifery manuals. Quakers had a reputation for medical skills and the roots of Quaker ascendancy were prescribed in medicine and pharmacy during the eighteenth century. Hess (p. 62) suggested that this arose from the respectability of seventeenth century Quakers as apothecaries, surgeons and midwives.

Quaker women's meetings supervised the Quaker midwives. For instance, Hess described extracts from the Swarthmore Hall meeting at Ulverston of 10 December 1675 in which Mabell Brittaine was stopped from practising in the area because of her bad practice (Cu RO 1675, pp. 66, 75).

> *Certaine women have been longe in travel, and have beene delivered of dead children under her hand. And some doth suppose it was for want of judgement and skill in her'. It is our judgement and testimony (and we doe warne her) that she doth not meddle in Imployment here after (sic).*

The above extract was checked in its original source to see if further discussion was recorded, but unfortunately it was not. What is interesting about this outcome on Mabell's practices was the underlying assumption in *'certaine women were longe in travel (sic)'*, that there was something she could have done about this length of time. From the information discussed previously in Chapter 8, on changing midwifery practice, it was found that this could have been internal rotation of the baby or the use of forcing medicines such as ergot to speed the labour. It could not have been forceps as it was too early in the period, in too rural a location, and no doctor practised in the area until 1743. In terms of why the baby died, it is interesting to speculate whether if she had left it late and used too much ergot she would have caused the death of the child. The death could also have occurred from just the length of time to delivery without resorting to forcing medicines.

Hess (1994, p. 69) also found in her searches that Quaker midwives developed procedural forms for consulting each other as colleagues and would send for the help of other midwives during a complicated labour. Apparently Mabell Brittaine did not do this. The care given by the Quaker midwives in Hawkshead seems to have been carefully supervised through their monthly meetings and there seems to have been a professional support system in place to provide aid when there were problem cases. Certainly the two Quaker midwives in Hawkshead were often at the same monthly meetings and appeared from the notes of the meeting to work together in Hawkshead.

However, it is likely that, in spite of the Quaker midwives' opposition, the mothers continued their lying-in customs. As late as 1785, the Rev Gorst (Davies, 1785, p. 185) recorded the annual income and expenditure for labourers in Morton, South of Ulverston in Westmorland, and this included 15s.0d for lying in, which is much higher than Davies's sum of 10s.0d.

Accepting some limitations for incomplete data, but taking into account the social history of Hawkshead, what then could have caused the high perinatal rate and incidences of childlessness within marriage in the parish? Having described the action

of ergot in previous discussions, the high stillbirth rate could of course have been caused by ergot in the diet or even an effect of the potency of ergot given during childbirth. This would assume that ergotised rye was available and eaten in the diet in Hawkshead. There does not seem to be any evidence of any consistently poor midwifery practice in Hawkshead and the number of women recorded as dying in childbirth in the period 1581-1710 was three (Schofield, 1970, p. 13).

To consider further the consequences of eating ergotised rye in Hawkshead, it is now important to determine whether rye was grown locally and could have been ergotised and was part of the staple diet.

Access to rye in Hawkshead

With reference to the points raised in the introduction to this chapter, the issues to address are whether rye was grown or bought locally, whether consumed by the residents, and, in times of dearth, whether there were established routes to other sources and markets for grain. Issues concerning soil, markets, weather and cooking methods will be important here as well as the use of rye.

The history of the area suggests that famine was never far away when harvests failed. Overton (1996, p. 141) suggested that, in the absence of direct information on the causes of death during local subsistence crises, it is difficult to be certain that they can be attributed to famine, but it seems likely that in Cumbria there were mortality peaks caused by famine in 1587, 1597 and 1623, with the most severe crises in 1596 -1597. The last period for which there was clear evidence of famine and subsistence crisis was 1622-3 when people starved to death in Cumberland, Westmorland and perhaps also some Durham parishes. Appleby (1973, p. 423), from his research on mortality, suggested none of the great killers of the sixteenth and seventeenth centuries satisfactorily fitted the evidence from the register in various parishes of the area, where there was also a drop in conceptions by around 40%. He concluded that the mortality was due to either the effect of starvation or some kind of epidemic (p. 432).

Cowper (1897, p. xv) suggested that the corn (grain) lands round the village of Hawkshead were scanty. *'Sufficient indeed for their own wants in good years, but liable no doubt to give short supplies in bad seasons.'* The inhabitants were shepherds rather than agriculturalists (p. xv).

Poor harvests in the Hawkshead Parish could leave subsistence farmers with insufficient food, so that they were forced to buy corn in the market when its price was high. The particularly bad harvests in the late seventeenth century were 1673 - 1674, 1691 - 1693, 1696 – 1697, and in the eighteenth century 1708 - 1709, 1739 - 1740, 1756 - 1757, 1795 - 96 and 1799 - 1800 (Overton, p. 172).

The weather could have been a factor, especially rainfall. Potentially, Hawkshead and the area around would have been an area particularly susceptible to ergot on the rye because of its high rainfall and soil type. In wet years, such as 1792, the rainfall was 82 inches, and in ordinary years 45-50 inches, while, in the driest, it was just 20 inches (Pringle, 1797, p. 260, Marshall, 1808, pp. 210 and 217). Such accuracy was achieved because the data were *'ascertained by rain gages (sic) kept at Kendal and on the banks of Windermere'*. Short recorded that 1702 was the rainiest year of all in Lancashire (1750, p. 357).

In the North and West of England Overton (1996) suggested that, where good arable land was relatively scarce, it was more difficult to produce enough corn for subsistence and grain was more likely to be bought in from outside. If the Hawkshead inhabitants were unable to grow enough grain, then where else could they obtain their supplies and what did they use as a bread grain? Cowper stated that the grain was supplied by the tenants of *'plain Furness, for the hill men grew no grains but what was sufficient for themselves'* (1897, p. xx). The plains of Furness would have been to the South West of Hawkshead, on sandy soil, towards Ulverston and the coast. The grain would have been brought to Hawkshead market. During his reign James 1 granted letters of patent for a weekly market and two fairs a year at Hawkshead (Cowper, 1897, p. xxi).

Even as late as 1795, David Davies, using the report from the Rev Gorst (pp. 184-5), referring to Marton two miles south of Ulverston, stated: *'Bread eaten by this class of people, is made of rye/barley.'* Also (p. 135), *'The food of day-labouring families is rye and barley bread, potatoes, milk and bread and oatmeal porridge. No meat, no beer. Yet the deficiencies are great'.*

An earlier reference was found in the Swarthmore Quaker household accounts held at Barrow-in-Furness library, which listed the amounts given out to needy *'Friends'*. It covered the area from Ulverston to Cartmel and Hawkshead. All grains were mentioned, including rye. In the accounts of 1 April, 1675, (p. 1940) it was stated *'to Mo rec'd of Jane Cotton for 3 hoo of ry yt I bought her of Robert Elletson of Stenerley 2s.6d'* and for 23rd November, 1677, (p. 439) *'by Mo pd for white bread and ry bread Elizabeth Gowth for Bro Lower 1s.10d'* (*sic*).

While Cowper stated that the grain came from the plains of Furness, the rye for Hawkshead market could have come from a number of other markets or direct suppliers as there is evidence that there were established routes to Hawkshead from the North, South and West.

It is possible that people in the northwest travelled further than 10 miles to obtain grain or had it brought to the Hawkshead market. Cowper (1897, p. xxxiv) in his introduction to *The oldest register book*, suggested that an occasional journey to Kendal, Ulverston and Ambleside and still more rarely to Keswick or Lancaster, was the farthest anyone would travel in this period and that most people would *'tramp'* and think little of it and for the longer journeys, his horse and small saddle would be all he wanted. He also described the journeys that people made: *'as such as made a journey to Kendal, Lancaster or Ravenglass, did it a-horse back, with their women-folk on a pillion, if they were a mind to go with them'* (Cowper, 1897, p. xxxi).

Of course travel and the condition of the roads depended on the weather. Cowper (1899, p. 243) referred to the great thunder, lightening and floods in Hawkshead on 10 June 1686, which *'cut the roads to pieces, which did great hurte* (*sic*) *the never*

like was knowne (*sic*) (p. xxxiv)'. Also in 1679, for instance, a severe thunderstorm was recorded in the Hawkshead Parish Register:

> *The water did so furiously run downe the highways, and made such deep holes and ditches in them that at several places neither horse nor foote coulde pass* (*sic*) (Fell, 1891, p. 368).

The oldest road from Hawkshead was the road to Ambleside. From Ambleside the main routes would be to Kendal or across to Appleby. However, there must have been a boat service across Lake Windermere from Hawkshead as well, as in the registers there is a record of a disaster on 6 October 1635 involving a wedding party that was crossing the lake in a storm, when everyone, including horses, drowned.

Before 1752, Cowper reported that there were six pack horses twice a week from Hawkshead to Kendal and eighteen a week from the port of Whitehaven: but the latter town only sprung into importance at the end of the seventeenth century. There is evidence from other sources that the crossing across the sands at Morecombe Bay was frequently used (Holt, 1795, Fell, 1891, p. 371, Penny, 1920, from Sarah Fell's *Household account book*, 1673-1678).

John Houghton, an apothecary in London, published a weekly journal from 1692 until 1703, which showed the returns from several corn markets in the country and the prices of corn. It clearly showed that Appleby, Carlisle and Kendal were major rye markets (Ashley, 1928). Marshall, in reviewing the Reports to the Board of Agriculture in 1808 (p. 217), stated that there were weekly markets at eight different towns in Westmorland but the only one of note was held at Kendal. The next town of consequence with a market in the area, he suggested, was Appleby, the county town.

The amount of grain used by the inhabitants of Hawkshead is hard to determine but the Corn Tracts were an attempt by Charles Smith, an owner of a large milling concern in Essex, to ascertain the amount of the home produce of cereals, the amount of imports and exports, the total quantity available in the country, and the relation of these data to the population of the period in 1764. While he deduced that the consumption of rye bread was on average 14.8 per cent across the country, in the north of Lancashire, which at that time included Hawkshead, it was 16 per cent,

while in the bordering county of Northumberland it was 32 per cent. Other authors referred to a number of routes from Hawkshead, where rye was extensively grown (Pringle, 1793, p. 271, Cowper, 1897, p. lxxiii).

From Kirkby Steven to Brough and Appleby and from Temple Sowerby, the soil was stated to be deep sand, which when cultivated became more compact and more retentive of moisture. Pringle (p. 271) reported that even in 1797;

> *there were particular farms where after the second crop which was generally inferior to the first, the land was summer fallowed, planted with potatoes, or sown with turnips, which 'lasts' (sic) were given to the wintering flocks of cattle or sheep. Dung was always laid upon the fields designed for turnips and potatoes, and the remainder upon the fallow, which was likewise invariably and always, successfully limed at the rate of 75 Winchester bushels[1] per acre. What was so fallowed was sown in the middle of September with two and half bushels of rye per acre. 30 Bushels are reckoned a good return.*

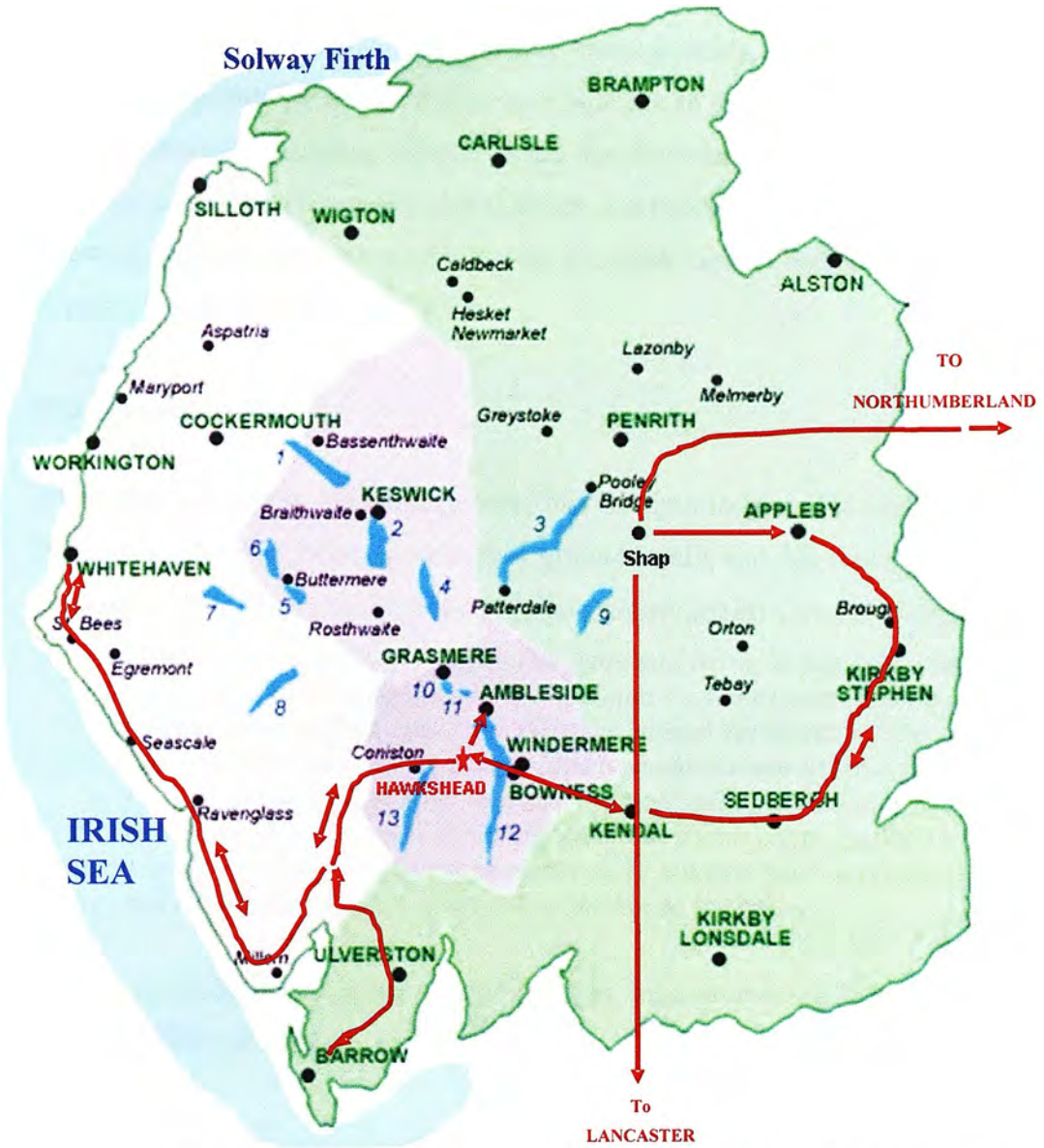
The records for the prices for threshing also suggested that rye was grown there (Pringle, 1793, p. 293), while in neighbouring Northumberland, Bailey and Culley in 1797 (p. 70) stated clearly that rye was formerly the principal grain grown upon all the dry, sandy and light soils, but since the use of lime, and the introduction of the turnips and artificial grasses, it was rarely cultivated, except upon very sandy soils. Then it was sown at two bushels per acre, which produced from twenty to thirty bushels per acre. The rye was consumed mostly in the southern parts of the county as it was *'the most general bread of the labouring people in the county'*. After being leavened it gained a considerable degree of acidity and it was made into loaves, and baked in a large brick oven, or made into thick cakes, one and a half to two inches thick, called four cakes and baked on the griddle. *'The bread is very firm and solid, dark coloured, and retains its moisture or juiciness longer than any bread we know'* (p.70).

What is important from all this evidence of routes, markets and agriculture, and the actual food that was eaten in all the areas near to Hawkshead, was that rye was

---

[1] Measures varied across regions and countries in the UK. Usually 1 bushel =36 litres. 1 boll = 2 bushels. Measures were by volume so actual weight depended on the type of grain and the compaction. 1 boll = 163 lbs of water= 74 kilograms = 2 bushels

recorded as being part of the staple diet of the area, was grown locally and, in times of deficiencies, Hawkshead had access to rye from a number of markets from across its borders. Figure 10.4 illustrates the access routes available.



Lakes 1. Bassenthwaite Lake 2. Derwentwater 3. Ullswater 4. Thirlmere 5. Buttermere 6. Crummock Water 7. Ennerdale 8. Wastwater 9. Haweswater 10.Grasmere 11. Rydal 12. Windermere 13. Coniston

Figure 10.4 Diagram to show the nearest markets and the trade routes from Hawkshead

Another issue was the ability of residents to buy food. Importantly, many people were poor in the area. In Hawkshead, Leonard calculated that in four twenty-year periods of the second register 1705-1787, they numbered 67, 110, 90 and 116 and she commented that this was a large proportion for the size of the parish (p. vii).

The amount of rye consumed was probably linked to ready cash. Overton (1996, p. 141) suggested that the small farmers were poor not so much because they were outside a national marketing framework but that they were the victims of premature specialisation. Prices for grain could fluctuate and become much higher than livestock product prices. As a consequence the small farmers had insufficient income in terms of ready money to buy food.

Processing grain

It was only later in the eighteenth century that the flour they needed was bought. Previously, they bought grain which they ground locally and this was probably processed within the home. In terms of grinding corn (grain) Cowper (1899) stated:

> *There is no evidence of the quern or hand mill being in actual use in recent times, but, considering the number of stones that are found, and the distance from some farms from any corn mills, we cannot but think that the use of the quern has died out only in comparatively modern times in the Lake District. The old sort of malt mill was a quern of upper and lower stones, but the upper was made to rotate by simple machinery with cogged wheels and a trundle. The more usual and probably more modern type was a large coffee mill attached to a beam in the loft of the house* (p. 192).

Without the knowledge concerning ergot fungus, local processing of rye would have meant that it could be easily contaminated.

Another clue to the high percentage of rye available comes from the type of houses within the area. Cowper (1897, p. xxvii) gives some information on the houses in Hawkshead and the material used for roofing. *'The house walls may have been constructed of timber, or dab and wattle, or of stone. The cottar's huts would have at one time been thatched'* (p. xxviii). That would have been until slate was discovered in Barrowdale. In Northumberland Bailey and Culley reported that straw thatch used

to be the universal covering (p. 28). The longest thatch from straw stalks was obtained from rye and it could have been used in Hawkshead as it was, for a period of time, commonly used in Lothian in Scotland (Robertson, 1795, pp. 118-119). Robertson described the thatch as excellent.

In terms of the susceptibility of the people of Hawkshead to ergot on rye within the diet, there is, therefore, evidence to suggest that the soil and climate were right and home-produced flour from rye was grown locally and the stalks were used as thatch for houses until slate was found in the area. In winter especially and in times of crises there was access to markets in other rye growing areas and bread made of rye and barley was probably the main part of the diet up until about the end of the eighteenth century. Therefore, there was enough circumstantial evidence along with poor weather conditions to suggest that this rye could have been contaminated with ergot.

Presence of ergot

The link between ergotised rye and epidemics has already been established. An epidemic of a convulsive form of ergot poisoning occurred in Lancashire and Cheshire in 1702 (reported on 26 June, and as having started in the previous year) and is referred to in Creighton's *History of Epidemics in Britain* (1891). It was said to be widespread and affecting many people. A reference from Short (1750, p. 357), already referred to, stated that 1702 was the rainiest year of all in Lancashire. A full discussion on this outbreak was presented in Chapter 7. The outbreak was reported to the Royal Society and published in their transactions (Creighton, pp. 58-61 and the *Philosophical Transaction,* p. xxiii, p. 1174, 26 June 1702).

It is interesting to note, within the report concerning the reported outbreak, the use of the word *'possessed'*, as these cases were of the convulsive ergotism type, which happened in areas where milk and dairy produce was not available. This should not have applied to Hawkshead in Lancashire as sheep and dairy farming with its access to milk would have prevented this type of ergotism (Mellanby, 1934, p. 128 and 1950, p. 52). However, foot and mouth (murrain) was present in this century which would have made milk scarce and expensive thereby reducing its availability as a

suggested antidote. By 1793 the Marbury Medical facility was recommending fresh eggs and butter as especially good preventatives of convulsive ergotism. Dickinson (1876, p. 114) described the practice of *'need fire'*, a superstition or folk-lore, used in the northern counties, where cattle were led through a ceremonial ring of fire apparently to ward off epidemics in cattle, and he suggested this was used for murrain or foot and mouth disease, *'a charm to check the ravages of the murrain'*.

Relating this to Hawkshead, it is interesting to note that, after the plague, Cowper (1899, p.125) stated that there were a number of sickly years following the worst plague years, in which many deaths occurred at a single farm. It is not clear in his writings whether he relates this to the plague or general years of sickness. While it is not known what the actual cause was, the epidemic could have been ergot poisoning, as ergot poisoning was widespread in Lancashire. The fact that many people were poor and often sickly, with families similarly afflicted and often dying around the same time, could suggest that it was due to ergot.

Conclusions

The registers of Hawkshead showed a high incidence of childlessness, stillbirths and early foetal deaths in the parish in the late seventeenth century. The available records were explored in order to determine whether ergot in the diet could be implicated.

In relation to Hawkshead, four questions were addressed: was there proof that rye was grown, marketed and eaten in Hawkshead; was there evidence of ergotism in the area; was there a correlation linking poor and good seasons with stillbirths, childlessness and illegitimacy and early and late ages of marriage and what was the impact of improved management of labour as determined from the social history of midwifery that described the level of good practice and registration in the parish.

These have been addressed. It was established that rye was present in the local diet, and formed an important part of it. There were sickly years in the latter part of the seventeenth century that could have been caused by ergot. The weather and geography were all indicating factors and evidence relating to a widespread epidemic

in 1701 in the counties of Lancashire and Cheshire which was reported to the Royal Society in 1702.

At the end of the seventeenth century childlessness and stillbirth rates were high, which could have been a consequence of ergot ingestion or use. If ergot was ingested in small amounts it could lead to symptoms of infertility connected to its contraceptive effect or its action as an abortive agent. This would show up as childlessness within marriage and increased stillbirths, and a release from these effects when rye was given up in preference to wheat and barley.

Between 1581 and 1710 Schofield (1973, p. 13) found only 3 incidences in the records of mothers dying in childbirth, which suggests that midwifery care was well managed. Midwifery practice was probably of a high standard for the period, as Quaker midwives were practising in Hawkshead. The midwives knew the importance of recording baptisms and the clerk to the parish was very diligent in his approach to detail in the Hawkshead registers, particularly with supporting evidence from the Kendal midwife's method of recording abortive and early infant deaths in her diary between 1669 and 1675.

In conclusion, the demography of Hawkshead appears to show that the late seventeenth and early eighteenth centuries were a time of high childlessness, and a time of high stillbirth rates for married women. Compared with the period that followed, they were also a period of relatively low illegitimate births and prenuptial babies, which may possibly suggest that fertility more generally was somewhat depressed.

This was also a parish where accumulated circumstantial evidence collected in this chapter suggests that rye was grown, used and eaten in the parish, and that, when required, it could be accessed from other markets that sold rye in the surrounding areas.

It is, therefore, possible that the puzzle over why the recorded stillbirths in Hawkshead were so high can be explained. Ergot on rye could have been a factor that affected infertility, through the ingestion of ergotised rye in small amounts over a long period of time, which would have acted as a contraceptive, and it could also have caused high stillbirth rates in Hawkshead in the late seventeenth and early eighteenth centuries.

While this hypothesis cannot be definitively confirmed, it is argued that the strong accumulated circumstantial evidence provided cannot be ignored and needs to be taken into account in the population debate and be tested by other researchers in further parish studies.

Chapter 11

Conclusions

This thesis set out to determine ergot usage and contamination of foodstuffs in England in the seventeenth and eighteenth centuries and the possible implications for population change. In particular it was important to understand exactly how the action of ergot affected fertility and under what circumstances.

Questions arising from the demography reported in the Cambridge Group's research study formed the basis for the thesis and may be seen to fall into two distinct themes. Firstly, that there could have been previous causal factors that held down fertility in the late seventeenth century that, when removed, led to an increase in fertility in the middle of the eighteenth century: the Cambridge Group study suggested a nutritional explanation here. Secondly, there appeared to be other factors which could have affected the mortality rates of women and babies during late pregnancy and labour that apparently lessened around the same time as fertility improved in the 1750s.

The hypothesis for this study was that ergot, particularly in rye bread, may have affected women's fertility in the long eighteenth century through ergot's contraceptive and abortive actions. An anomaly concerning improvements in midwifery and decreased maternity and endogenous infant mortality rates also needed to be examined within this hypothesis. The method chosen to address the hypothesis was historical research. Many contemporary documents were searched which provided circumstantial evidence to support the hypothesis that ergot could have been a contributory factor to the outcomes highlighted.

The history of ergot in Chapter 3 highlighted the danger of rye within a staple diet which could have been contaminated with the fungus ergot. Two types of ergotism, convulsive and gangrenous ergotism, were found according to the predominate diet of the population. While cases of ergotism in Europe were common, at first, there appeared to be little evidence of overt ergotism in England.

However, what was revealed in Chapters 3 and 4 was that the effect of ergot consumption could occur not just when there was a large intake of ergot over a short period, but also if there had been a regular small intake over a long period and where people were particularly sensitive to the fungus (milk and dairy produce were identified as possible antidotes which could lessen the effects of ergot in the diet).

In Chapter 4, a modern understanding of this complex drug indicated that most importantly ergot also affected the fertility of woman if taken in very small doses, acting as a contraceptive and an abortive agent, but also, paradoxically, as aid to women in childbirth.

The pioneering research by Shelesnyak and Coutinho in the 1960s and 1970s, on how nidation takes place and the role of progesterone, led to trials using ergot as a possible contraceptive pill. The trial using ergot, funded by the International Committee for Contraceptive Research (ICCR), the World Health Organisation and The Ford Foundation, found that ergot compounds were powerful stimulants of oviductal motility inducing long lasting contractions from relatively small doses of ergot and were induced at all stages of the menstrual cycle. Preliminary trials reported in the 1975 paper did indeed indicate that ergonovine maleate (ergometrine in UK) given at a daily dose of 0.20mg orally had a contraceptive effect. While this trial was overtaken by more promising lines of research involving progesterone, crucially for this thesis the research demonstrated how the effect of ergot taken in small doses in the diet could affect the fertility of women because of its contraceptive effect. On the basis of this modern knowledge, it was clearly possible that ergot could have affected fertility in the eighteenth century if women were consuming enough of it to suffer the effects. It was felt justified to infer that it could be applied to the Little Ice-Age, in Chapter 7.

The need to introduce modern standards to prevent the ergot contamination of crops in developed countries has demonstrated that ergot growth can still be a problem in agriculture today, resulting in the contamination of foodstuffs. Standards for growing rye, in particular, and processing the resulting foodstuffs and alcohol have been put

in place in developed countries. Concern is growing as to the potential for future problems, particularly in recognition of climate change and the current fashion for increased organic farming techniques, which may become widespread.

Using the seminal work of Ashley it was shown that rye was an important and large part of the staple diet of labourers in England at the end of the seventeenth century that gradually decreased in favour of wheat across the eighteenth century, with the south of England leading the change.

The modern standards, outlined in Chapter 4, were used to compare the farming and food processing methods in England during the long eighteenth century to current processes. This information indicated the level of the technology and crop monitoring necessary to ensure minimum levels of ergot contamination and therefore by inference demonstrated how, in the absence of these technologies, ergot could have been a problem in the long eighteenth century. These comparisons were crucial to understanding the possible mechanism for contamination at that time.

The climate and agricultural conditions for ergot to flourish on rye were found to be present in England in the late seventeenth century. These included long cold Springs, sandy soils, the lack of hygiene during the clearing of the fields after harvests and the lack of improvements in agriculture to limit ergot growth, compared with the present modern understanding of the means of prevention of ergot on rye grown today.

Similarly, the processing of grain for food in the seventeenth century and early eighteenth centuries was found to favour ergot contamination when compared with modern methods of prevention of contamination in the production of flour and meal. Although, even today these methods of prevention are not entirely foolproof. Later, as wheat became more plentiful by the end of the eighteenth century, rye was mostly replaced by a new '*higher diet*' of wheat and therefore ergot consumption, if present, would have fallen.

In addition, the notion that ergotism was not a problem in England was found to be not proven in Chapter 7. Documents were found, mostly from discussions published in the *Philosophical Transactions* by the Royal Society, detailing incidences of ergotism in the UK for the long eighteenth century. Also, other possible occurrences in the contemporary literature were discovered where the symptoms of diseases were often not understood or muddled and then put down to poor corn in the staple diet or classed as other diseases.

The identification of other outbreaks of diseases, which could have been caused by ergot, was difficult to establish conclusively, as the descriptions of the symptoms and the outcomes involved contemporary word usage and associations, and obviously certain data was missing. A discussion on this point sought to outline the dangers of applying modern knowledge of diseases to poorly described symptoms of illnesses of the past, as any conclusion would remain highly speculative and therefore caution was applied in claiming that certain diseases were in fact due to ergot.

Further evidence was difficult to find because at that time the means of communication and dissemination of knowledge relating to diseases were only just being established in England, and, even then, mostly, among the upper classes and those with some degree of education. It was found in general the government was relatively uninterested in the health and standard of living of the mass of the population, except in larger urban communities such as London, where this concern was reflected in the Bills of Mortality.

However, using other sources, potential incidences of ergotism in England were also corroborated from other documentary evidence. In particular, agricultural writers of the time recognized that ergot, referred to as '*blasted rye*', was a problem in cold Spring times and there was a need to stack the contaminated grain separately for long periods, of up to three years, in order to render it useful. This evidence revealed that while ergot contamination was not always recognized for the damage it could cause by ingestion, and did not necessarily cause full blown ergotism, it was not uncommon in the fields of rye in England.

Overall, the evidence presented in this thesis in Chapters 3 to 6, and suggested inference from the Hawkshead case study in Chapter 10 does indeed suggest that one of the contributory factors at the end of the seventeenth century for the low fertility rate could have been the contraceptive and abortive action of ergot in the diet of women. This would have continued, until, from the middle of the eighteenth century, there was a gradual move from rye to wheat as the main grain within the staple diet. Of the key issues for this thesis arising from the questions in Chapter 1, the contraceptive effect could explain sterility, late marriage, low illegitimacy and longer intervals between births in the late seventeenth and early eighteenth centuries. The rise in fertility in the mid-eighteenth century appeared to have coincided with rye decreasing as a staple diet.

This evidence, however, did not explain why maternal and especially endogenous infant mortality also started to decrease from the middle of the eighteenth century. The questions still unanswered from Chapter 1 were therefore, why was there:

- A decrease in infant mortality, especially endogenous rather than exogenous, that commenced gradually from the start of the eighteenth century. Endogenous infant mortality, while peaking in the final quarter of the seventeenth century and falling gently thereafter, descended sharply from 1740 onwards. This raised questions as to whether delivery skills and lying-in practices changed and affected the rate of endogenous infant mortality and maternal deaths. Conversely, could it also be related to better nutritional benefits for mothers and their babies, or to both points?

- A marked decrease in the death of women during childbirth from around 1700 - was this linked to the point above, or were there quite separate mechanisms at work?

In order to understand the factors that may have contributed to changes in mortality for women and children during labour two approaches were taken in Chapters 8 and

9. First of all, in Chapter 8, a number of changes which were thought to have led to improvements in medical midwifery management were examined. The move to men-midwives and the use of instruments during a difficult labour were found to coincide with an increase in knowledge and understanding concerning the female anatomy from around 1732. However, the numbers of new practitioners and the cases they were involved in were argued to have had little impact in rural areas. Within the large cities these new practitioners were shown to have added to the problems of maternal and infant mortality rates by the introduction of infection to women by puerperal sepsis, particularly in the newly set up lying-in hospitals. When it is appreciated that the main cause of death was sepsis, that was introduced into these new institutions, together with other medical conditions, such as toxaemia of pregnancy and haemorrhages, which were not finally understood and treated effectively until the nineteenth and twentieth centuries, it is highly improbable that these new practitioners could have been able to make any real impact on the causes of death in women and the newborn. These new professional changes in the management of labour therefore need to be considered as having little substantial effect on the mortality rates of women and infants, although the increase in knowledge of childbirth and the dissemination of education on the topic would have begun to gradually spread to many practitioners.

However, when the skills of the midwife and the substances she used were examined in Chapter 8, it was found that in normal cases of labour '*forcing medicines*' were used, named as '*midwife's powder*' or ergot, for cases where the labour pains were prolonged or where they had faded. Ergot used by experienced midwives, given only when required when labour pains faded, was often successful in keeping the mother alive but could kill the baby during labour by its stimulation of sustained contractions causing damage to the brain of the baby and asphyxiation, resulting in stillbirth.

Contemporary midwifery documents examined during research for this thesis, showed that the action of the drug ergot was poorly understood and it was only gradually through the nineteenth century that its full action in stemming haemorrhages and as an aid in the delivery of the placenta was recognized.

Thereafter, the baby was given a greater chance of survival, as better understanding led to ergot medication being given at a later stage in the birth process. In the late seventeenth and early eighteenth centuries, while the powder would have helped the mother, the infant could have suffered if it was given too early in the labour or if too much was ingested. The overall outcome would have been that the powder may have had a role in improving maternal survivability but could have been detrimental to the infant if given by inexperienced practitioners.

The effect of giving too much ergot during a birth could have a number of detrimental and fatal effects on a baby. When it was ingested during birth, or afterwards during the gossips' month-long parties, or even through the transfer of ergot to the child in the mother's milk, it had the potential to cause problems. It might dry up the mother's milk, or cause so-called gut rot or griping in the new born infant, which could have been signs of mesenteric gangrene. Problems associated with ergot drying up the mother's milk were identified by the WHO had identified in 2002, as requiring further research; a further indicator of the continuing effect of ergot on fertility and survival.

This thesis also examined another vehicle for transmission of ergot, discussed in Chapter 9, which could possibly have overdosed an infant during birth. This was caudle. In the late seventeenth and early eighteenth centuries caudle would have been made up with rye and this could have been contaminated by ergot both in the gruel base and through contaminated gin or Holland which was often an ingredient. Evidence was produced for the contamination of rye and the adulteration of gin. The gossips and midwives used caudle both as a help for women in labour as well as a relief from the pains after birth. This common custom suggested that the use of caudle in childbirth had been built up through experience, even if all its actions were not necessarily understood. This would have meant that, depending on its strength, while helpful to the women, if given too early in the birth it could, if it accidentally or possibly even deliberately contained ergot, have had detrimental effects on the baby as a result of sustained contractions, leading to stillbirth. Given together with medicinal ergot or the midwife's powder, too early in the labour, caudle could also

have caused rupture of the uterus. However, experienced midwives would not have seen the need to give forcing medicines when labour was progressing well. Contaminated caudle, together with any ergot given as medicine, would have meant that dangerous doses could have affected the survival chances of the infant, although probably the women would have survived.

The rates for endogenous infant mortality in particular fell by 50% after the decade of the 1750s. While this may not have been because there was a change in practices as to when ergot as a drug was given in childbirth, one possibility is that the caudle, which was made up and given by the gossips, contained less and less contaminated rye as the change to wheat took hold and the adulterated gin, or Holland, with added poor grain ingredients, was regulated. Thus the amount of ergot that could affect the baby was dramatically reduced and would have meant that the survival chances of the infant could have been greatly increased.

When Hardy critiqued Matossian's published work the issues raised concerned both the lack of research and the failure of Matossian to define her claim that ergot acted as a fertility suppressant, implying that this was due to infant mortality, miscarriage, or temporary female infertility. Therefore, one of the important areas that was explored in this thesis was to find research evidence of how exactly ergot could have acted on women's fertility during the long eighteenth century, by retrospectively applying modern knowledge of its action, to this period.

One of the most important pieces of modern evidence noted was that ergot, when ingested in small amounts over long period of time, could have had a contraceptive and an abortive affect on the women eating it. The mechanism by which ergot affected the protective hormone progesterone, responsible for protecting nidation and the pregnant uterus from contracting, was fully explained in Chapter 9. It was discovered that ergot particularly affects, and has the potential to overcome, progesterone at key points in the reproduction cycle and during pregnancy and labour: during implantation of the ovum, when ergot may cause failure of nidation, in the first three months of pregnancy and the last three months, when abortion or

miscarriage can occur, during labour when it can affect the stages of labour, and, postnatally, when it can affect the passage of the placenta and haemorrhages, as well as having a detrimental effect on milk production.

Of the two methods of ingestion of ergot, that is regular ingestion of small amounts over a long period or prescribed ingestion during labour, statistically it is likely that the greater impact would have occurred from the contraceptive and abortive action of ergot, rather than its medicinal action. In the early part of the long eighteenth century, but obviously after about 1750, the impact of ergot given in labour by experienced midwives could also have been a contributory factor of some significance in improving maternal and especially perinatal mortality rates.

The possibility of ergot being ingested regularly in food and drink would gradually have declined. By about 1750, the main diet of the population changed to wheat and the regulation of gin, as part of the control of the distilling industry, prevented the inclusion of poor coarse corn in the spirit.

Concurrently during this period, ergot use in labour as a medicine, when given by experienced practitioners, would have often helped some women in difficulty to survive. However, the baby had less chance if the drug was given too early in the labour, along with other doses of ergot within the caudle and gin given to the mother during the birth.

The demography concerning infant mortality, especially stillbirth and childlessness, or reduced fertility, and the effect of ergot, ideally needed to be demonstrated in at least one parish. In order to provide further corroborative evidence to support the thesis, a case study of Hawkshead was undertaken which showed that fertility during marriage was considered to be low while stillbirths were thought to be high in the late seventeenth and early eighteenth centuries. The data available was explored further in order to probe the question of whether ergot could have been implicated or present as a contributory factor: the accumulated circumstantial evidence collected in this chapter suggested that rye was grown, used and eaten locally, and that when

required it could be accessed from other markets that sold rye in the surrounding areas. The study served to corroborate and strengthen the argument presented and provided some further accumulated circumstantial evidence that ergot was a factor in population changes in the long eighteenth century, even though there was some limitations due to changes in recording stillbirths in the second register for Hawkshead.

In conclusion then, the fit between the demography as indicated and the accumulated circumstantial evidence produced does appear to suggest that the regular eating of small amounts of contaminated rye and its use during labour could indeed have been a factor that made some contribution to the check in population, seen at the end of the seventeenth and during the early eighteenth centuries. The reduction in rye as a constituent within the staple diet from the middle of the eighteenth century, and the possibility that ergot contamination was reduced, would have enabled women to become more fertile. This process, deduced from the evidence presented in this thesis, had the potential to deliver an impact on population changes.

This thesis has tried to address a hypothesis and has systematically accumulated potential evidence that appears to support this contention. However, it is of course recognized that this remains speculative. It is acknowledged that indirect research can never provide conclusive historical explanations; however, indirect evidence can point to possible outcomes and consequences with a degree of probability that must be assessed in each case. This thesis has shown that there is a high probability that ergot ingestion, either through long term low level dosages or, through concentrated administration during childbirth, contributed to the population changes in the mid-eighteenth century, previously identified by the Cambridge Group.

Overall, therefore, within this thesis, more light has been thrown on the hypothesis that ergot in foodstuffs could possibly have been a factor in changes in fertility in the long eighteenth century in England. While this hypothesis cannot be shown to have been definitively supported, nevertheless it is argued that the accumulated circumstantial evidence provided in this thesis should not be ignored, and needs to be

taken into account in the population debate and be tested, or at least borne in mind, by other researchers in further parish studies.

REFERENCES

Acton E (1857) *The English bread book* Longman London

Adair RL (1991) *Regional variations in illegitimacy and courtship patterns in England 1538-1754* Unpublished PhD Thesis University of Cambridge

Akerly S (1809) *Account of the ergot or spurred rye as employed in certain cases of difficult parturition* in a letter to Dr Wp.Dewees Medical Repository New York 6 pp. 341-347

Akerstrand (1980) Ergots *Var Foda* 32 pp. 442-446 (in Swedish) cited by WHO Expert Report

Allen H C (2005) *The material medica of the nosodes secale cornutum* Online http:// www. Homeoint.org/books1/allennosodes/secalcorntutum.htm 4/4 Accessed April 2005

Anon (1682) *The English midwife enlarged* London

Anon (1739) *The farmer restored or the landed interest preserved most humbly offered to the consideration of the Right Honourable The House of Commons* London http://galenet.galegroup.com/servlet/ECCO accessed 29/07/2008

Anon *(1776) Gentleman's Magazine* London

Anon (1802) *Ipswich Journal* 31st April Issue 3603 19th century British Library Newspapers on line Accessed on 13th May 2008

Anon (1973) An onlooker's notebook: Lavender Water Leeches and Covent Garden *The Pharmaceutical Journal* volume 210 April 21st p.327

Appleby A B (1973) Disease or Famine? Mortality in Cumberland and Westmoreland 1580-1640 *The Economic History Review* New series volume 26 number 3 pp. 403-432

Ashley W (1921) The place of rye in the history of English food *The Economic Journal* 123 volume xxxi September pp. 285-308

Ashley W (1928) *The bread of our forefathers: an inquiry in economic history* Clarendon Press Oxford

Assured UK Malt Standard (2008) *The assured UK malt standard - version 3.4* January section 2.3.1 p.14

Attree J (1741) Observations relating to the cause of the present epidemic fever *London Magazine*p.610 Printed by Ackers C for Wilford J Cox T Clarke J and Astley T London

Bachelor T (1808) *General view of the county of Bedfordshire* Board of Agriculture London

Bacon R N (1844) *Report on the agriculture of Norfolk* A Prize essay on the agriculture of Norfolk London

Bailey J and G Culley (1797) *General view of the agriculture of Northumberland* S Hodgson Newcastle and (1805) 3rd edition Richard Phillips London

Baker M (1974) *Folklore and customs of rural England* David and Charles Newton Abbott

Bangh S A Hughes K A Roberts D J Kovarik S M (2005) *American Journal of Perinatology* 22: 5 pp 239-43

Barger G (1931) *Ergot and ergotism* Gurney and Jackson London and Edinburgh

Barnes H (1889) Visitation of the plague in Cumberland and Westmorland *Transactions of the Cumberland and Westmorland Society* xi pp.158-186

Bates T (1713) *Bates dispensatory* Chapter 11 p.625

Bates T (1717-1719) A brief account of the contagious disease which raged among milk cows in the year 1714 *Philosophical Transactions* volume 30 (1717-1719) pp.872-885

Baumann U Hunziker HR Zimmerli B (1985) Ergot alkaloids in Swiss grain products *Mitteilungen aus dem Gebiete der Lebensmitteluntersuchung und Hygiene* 76 pp. 609-630 (in German) cited in the WHO expert group paper

BBC Medical notes on line-leprosy http://news.bbc.co.uk/1/hi/health/medical-notes/166163.stm Accessed 21/1/08

Beatty T E (1866) *Contribution to medicine and midwifery* Fannin and Co Dublin Chapter V based on January 1834 article in Dublin Medical Journal On the means of preventing uterine haemorrhage after delivery and a paper read before the Dublin Obstetrical Society on March 1844 on 'The influence of ergot of rye on the foetus in utero

Beck T (1909) cited by Bové p.141

Berde B and Schild H O editors (1978) Ergot Alkaloids *Handbook of Experimental Pharmacology* volume 49 Springer Verlag Berlin

Berry B M and Schofield R S (1971) Age at baptism *Population Studies* volume 25 number 3 pp.453-463

Best H (1857) *Farming book 1641* Published by the Surtees Society

Bhat R V Roy D N and Tulpulep.G (1976) The nature of alkaloids of ergoty pearl millet or bajra and its comparison with alkaloids of ergoty rye and ergoty wheat *Toxicology Applied to Pharmacology* volume 36 pp. 11-17

Bigelow J (1816) On the clavus, or ergot of rye and other plants *New England Journal of Medicine and Surgery* volume 5 pp. 156-164

Blaikie N (2001) *Designing social research* Polity Press Cambridge

Blaikie N (2003) *Analyzing quantitative data* Sage Publications London

Board of Agriculture (1795) *Account of the experiment on bread* G Nicol Bookseller to His Majesty the King London

Bones J (1762) Report on Wattisham April 30th and May 6th *Philosophical Transactions* Lxxxiii pp.526-533

Bongaarts J (1980) Does malnutrition affect fecundity? A summary of evidence *Science* 208 p.564

Bongaarts J and Menken J (1983) The supply of children: a critical essay in Bulatao R A and Lee R D editors 1983) *Supply and demand for children* volume 1 Academic Press New York pp. 27-60

Bové F J (1970) *The story of ergot* S Karger Basel

Bowden P J (1985) Agricultural prices wages farm profits and rents pp.1-117 in Thirsk J *The agrarian history of England and Wales* volume 5 1640-1750 Cambridge University Press Cambridge

Bowman W C and Rand M J (1980) *Textbook of Pharmacology* 2nd Edition Section 11.4.3, 35.1 Chapter 35 Blackwell Scientific Publications Oxford

Bracken H (1737) *The midwife's companion or a treatise of midwifery: where the whole art is explained together with an account...etc* London Eighteenth Century Collections On Line Gale Group Accessed June 2006

Brereton C D (1825) *Practical enquiry into the numbers of agricultural labourers* for J Hatchard and Son London Norwich

British Medical Association and the Royal Pharmaceutical Association of Great Britain (1994) *British National Formulary* (BNF) London

Britannica Online Encyclopaedia Accessed January 2009

Bross W Cisek T CzeraduT and Kazimuniski S (1963) *The Lancet* 1 p.85 cited by Van Rensberg S J and Altenkirk B (1974) Chapter 3 in Purchase I F H Mycotoxins

Brunt L (2003) Mechanical innovation in the industrial revolution: the case of plough design *Economic History Review* volume 56 number 3 pp.444-477 August

Buchan W (1769) *Domestic medicine or the family physician* Balfour Edinburgh

Buchan W (1772) 2nd edition *Domestic medicine: or a treatise on the prevention of diseases by regimen and simple medicines* London Eighteenth Century Collections on Line Gale Accessed June 2006

Buchan W (1772) *Domestic medicine: or a treatise on the prevention of diseases by regimen and simple medicines* Strahan London

Buckheim (1859) cited by Clarke (1927)

Bulatao R A and Lee R D (1983) An overview of fertility determinants in developing countries in Bulatao RA and Lee RD editors *Determinants of fertility in developing countries* volume 2 Academic Press New York pp. 757-787

Burnett J (1989) 3rd edition *Plenty and want- a social history of food* Routledge London

Caporael L R (1976) Ergotism: the satan loosed in Salem *Science* 192 pp. 21-26

Chalmers R (1782) *An estimate of the comparative strength of Britain* printed for C Dilly and J Bowen

Chapman E (1735) (1st edition 1733) 2nd edition *A Treatise on the improvement of midwifery* Printed for Bradley J Clarke J and Corbett C London

Cheyne G (1733) *The English malady: or a treaty of nervous kinds* etc

Christison R (1829) *A treatise on poisons* Chapter 37 Adam Black Edinburgh

Christopoulos S Szilagyi A and Kahn S R (2001) Saint-Anthony's fire *The Lancet* volume 358 November 17th p.1694

Clarke A J (1927) *Do the pharmocopreal preparations of ergot contain any active principles*? Paper read to Royal College of Obstetricians and Gynaecologists 9th March

Cobbett W (1821) (1828 edition used) *Cottage economy*

Confidential Enquiry into Maternal and Child Health (CEMACH) (2008) *Perinatal mortality 2006: England Wales and Northern Ireland* CEMACH London

Counsell G (1752) *The art of midwifery or the midwife's sure guide* Bathurst London

Coutinho E M (1971) Physiologic and pharmacologic studies of the human oviduct *Fertility and Sterility* 22 pp.807-815

Coutinho E M (1975) Interference with ovum transport: implications for fertility control *Symposium on Ovum Transport and Fertility Regulation* San Antonio June 23rd-27th editors Harper M J K Panerstein C J Adams C E Scriptor Copenhagen pp.544-555

Cowper H S (1897) *The oldest register book of Hawkshead in Lancaster (1568-1704)* Bemrose and Sons London and Derby

Cowper H S (1899) *Hawkshead: The Northernmost Parish of Lancashire - its history, archaeology, industries etc* Bemrose and Sons London and Derby

Creighton C (1891-1894) *A history of epidemics in Britain* volume 1 From A D to the extinction of plague pp.52-68 Cambridge University Press

Cross H E and McKusick V A (1970) Amish demography *Social Biology* volume 17 number 2 pp. 83-101

Culpeper N (1701) *A directory for midwives* London

Curwen Archives Trust (2001) number 3 *The diary of a Kendal midwife: 1669 – 1675*

Darwin E (1791) *The botanical garden* Part 1 canto IV p.203 London

Davenant C (1771) *Political and commercial works* 5 volumes editor Sir C Whitworth London

Davies D (1795) *The case of labourers in husbandry* Published Bath Printed by Cruttwell R for GG and J Robinson London

Davies H (1825) On the secale cornutus clavus or ergot of rye *The London Medical and Physical Journal* volume 54 pp.1-7 and pp.100-102

Dawkes T (1736) *The midwife rightly instructed* London

Denman T (1782) *Introduction to the practice of midwifery* Marc Link Guardbook Conversion

Dickinson W (1876) *Cumbriana or fragments of Cumbrian life* Whitaker and Co London

Dillon P (2002) *The much lamented death of Madame Geneva - The eighteenth century gin craze* Headline books review London

Dobson M J (1989) The last hiccup of the old demographic regime: population stagnation and decline in late seventeenth and early eighteenth-century England *Continuity and Change* volume 4 issue 3 pp.395-428

Drummond J C and Wilbraham A (1958) *The Englishman's food* Jonathan Cape London

Dunn P M (1993) Adam Neale (c1780-1832) and ergot of rye *Archives of Diseases in Childhood* volume 68 pp.617-618

Dunn P.M (1997) Dr Percival Willughby MD (1596-1685): pioneer 'man' midwife of Derby *Archives of Diseases in Childhood* 76 pp. 212-213

Dunn P M (1999) Perinatal lessons from the past: The Chamberlen family (1580-1728) and obstetric forceps *Archives of Diseases of Childhood* Fetal neonatal edition volume 81 pp.232-234 November

Eaton A and Mayer J (1953) The social biology of very high fertility among the Hutterites *Human Biology* volume 25 pp.206-264

Eden F M (1797) *The state of the poor* volumes 1-3 Davis London

Etherington J (1839) *Observations on the medicinal action of the ergot of rye* Read before the Royal Medical Society of Edinburgh March 15th Essay iv MDCCCXLL Rickard Edinburgh

European Mycotoxin Awareness Network (EMAN) (2000) website e-mail eman@leatherheadfood.com, http://www.lfra.co.uk/eman2/fsheet14.asp Accessed on Feb 2005

Evenden D (2000) *The midwives of seventeenth century London* Cambridge University Press Cambridge

Fay C R (1923) The miller and the baker: a note on commercial transactions 1770-83 *Cambridge Historical Journal* volume 1 pp.85-91

Fell J (1891) Some illustrations of home life in Lonsdale north of the sands in the 17th and 18th century *Transactions of the Cumberland and Westmorland Society* xi pp.368-398

Finlay R (1980) Distance to church and registration experience *Local Population Studies* number 24 pp. 26-40

Flinn M W (1970) *British population growth 1700-1850* Studies in economic and social history Macmillan Press Ltd London

Floud R Wachter K and Gregory A (1990) *Height, health and history: nutritional status in the United Kingdom 1750-1980* Chapter 5 Cambridge University Press Cambridge

Fogel R W (2004) *The escape from hunger and premature death 1700-2100* Cambridge University Press Cambridge

Freind J (1700-1701) *A letter in Latin* dated Christ Church March 31st p.799

Frisch R E (1977) Population food intake and fertility *Science* volume 199 6th January pp.22-30

Frisch R E (1983) Population nutrition and fecundity: significance for interpretation of changes in fertility in Eberstradt E editor *Fertility decline in less developed countries* pp.319-336 Praeger New York

Giffard W (1734) *Cases in midwifery* revised and edited by Edward Hody London

Goodman and Gilman (1975) *The Pharmacological Basis of Therapeutics* 5Th edition Chapter 42 p.872

Gordon A (1795) *A treatise on the epidemic puerperal fever of Aberdeen* Robinson G G and J London

Gras N S B (1915) *The evolution of the English corn market from the 12th to the 18th century* Harvard Press Cambridge

Grasso V (1957) cited by Bové (1970) p.39

Gray R (1983) The impact of health and nutrition on national fertility in Bulatao R A and Lee R D editors volume 1 *Supply and demand for children* Academic Press New York pp.139-162

Grot (1887) cited by Bové p.163

Grundy I (1995) Sarah Stone: enlightened midwife in Porter R *Medicine in the Enlightenment* Rodophi Amsterdam pp.128-144

Habakkuk H J (1965) English population in the eighteenth century pp.269-284 in Glass D V and Eversley D E C *Population in history* Edward Arnold London Originally published in Economic Review 2nd series volume 6 1953 pp.117-133

Habakkuk H J (1971) *Population and economic development since 1750* Leicester University Press Leicester

Hales S (1734) *A friendly admonition to the drinkers of brandy, and other distilled spirituous liquors* London

Hamilton A (1781) *A treatise on midwifery*

Hardy A (1988) Diagnosis death and diet: the case of London 1750-1909 *Journal of Interdisciplinary History* volume 18 number 3 winter pp.387- 401

Hardy A *(1991)* Book review of Poisons of the past. *Journal of Interdisciplinary History* volume 21 number 5 pp.509-513

Harley D (1990) Historians as demonologists: the myth of the midwife-witch *Social History of Medicine* volume 3 number1 April pp.1-26

Harley D (1994) Provincial midwives in England: Lancashire and Cheshire 1660-1760 Chapter 2 pp 27-48 in Marland H *The Art of Midwifery* Routledge London

Hart N (1993) Famine maternal nutrition and infant mortality: a re-examination of the Dutch Hunger *Population Studies* Winter volume 47 pp.27-46

Hart N (1998) Beyond infant mortality: gender and still birth in reproductive mortality before the twentieth century *Population Studies* volume 52 number 2 pp. 215-229

Harte (1764) *Essays on husbandry in the past Essay 1: a general introduction* Printed for Frederick W London

Hecke L (1921) cited by Barger (1931) pp.96, 99-100

Henry D (1771) *The compleate English farmer* Eighteenth Century Collections on Line Gale Group Accessed 25 /05/2006

Henry L (1961) Some data on natural fertility *Eugenics Quarterly* 6 pp.81-91

Henslow Rev (1841) *Journal of Agricultural Society of England* volume 2 pp.4-19 Section 9 on Ergot John Murray London

Hess A G (1994) Midwifery practice among the Quakers in southern rural England in the 17th century Chapter 3 pp.49-76 in Marland H *The art of midwifery* Routledge London

Hinde A (2003) *England's population : a history since the doomsday survey* Hodder Arnold London

Hofman A (1972) Ergot – A rich source of pharmacologically active substances in Swain T *Plants in the development of modern medicine* pp.235- 260 Harvard University Press Cambridge Mass

Holmes G, Martin E, Tabua S (1969) Mesenteric vascular occlusion in pregnancy: suspected ergot poisoning *Medical Journal of Australia* 2 pp.1009-10

Holt J (1795) *General view of County of Lancaster: with observations on the means of its improvement* G Nicol London

Hosack D (1822) *Essays on various subjects of medical science* number 19 Observations on ergot 2 pp.295-301

Hosack D (1824) *Letter to James Hamilton* Professor of Obstetrics in the University of Edinburgh dated June 2 1822 New York

Houghton J (1692-1703) *A collection of letters for the improvement of husbandry and trade London* Reprinted by Rogers T History of agriculture and prices volume 6 pp.101-198

Hunter W (around 1770) *In his lectures* p.91 cited by Wilson D (1995 p.181)

Huston R M (1829) Midwifery: on the dangerous effects of secale cornutum *North American Medical and Surgical Journal* volume lxii pp.181-184

Geissler C and Oddy D J (1993) Food diet and economic change Leicester University Press Leicester

Jenkins H M (1869) The Lodge Farm Castle Acre Norfolk in the occupation of Mr John Hudson *Journal of the Royal Agricultural Society of England* 2nd series volume 5 pp.460-74

Johnstone R W (1952) *William Smellie: the master of British midwifery* E S Livingstone Ltd Edinburgh and London

Kent N (1775) *Hints to gentlemen of landed property* London

Kent N (1791) Exported produce of Norfolk in *Annals of agriculture* volume 22 London

Kent N (1794a) *Agricultural survey of Norfolk* London

Kent N (1794b) Exported produce of Norfolk in Young A editor *Annals of agriculture* volume 22 pp. 35-45 London

Kent N (1796) *Agricultural survey of Norfolk* London

Kent N L (1984) *Technology of cereals* 3rd edition Pergamon Press Oxford

Kerridge E (1967) *The agricultural revolution* A M Kelley London

Knodel J (1988) *Demographic behaviour in the past: a study of fourteen German populations in the eighteenth and nineteenth centuries* Cambridge University Press Cambridge

Kobert R (1899) Mutterkorn in Geissler E and Moeller J *Real-Encyclopadie der Gesamten Pharmacie* 7 Bd pp.172-198 Urban and Schwarzenberg Wien

Kraicerp F and Shelesnyak M C (1964) Studies on the mechanism of nidation 9 Analysis of the responses to ergocornine *Journal of Reproduction and Fertility* volume 8 pp.225-233

Lamb H H (1969) Climatic Fluctuations General Climatology 2 *World survey of climatology* volume 2 editor H Flohn Elsevier Publisher pp.173-244

Lamb H H (1977*) Climate present and past and future* volume 2 Methuen London

Lancashire Parish Register Society volumes 1-78

Landers J (1993) *Death and the metropolis* Cambridge University Press Cambridge

Landes D S and Tilly C (1971) editors *History as social science* Prentice Hall Englewood Cliffs

Langdon R F (1954) New species of Claviceps *University of Queensland Papers* 3 pp.39-40

Laslett P (1980) Introduction: comparing illegitimacy over time and between cultures in Laslett P Oosterveen K and Smith RM *Bastardy and its comparative history* Edward Arnold Publisher for Cambridge Group for the History of Population and Social Structure

Laslett P Oosterveen K and Smith R M editors (1980) *Bastardy and its comparative history*: studies in the history of illegitimacy and marital nonconformism in Britain etc Edward Arnold London

Laxton P and Williams N (1989) Urbanisation and infant mortality in England: a long term perspective and review in Nelson M C and Rogers J *Urbanisation and the epidemiological transition* Uppsala University Press pp.109-135

Leake J (1772) *An introduction to the theory and practice of midwifery* London

Leake J (1792) *Practical observations on the child birth fever* Walter London

Leigh C (1702) *Philosophical Transactions* 23 p.1174 June 26th

Leininger M M (1985) Nature rationale and importance of qualitative research methods in nursing in Leininger M M editor *Qualitative research methods in nursing* Grune and Stratton Inc Orlando

Leonard K Leonard G O G (1968) editors *The second register book of the Parish of Hawkshead in the diocese of Carlisle and the County of Lancaster* 1705-1797 Hawkshead Parochial Church Council

Leonard K (1971) editor *A register of births and baptisms deaths and burials 1788-1812 and of baptisms and burials 1813-1837 in the Parish of Hawkshead Lancashire* Research Publishing Co London for Hawkshead Parochial Church

Leridon H (1977) *Human fertility: the basic components* University of Chicago Press Chicago

Levene A (2005) The estimation of mortality at the London Foundling Hospital 1741-99 *Population Studies* volume 59 number 1 pp.87-97

Levine D and Wrightson K (1980) The social context of illegitimacy in early modern England in Laslett P Oosterveen K and Smith R M (1980) *Bastardy and its comparative histor*y Edward Arnold Publisher for Cambridge Group for the History of Population and Social Structure

Lewis G (2007) editor *Saving mothers' lives: reviewing maternal deaths to make motherhood safer 2003-2005 - The seventh sixth report of confidential enquiries into maternal deaths in the United Kingdom* CEMACH London

Lewis G and CEMACH (2006) *Why mothers die 2000-2002 The sixth report* of *confidential enquiries into maternal deaths in the United Kingdom* CEMACH London M Magora F Rogel S Romanoff H (1970) *Angiology* 21 p.565

Lonicer A (1582) *Krauter-Buch Barthomai Ulum* cited by Bové p.164

Loudon I (1992) *Death in childbirth (1800-1950): an international study of maternal mortality* Clavendon Press Oxford

Lumey L H and van Poppel F W A (1994) The Dutch Famine of 1944-45 Mortality and morbidity in past and present generations *Social History of Medicine* Number 7 Volume 2 August pp. 229-46

MacFarlane A (1970) *Witchcraft in Tudor and Stuart England* Harper and Row London

Magpie Trial Co-ordinating Centre (2004) The Magpie trial follow up study *Pregnancy and Childbirth* 4:5 Oxford

Maitland W (1756) *History of the survey of London*

Malthus T R (1798) *An essay on the principle of population* editor Appleman P Norton and Company London

Manningham R (1744) *An abstract of midwifery for the use of the lying-in Infirmary* London

Mantle P G (1969) The role of alkaloids in the poisoning of mammals by sclerotia of claviceps spp *Journal of Stored Products Research* Pergamon Press volume 5 Part 3 pp.237-244

Marland H (1994) *The art of midwifery* Routledge London

Marshall W (1783) *The rural economy of Norfolk* London

Marshall W (1795) The rural economy of Norfolk: comprising the management of landed estates and the present practice of husbandry 2nd edition volume 1 London Eighteenth century books on line Gale Group http://galenet.galegroup.com/servlet/ECCo Accessed 3/10/207

Marshall W (1808) *Review of reports to the Board of Agriculture* T Wilson and Son London

Mathias P 1959 *The brewing industry in England 1700-1830* University of Cambridge Press Cambridge

Matossian M K (1985) Death in London 1750-1900 *Journal of Interdisciplinary History* 16 pp.183-197

Matossian M K (1989) *Poisons of the past: molds epidemics and history* Yale University Press New Haven and London

McKeown T (1976) *The modern rise of population* Arnold London

Medawar P B (1964) Is the scientific paper a fraud? in Edge D editor *Experiment* BBC Publications London

Mellanby E (1934) *Nutrition and disease: the interaction of clinical and experimental work* Oliver and Boyd Edinburgh

Mellanby E (1950) *The story of nutritional research: the effect of some dietary factors on bones and the nervous system* The William and Wilkins Company Baltimore

Merriman S (1820) *A synopsis of the various kinds of difficult parturition* 3rd edition London

Michell W (1828) *On difficult cases of parturition and the use of ergot of rye* Thomas and George Underwood London

Miller P (1724) *The gardener's dictionary* second edition 1733 Rivington London

Moir J C (1932) Ergot preparations and the puerperal uterus *The British Medical Journal* June 18th pp.1119-1122

Moir J C (1955) The history and present-day use of ergot *The Canadian Medical Association Journal* 72 pp.737-734

Moir J C (1974) Ergot: From St Anthony's fire to the isolation of its active principle, ergometrine (ergonovine) *American Journal of Obstetrics and Gynecology* 120:2 pp.291-296

Moldenke H N and Moldenke A L (1952) *Plants of the bible* Chronica Batannica Co Waltham Mass

Morgan M T (1930) Report on an outbreak of alleged ergot poisoning by rye bread in Manchester *Journal of Hygiene* volume xxix p.51

Mortimer J (1721) The whole art of husbandry: or, the way of improving the land volume 1 London Eighteenth Century on Line Gale Group http://galenet.galegroup.com/servelet/ECCo_Accessed 16/11 2007

Neale A (1828) On difficult cases of parturition and the use of ergot of rye: *Researches respecting the natural history chemical analysis and medical virtues of the spur or ergot of rye, when administered as a remedy in certain states of the uterus* Horatio Phillips London

Neeson J M (1993) *Commoners: common right, enclosure and social change in England 1700-1820* University of Cambridge Press Cambridge

Nichols (1700) *History of Leicestershire* part 2 p.366 cited by Creighton1894 p.61 but not traced or initial found

Nihell E (1760) *A treatise on the art of midwifery: setting forth various abuses there in especially as to the practice with instruments* Morley London

O'Gorman F (1997) *The long eighteenth century: British political and social history 1688-1832* Arnold London

Oosterveen K Smith R M (1980) Bastardy and the family reconstitution studies of Colyton Aldenham Alcester and Hawkshead in Laslett P Oosterveen K and Smith R M (1980) *Bastardy and its comparative history* Edward Arnold Publisher for Cambridge Group for the History of Population and Social Structure

Osborn W (1792) *Essays on the practice of midwifery in natural and difficult labours* London

Ould F (1742) *A treatise of midwifery* Dublin

Outhwaite R B (1991) *Dearth, public policy and social disturbance in England 1550- 1800* Studies in economic and social history Macmillan Educational Hampshire

Overton M (1989) Agricultural history volume 63 number 2 *Climate Agriculture and History* Spring pp.77-88

Overton M (1996) *Agricultural revolution in England* Cambridge University Press

Passmore J B (1930) The English plough in *The handbook of the collections illustrating agricultural implements and machinery* H M Stationery Office London

Paterson J (1838) Interesting midwifery case with remarks *London Medical Gazette* volume 2 series 1837-38 September 8th pp.935-937

Penn W (1694) *A brief account of the rise and progress of the people called Quakers* London

Penny N (1920) editor *Account book of Sarah Fell of Swarthmore Hall 1673-1678* Cambridge

Percival (1807) *Observations on the state of population in Manchester* 1774 Works 4

Oxford English Dictionary and Thesaurus (1987)

Phillips E M Pugh D S (1987) *How to get a PhD* Open University Press Milton Keynes

Polit D F and Hungler (1991) *Nursing research principles and methods* Lippincott Company London

Popper K (1972) *The logic of scientific discovery* 3rd edition Hutchinson London

Porter G R (1847) *The progress of the nation* new edition 1851 John Murray London

Porter G R (1851) *The progress of the nation* John Murray London

Porter R (1992) The rise of medical journalism in Britain to 1800 pp.6-28 in Bynum W F Look S Porter R *Medical journals and medical knowledge: historical essays* Routledge London

Prescott O (1813) *A dissertation on the natural history and effects of secale cornutum or ergot* Read at the annual meeting of the Massachusett's Medical Society June 2nd

Prescott O (1813) *A dissertation on the natural history and medicinal effects of the secale cornutum or ergot* Cummings and Hilliard Andover

Pringle G A (1794) *General view of the agriculture of the county of Westmoreland* Chapman Co Edinburgh

Prothero R E (1888) *The pioneers and progress of English farming* Longman and Co London

Rabb T K and Rotberg R I (editors) (1985) *Hunger and history: the impact of changing food production and consumption patterns on society* Cambridge University Press Cambridge

Ramsbottom Dr (1839) Medical Intelligence *London Medical Gazette* 15th June

Rang H P and Dale N M (1991) 2nd edition *Pharmacology* Churchill Livingstone Edinburgh

Rathlauw J P (1947) a paper in Danish cited by Barger G (1931) pp.12-13

Ray J (1677) *Catalogus plantarus anglioe* Clark London

Razzell P (1998) The conundrums of eighteenth century English population growth *Social History of Medicine* volume 2 number 3 pp. 469-500

Razzell P (2007) *Population and disease: transforming English Society 1550-1850* Caliban Books London

Rham W L (1760) *The compleat farmer*

Rham W L (1844) *Dictionary of the farm 1675*

Rham W L (1853) *Dictionary of the farm 1675* S V Rye Mortimer Systema Agriculture 2nd edition Raynbird

Riches N (1967) *The agricultural revolution in Norfolk* Frank Cass and Co Ltd London

Richmond L Stevenson J Turton A editors (2003) *The pharmaceutical industry: a guide to historical records* Ashgate

Robertson G (1795) *General view of the agriculture of the county of Mid-Lothian with observations on the means of its improvement Drawn up for the consideration of the Board of Agriculture and Internal Improvement* Printed by J Ruthven and Sons for G Nicol London

Robson J M Lewis T L T (1952) Ergot and its derivatives in clinical practice *The Practitioner* Current Therapeutics volume169 September pp.294-298

Rogers AGL (1902) *History of agriculture and prices* volume 7 pt 2 Clarendon Press Oxford

Rogers A G L (1922) Was rye ever the ordinary food of the English? *The Economic Journal* volume 32 number 125 March pp.119-124

Rogers J E T (1866) *History of agriculture and prices* volume 1 Clarendon Press Oxford pp.26-27 and volume 7 1703-1793

Rogers J E T (1866-1902) *History of agriculture and prices* Clarendon Press Oxford

Rogers J E T (1884) *Six centuries of work and wages* Swan Sonnenschein's and Co London

Rogers J E T (1908) *Six centuries of work and wages* Swan Sonnenschein's and Co London

Royal Society (1702) *Philosophical Transactions* volume 22 Oxford

Royal Society (1702) *Philosophical Transactions* volume 52 pp. 523-526 and pp.529-533 Letters from Charlton Wollaston and Rev Bones concerning ergotism in Wattisham in Suffolk 1762

Salaman R (1989) *The history and social influence of the potato* Cambridge University press

Santow G (1995) *Coitus interruptus* and the control of natural fertility *Population Studies* volume 49 pp.19-43

Schofield R (1985) English marriage patterns revisited *Journal of Family History* Spring pp.2-20

Schofield R S (1970) Perinatal mortality in Hawkshead Lancashire *Local Population Studies Magazine and Newsletter* number 4 Spring pp.11-16 Nottingham University Department of Adult Education

Scott P .M and Lawrence G A (1982) Losses of ergot alkaloids during making of bread and pancakes *Journal of Agriculture and Food Chemistry* 30 pp.445-450

Sharp J (1725) 4th edition *The compleat midwife's companion or the art of midwifery improved* Marsall London

Shelesnyak M C (1961) Further studies on the mechanism of ergocornine interference with hormonal requirements for decidualization and nidation *Bulletin de la Societe Royale Belge de Gynecologie et d'Obstetrique* volume 31 pp.375-379

Shelesnyak M C (1986) Nidation: a symposium held in honour of Professor M C Shelesnyak editor Series *Annals of the New York Academy of Sciences* volume 476 New York Academy of Sciences New York

Shelesnyak M C Lunenfeld B and Hoig B (1963) Studies on the mechanism of ergocornine interference with decidualization and nidation *Life Sciences* number 1 pp.73 – 79

Short T (1750) *New observations natural moral civil political medical: on city town and country bills of mortality etc* Longman T and Millar A

Smellie W (1794) *Treatise on the theory and practise of midwifery* 3 volumes Murray London

Smith C (1804) *Tracts on the corn trade and corn laws* Stockdale London

Smith R M (1980) Family reconstitution and the study of bastardy: evidence from certain English parishes in Laslett P Oosterveen K and Smith R M *Bastardy and its comparative history* Edward Arnold Publisher for Cambridge Group for the History of Population and Social Structure

Smith R M (1981) Fertility, economy and household formation in England over three centuries *Population and Development Review* 7 pp. 595-622

Smith R M (1999) Relative prices forms of agrarian labour and female marriage patterns in England 1350-1800 in Devos I and Kennedy L *Marriage and Rural Economy Western Europe since 1400* pp.19-48 Brepols Turnhout

Spencer A J and Passmore J B (1930) *Handbook of the collections illustrating agricultural implements and machinery* HMSO London

Spiegel F (1971) editor *A small book of grave humour*

Stearns J (1807) Account of pulvis parturiens: a remedy for quickening childbirth *Medical Philosophy News* pp.308-309

Stearns J (1808) An account of the pulvis parturiens: a remedy for quickening child-birth *Medical Repository of New York* 5 pp.308-309

Stoll A (1952) *Ergot through the ages* Lecture delivered at the Indian Science Congress Calcutta January

Stoll A (1965) Ergot - a treasure house for drugs *The Pharmaceutical Journal* 194 pp.605-613

Stone S (1737) *A complete practice of midwifery* London

Stratton J M (1969) *Agricultural records AD 220-1968* editor R Whitlock John Baker London

Stratton J M (1978) *Agricultural records A.D. 220-1977*

Swarthmore monthly meetings (1675) *Women's meeting minute book 1671-1700* minute 10/12 75 CuRO BBFc/F/2/5

Sylvan A (1776-1780) The farmer's magazine Article 13, 5 volumes Eighteenth century books on line http://galenet.galegroup.com/servlet/ECCO

Tansey E M (2001) Ergot and Ergometrine: An obstetric renaissance in Conrad L Hardy A *Women and modern medicine* Chapter 9 pp.195-216 Rodopi Amsterdam

Taube J (1782) cited by Barger pp.73 and 268

Taylor A S (1854) editor *Medical Jurisprudence:* poisons p.622

Thirsk J (1967 1984 1985) *Cambridge agrarian history* volumes 4 and 6 and 7 Cambridge

Thirsk J (1987) *England's agricultural regions and agrarian history 1500 - 1750* Macmillan Basingstoke

Thirsk J and Cooper J P (1972) *Seventeenth century economic documents* Cambridge Press Oxford

Thompson C J S (1929) *The mystery and art of the apothecary*

Tietze C (1957) Reproductive span among Hutterites *Fertility and Sterility* volume 8 number1 pp.89-97

Tooke T (1838*) History of prices* volume 1 Printed for Longman Orme Brown Green and Longman

Trumbach R (1978) *The rise of the egalitarian family, aristocratic kinship and domestic relations in the Eighteenth Century* Academic Press New York London

Tulasne L R (1853) cited by Barger p.270

Turner M E (1984) *Enclosures in Britain 1750-1830* Studies in economic and social history Basingstoke

Tyler V E (1961) Biosynthesis of the ergot alkaloids *Journal of Pharmaceutical Science* 50 pp.629 - 640

Van Rensburg S J and Altenkirk B (1974) Claviceps Purpura- Ergotism in Purchase IFH *Mycotoxins* Elsevier Scientific Publisher Amsterdam Chapter 3 pp.69-96

Vernon J (2007) *Hunger* Harvard University Press Cambridge Mass. and London

Versluysen M C (1981) Midwives, medical men and poor women labouring with child: lying-in hospitals in eighteenth century London pp.18-49 and p.31 in Roberts H *Women health and reproduction* Routledge London

Ward E (exact date not known - given as 1710 or 1714) *The whole pleasures of matrimony* London Eighteenth Century Collections Online Gale Group Accessed June 2006

Wasicky R (1913) Paper in German cited by Barger G p.227

Weber M (1947) *The theory of social and economic organisation* Translated by Henderson A M Parson T The Free Press of Glencoe London

Weir D R (1984) Rather never than late: celibacy and age at marriage in English cohort fertility *Journal of Family History* 9:4 Winter Special Issue on Spinsterhood pp.340-354

White C (1772) *A treatise on the management of pregnant and lying-in women* London

White G (1778) Letter Lxxix *Natural history of Selbourne*

WHO International programme on chemical safety (IPCS) (1990) *Environmental Health Criteria 105 Selected Mycotoxins: Ochratoxins trichothecenes ergot* http://www.inchem.org/documents/ehc/ehc/ehc105 Accessed on 25/02/2005

Wilkinson L (1990) Book review *Medical History* 34 pp.446-447

Willughby P (1863) (Practised 1630-1670) *Observations in midwifery: as also the country midwife's opusculum or vade mecum* Blenkinsop H (ed) with a new introduction by Thornton J L (1972) SR Publishers Wakefield

Wilson A (1990) The ceremony of childbirth and its interpretation in Fildes V editor *Women as mothers in pre-industrial England* pp.67-107 Routledge London and New York

Wilson A (1995) *The making of man-midwifery: childbirth in England 1660-1770* UCL London

Wollaston C (1762) Extract of letter in the case of John Downing April 13th *Philosophical Transactions* Lxxxiii pp.523-6

Woodforde Parson (1924-1931) *Diary of a country parson 1758-1802* editor John Beresford 5 volumes London

Woods R (2005) The measurement of historical trends in fetal mortality in England and Wales *Local Population Studies* volume 59 number 2 pp.147-162

World wide words-on line Accessed June 2006

Wright S (1840) An experimental inquiry into the physiological action of ergot of rye *Edinburgh Medical and Surgical Journal* 53rd edition J Stark

Wright T (1838*) Early mysteries and other Latin poems of the 12th and 13th centuries* MARC Link Guardbook conversion

Wrigley E A Schofield R S (1989) *The population history of England* Edward Arnold Ltd London

Wrigley E A (1987) *People cities and wealth* Oxford

Wrigley E A (1998) Explaining the rise in marital fertility in England in the long eighteenth century *Economic History Review* volume 51 number 3 pp.435-464

Wrigley E A (2004) *Poverty progress and population* Cambridge University Press Cambridge

Wrigley E A and Schofield R S (1981*) The population history of England 1541-1871* Edward Arnold London

Wrigley E A and Schofield R S (1989*) The population history of England 1541-1871* Cambridge Group for the history of population and social structure Cambridge University Press Cambridge

Wrigley E A Davies R S Oeppen J E and Schofield R S (1997) *English population history from family reconstitution 1580-1837* Cambridge University Press

Yarham D J (1993) Ergot of cereals: a literature review and survey of incidence in traded grain *Home grown cereal authority research review 25* http://www.hgca.com/cms_publications output Accessed on 2 /5/2008

Young A (1770) *Six month tour of the North of England* Dublin

Young A (1771) *Farmers' letters* 3rd edition volume 1 Strahan London

Young A (1794) *Travels in France* 1787-9 volume 2 Dublin edition

Young A (1796*) Annals of agriculture* volume 25

Young A (1804) *General view of the agriculture of Norfolk* McMillan London

Young J C (1981a) Variability in the content and composition of alkaloids found in Canadian ergot I Rye *Journal of Environmental Science and Health* B16:1 pp.381-393

Young J C (1981b) Variability in the content and composition of alkaloids found in Canadian ergot II Rye *Journal of Environmental Science and Health* B16:4 pp. 83-111

Young J C Chen Z (1982) Variability in the content and composition of alkaloids found in Canadian ergot III Triticale barley and rye *Journal of Environmental Science and Health* B17:2 pp.93-107

Young J C Chen Z Marquardt R R (1983) Reduction in alkaloid content of ergot sclerotia by chemical and physical treatment *Journal of Agriculture and Food Chemistry* 31 p.413

BIBLIOGRAPHY

PRIMARY SOURCES

Manuscripts and Documents

Moir Sir John Chassar (1900-1997) *Private papers* S2/1-10
Special collection at Royal College of Obstetricians and Gynaecologists London
Swarthmore monthly meetings (1675-1700) *Women's meeting minute book 1671-1700* minute 10/12 75 Cumbria records CuRO BBFc/F/2/5 Barrow-in-Furness Archives
Thomas Morson and Sons Ltd- records of their pharmaceutical business Wellcome Library Archives (SA/MOR/G.1 p.12)
Thompson E (17th century) *The Kendal midwife's diary (1669-1675)* WD/Cr/11/60 Cumbria records Kendal Archives Kendal (Also reproduced by Curwen Archives Trust (2001) number 3 *The diary of a Kendal midwife: 1669 – 1675)*

Registers and account books in transcriptions in Barrow-in-Furness Archives

Cowper H S (1897) *The oldest register book of Hawkshead in Lancaster (1568-1704)* Bemrose and Sons London and Derby
Leonard K Leonard G O G (1968) editors *The second register book of the Parish of Hawkshead in the diocese of Carlisle and the County of Lancaster 1705-1797* Hawkshead Parochial Church Council
Leonard K (1971) editor *A register of births and baptisms deaths and burials 1788-1812 and of baptisms and burials 1813-1837 in the Parish of Hawkshead* Lancashire Research Publishing Co London for Hawkshead Parochial Church
Penny N (1920) editor *Account book of Sarah Fell of Swarthmore Hall 1673-1678* Cambridge

Printed contemporary sources in the long eighteenth century (1688-1832) researched at the National Library for Scotland special collections, the University of Edinburgh special collections, and from online resources.

Agriculture

Anon (1739) *The farmer restored or the landed interest preserved most humbly offered to the consideration of the Right Honourable The House of Commons* London http://galenet.galegroup.com/servlet/ECCO accessed 29/07/2008

Anon (1776) Letter *Gentleman's Magazine* London

Bacon R N (1844) *Report on the agriculture of Norfolk* A Prize essay on the agriculture of Norfolk London

Attree J (1741) Observations relating to the cause of the present epidemic fever *London Magazine* p. 610 Printed by Ackers C for Wilford J Cox T Clarke J and Astley T London

Barnes H (1889) Visitation of the plague in Cumberland and Westmorland *Transactions of the Cumberland and Westmorland Society* xi p158-186

Bates T (1717-1719) A brief account of the contagious disease which raged among milk cows in the year 1714 *Philosophical Transactions* volume 30 (1717-1719) pp. 872-885

Best H (1857) *Farming book* 1641 Published by the Surtees Society

Brereton C D (1825) *Practical enquiry into the numbers of agricultural labourers* for J Hatchard and Son London and Norwich

Darwin E (1791) *The botanical garden* Part 1 canto IV p. 203 London

Davies D (1795) *The case of labourers in husbandry* Published Bath Printed by Cruttwell R for G G and J Robinson London

Eden F M (1797) *The state of the poor* volumes 1-3 Davis London

Harte (1764) *Essays on husbandry in the past Essay 1: a general introduction* Printed for Frederick W London

Henry D (1771) *The compleate English farmer* Eighteenth Century Collections On Line Gale Group Accessed 25 /05/2006

Houghton J (1692-1703) A collection of letters for the improvement of husbandry and trade London Reprinted by Rogers J E T *History of agriculture and prices* volume 6 (1866-1902) pp.101-198
Lonicer A (1582) *Krauter-Buch Barthomai Ulum* cited by Bové p. 164
Miller P (1724) *The gardener's dictionary* second edition 1733 Rivington London
Mortimer J (1721) *The whole art of husbandry: or the way of improving the land* volume 1 London Eighteenth Century On line Gale Group http://galenet.galegroup.com/servelet/ECCO Accessed 16/11 2007
Ray J (1677) *Catalogus plantarus anglioe* Clark London
Rham W L (1760) *The compleat farmer*
Rham W L (1844) *Dictionary of the farm 1675*
Rham W L (1853) *Dictionary of the farm 1675* S V Rye Mortimer Systema Agriculture 2nd edition Raynbird
Sylvan A (1776-1780) *The farmer's magazine* Article 13, volume 5 Eighteenth century books On line http://galenet.galegroup.com/servlet/ECCO
Young A (1770) *Six month tour of the North* of England Dublin
Young A (1771) *Farmers' letters* 3rd edition volume 1 Strahan London
Young A (1794) *Travels in France 1787-9* volume 2 Dublin edition

Board of Agriculture

Bachelor T (1808) *General view of the county of Bedfordshire* Board of Agriculture London
Bailey J and Culley G (1797) *General view of the agriculture of Northumberland* S Hodgson Newcastle and (1805) 3rd edition Richard Phillips London
Board of Agriculture (1795) *Account of the experiment on bread* G Nicol Bookseller to His Majesty the King London
Holt J (1795) *General view of County of Lancaster: with observations on the means of its improvement* G Nicol London
Kent N (1791) Exported produce of Norfolk in *Annals of agriculture* volume 22 London
Kent N (1794a) *Agricultural survey of Norfolk* London

Kent N (1794b) Exported produce of Norfolk in Young A editor *Annals of agriculture* volume 22 pp. 35-45 London

Kent N (1796) *Agricultural survey of Norfolk* London

Marshall W (1783) *The rural economy of Norfolk* London

Marshall W (1795*) The rural economy of Norfolk: comprising the management of landed estates and the present practice of husbandry* 2nd edition volume 1 London Eighteenth century books On line Gale Group http://galenet.galegroup.com/servlet/ECCo Accessed 3/10/207

Marshall W (1808) *Review of reports to the Board of Agriculture* T Wilson and Son London

Pringle G A (1794) *General view of the agriculture of the county of Westmoreland* Chapman Co Edinburgh

Robertson G (1795) *General view of the agriculture of the county of Mid-Lothian with observations on the means of its improvement* Drawn up for the consideration of the Board of Agriculture and Internal Improvement Printed by J Ruthven and Sons for G Nicol London

Young A (1796) *Annals of agriculture* volume 25

Young A (1804) *General view of the agriculture of Norfolk* McMillan London

Economic, social and general commentary

Chalmers R (1782) *An estimate of the comparative strength of Britain* printed for C Dilly Cobbett W (1821) (1828 edition used) *Cottage economy*

Davenant C (1771) *Political and commercial works* 5 volumes editor Sir C Whitworth London

Kent N (1775) *Hints to gentlemen of landed property* London

Maitland W (1756) *History of the survey of London*

Malthus T R (1798) *An essay on the principle of population* editor Appleman P Norton and Company London

Percival (1807) *Observations on the state of population in Manchester 1774* Works 4

Penn W (1694) *A brief account of the rise and progress of the people called Quakers* London

Short T (1750) *New observations natural moral civil political medical: on city town and country bills of mortality etc* Longman T and Millar A
Smith C (1804) *Tracts on the corn trade and corn laws* Stockdale London
White G (1778) Letter Lxxix *Natural history of Selbourne*
Woodforde Parson (1924-1931) *Diary of a country parson 1758-1802* editor John Beresford 5 volumes London

Medicine

Buchan W (1769) *Domestic medicine or the family physician* Balfour Edinburgh
Buchan W (1772) 2nd edition *Domestic medicine: or a treatise on the prevention of diseases by regimen and simple medicines* London Eighteenth Century Collections On line Gale Accessed June 2006
Buchan W (1772) *Domestic medicine: or a treatise on the prevention of diseases by regimen and simple medicines* Strahan London
Hales S (1734) *A friendly admonition to the drinkers of brandy, and other distilled spirituous liquor*s London

Midwifery

Anon (1682) *The English midwife* enlarged London
Bracken H (1737) *The midwife's companion or a treatise of midwifery: where the whole art is explained together with an account...etc* London Eighteenth Century Collections On Line Gale Group Accessed June 2006
Chapman E (1735) (1st edition 1733) 2nd edition A *Treatise on the improvement of midwifer*y Printed for Bradley J Clarke J and Corbett C London
Cheyne G (1733) *The English malady: or a treaty of nervous kinds etc*
Counsell G (1752) *The art of midwifery or the midwife's sure guide* Bathurst London
Culpeper N (1701) *A directory for midwives* London
Dawkes T (1736) *The midwife rightly instructed* London
Denman T (1782) *Introduction to the practice of midwifery* Marc Link Guardbook Conversion
Giffard W (1734) *Cases in midwifery* revised and edited by Edward Hody London

Gordon A (1795) *A treatise on the epidemic puerperal fever of Aberdeen* Robinson G G and J London

Hamilton A (1781) *A treatise on midwifery*

Hunter W (around 1770) *In his lectures* p. 91 cited by Wilson D (1995 p. 181)

Leake J (1772) *An introduction to the theory and practice of midwifery* London

Leake J (1792) *Practical observations on the child birth fever* Walter London

Manningham R (1744) *An abstract of midwifery for the use of the lying-in Infirmary* London

Nihell E (1760) *A treatise on the art of midwifery: setting forth various abuses there in especially as to the practice with instruments* Morley London

Osborn W (1792) *Essays on the practice of midwifery in natural and difficult labours* London

Ould F (1742) *A treatise of midwifery* Dublin

Sharp J (1725) 4th edition *The compleat midwife's companion or the art of midwifery improved* Marsall London

Smellie W (1794) *Treatise on the theory and practice of midwifery* 3 volumes Murray London

Stone S (1737) *A complete practice of m*idwifery London

Ward E (exact date not known - given as 1710 or 1714) *The whole pleasures of matrimony* London Eighteenth Century Collections On line Gale Group Accessed June 2006

White C (1772) *A treatise on the management of pregnant and lying-in women* London

Willughby P (1863) (Practised 1630-1670) *Observations in midwifery: as also the country midwife's opusculum or vade mecum* Blenkinsop H (ed) with a new introduction by Thornton J L (1972) SR Publishers Wakefield

Sources of Information on ergot by century

Eighteenth century

Bates (1713) *Bates dispensatory* Chapter 11 p. 625

Bones J (1762) Report on Wattisham April 30th and May 6th *Philosophical Transactions* L xxxiii pp. 526-533

Freind J (1700-1701) A letter in Latin dated Christ Church March 31st *Philosophical Transactions* p. 799

Leigh C (1702) A letter *Philosophical Transactions* 23 p. 1174 June 26th

Royal Society (1702) A letter *Philosophical Transactions* volume 22 Oxford

Royal Society (1762) A letter from Rev Bones concerning ergotism in Wattisham in Suffolk 1762 *Philosophical Transactions* volume 52 pp. 529-533

Taube J (1782) cited by Barger (1931) in *Ergot and ergotism* pp. 73 and 268

Wollaston C (1762) Extract of letter in the case of John Downing April 13th *Philosophical Transactions* 52 pp. 523-6

Nineteenth century

Acton E (1857) *The English bread book* Longman London

Akerly S (1809) Account of the ergot or spurred rye as employed in certain cases of difficult parturition in a letter to Dr W P Dewees *Medical Repository* New York 6 pp. 341-347

Anon (1802) *Ipswich Journal* 31st April Issue 3603 19th century British Library Newspapers on line accessed on 13th May 2008

Beatty T E (1866) *Contribution to medicine and midwifery* Fannin and Co Dublin Chapter V based on January 1834 article in Dublin Medical Journal On the means of preventing uterine haemorrhage after delivery and a paper read before the Dublin Obstetrical Society on March 1844 on The influence of ergot of rye on the foetus in utero.

Bigelow J (1816) On the clavus, or ergot of rye and other plants *New England Journal of Medicine and Surgery* volume 5 pp. 156-164

Buckheim (1859) cited by Clarke(1927) in his paper read to Royal College of Obstetricians and Gynaecologists *Do the pharmocopreal preparations of ergot contain any active principles?*

Christison R (1829) *A treatise on poisons* Chapter 37 Adam Black Edinburgh

Creighton C (1891-1894) *A history of epidemics in Britain* volume 1 From A D to the extinction of plague pp. 52-68 Cambridge University Press

Davies H (1825) On the secale cornutus clavus or ergot of rye *The London Medical and Physical Journal* volume 54 pp.1-7 and pp. 100-102

Etherington J (1839) *Observations on the medicinal action of the ergot of rye* Read before the Royal Medical Society of Edinburgh March 15th Essay iv MDCCCXLL Rickard Edinburgh

Henslow Rev (1841) *Journal of Agricultural Society of England* volume 2 pp. 14-19 Section 9 on Ergot John Murray London

Hosack D (1822) *Essays on various subjects of medical science* number 19 Observations on ergot 2 pp. 295-301

Hosack D (1824) *Letter to James Hamilton Professor of Obstetrics in the University of Edinburgh* dated June 2 1822 New York

Huston R M (1829) Midwifery: on the dangerous effects of secale cornutum *North American Medical and Surgical Journal* volume lxii pp. 181-184

Kobert R (1899) Mutterkorn in Geissler E and Moeller J *Real-Encyclopadie der Gesamten Pharmacie* 7 Bd pp.172-198 Urban and Schwarzenberg Wien

Merriman S (1820) *A synopsis of the various kinds of difficult parturition* 3rd edition London

Michell W (1828) *On difficult cases of parturition and the use of ergot of rye* Thomas and George Underwood London

Taylor A S (1854) editor *Medical Jurisprudence*: poisons p. 622

Neale A (1828) *On difficult cases of parturition and the use of ergot of rye: Researches respecting the natural history chemical analysis and medical virtues of the spur or ergot of rye, when administered as a remedy in certain states of the uterus* Horatio Phillips London

Prescott O (1813) *A dissertation on the natural history and effects of secale cornutum or ergot* Read at the annual meeting of the Massachusett's Medical Society June 2nd

Prescott O (1813) *A dissertation on the natural history and medicinal effects of the secale cornutum or ergot* Cummings and Hilliard Andover

Stearns J (1807) Account of pulvis parturiens: a remedy for quickening childbirth *Medical Philosophy* News pp. 308-309

Stearns J (1808) An account of the pulvis parturiens: a remedy for quickening child-birth *Medical Repository of New York* 5 pp. 308-309

Wright S (1840) An experimental inquiry into the physiological action of ergot of rye *Edinburgh Medical and Surgical Journal* 53rd edition J Stark

Twentieth century

Akerstrand (1980) Ergots *Var Foda* 32 pp. 442-446 (in Swedish) cited by WHO Expert Report

Anon (1973) An onlooker's notebook: Lavender Water Leeches and Covent Garden *The Pharmaceutical Journal* volume 210 April 21st p. 327

Baker M (1974) *Folklore and customs of rural England* David and Charles Newton Abbott

Barger G (1931) *Ergot and ergotism* Gurney and Jackson London and Edinburgh

BBC Medical notes on line *Leprosy* http://news.bbc.co.uk/1/hi/health/medical-notes/166163.stm Accessed 21/1/08

Baumann U Hunziker HR Zimmerli B (1985) Ergot alkaloids in Swiss grain products *Mitteilungen aus dem Gebiete der Lebensmitteluntersuchung und Hygiene* 76 pp. 609-630 (in German) cited in the WHO expert group paper

Beck T (1909) cited by Bové (1970) in *The story of ergot* p. 141

Berde B and Schild H O editors (1978) Ergot Alkaloids *Handbook of Experimental Pharmacology* volume 49 Springer Verlag Berlin

Bhat RV Roy D N and Tulpule P G (1976) The nature of alkaloids of ergoty pearl millet or bajra and its comparison with alkaloids of ergoty rye and ergoty wheat *Toxicology Applied to Pharmacology* volume 36 pp. 11-17

Bové F J (1970) *The story of ergot* S Karger Basel

Bowman W C and Rand M J (1980) *Textbook of Pharmacology* 2nd Edition Section 11.4.3, 35.1 Chapter 35 Blackwell Scientific Publications Oxford

Britannica Online Encyclopaedia Accessed January 2009

British Medical Association and the Royal Pharmaceutical Association of Great Britain (1994) *British National Formulary* (BNF) London

Bross W Cisek T CzeraduT and Kazimuniski S (1963) *The Lancet* 1 p. 85 cited by Van Rensberg S J and Altenkirk B (1974) Chapter 3 in Purchase I F H *Mycotoxins*

Bulatao R A and Lee R D (1983) An overview of fertility determinants in developing countries in Bulatao RA and Lee RD editors *Determinants of fertility in developing countries* volume 2 Academic Press New York pp. 757-787

Caporael L R (1976) Ergotism: the satan loosed in Salem *Science* 192 pp. 21-26

Clarke A J (1927) *Do the pharmocopreal preparations of ergot contain any active principles?* Paper read to Royal College of Obstetricians and Gynaecologists 9th March

Coutinho E M (1971) Physiologic and pharmacologic studies of the human oviduct *Fertility and Sterility* 22 pp. 807-815

Coutinho E M (1975) Interference with ovum transport: implications for fertility control *Symposium on Ovum Transport and Fertility Regulation* San Antonio June 23rd-27th editors Harper M J K Panerstein C J Adams C E Scriptor Copenhagen pp. 544-555

Dunn P M (1993) Adam Neale (c1780-1832) and ergot of rye *Archives of Diseases in Childhood* volume 68 pp. 617-618

Goodman and Gilman (1975) *The Pharmacological Basis of Therapeutics* 5th edition p. 872 Chapter 42

Grasso V (1957) cited by Bové (1970) p. 39 not traced but article found for 1955 Rassegna della specie di *Claviceps* e delle loro piante ospiti. Parte I. *Ann. Sper. Agric.* N.S., Suppl. **9** (1): li-lxxxix.

Hardy A (1988) Diagnosis death and diet: the case of London 1750-1909 *Journal of Interdisciplinary History* volume 18 number 3 winter pp. 387- 401

Hardy A (1991) Book review of Poisons of the past *Journal of Interdisciplinary History* volume 21 number 5 pp. 509-513

Hofman A (1972) Ergot - A rich source of pharmacologically active substances in Swain T *Plants in the development of modern m*edicine pp. 235- 260 Harvard University Press Cambridge Mass

Holmes G Martin E Tabua S (1969) Mesenteric vascular occlusion in pregnancy: suspected ergot poisoning *Medical Journal of Australia* 2 pp. 1009-10

Kraicer P F and Shelesnyak M C (1964) Studies on the mechanism of nidation 9 Analysis of the responses to ergocornine *Journal of Reproduction and Fertility* volume 8 pp. 225-233

Langdon R F (1954) New species of Claviceps *University of Queensland Papers* 3 pp. 39-40

MacFarlane A (1970) *Witchcraft in Tudor and Stuart England* Harper and Row London

Magora F Rogel S Romanoff H (1970) *Angiology* 21 p. 565

Mantle P G (1969) The role of alkaloids in the poisoning of mammals by sclerotia of claviceps spp *Journal of Stored Products Research* Pergamon Press volume 5 Part 3 pp. 237-244

Mathias P (1959) *The brewing industry in England 1700-1830* University of Cambridge Press Cambridge

Mellanby E (1934*) Nutrition and disease: the interaction of clinical and experimental work* Oliver and Boyd Edinburgh

Moir J C (1932) Ergot preparations and the puerperal uterus *The British Medical Journal* volume 1 June 18th pp. 1119-1122

Moir J C (1955) The history and present-day use of ergot *The Canadian Medical Association Journal* 72 pp. 737-734

Moir J C (1974) Ergot: From St Anthony's fire to the isolation of its active principle, ergometrine (ergonovine) *American Journal of Obstetrics and Gynecology* 120:2 pp. 291-296

Morgan M T (1930) Report on an outbreak of alleged ergot poisoning by rye bread in Manchester *Journal of Hygiene* volume xxix p. 51

Matossian M K (1985) Death in London 1750-1900 *Journal of Interdisciplinary History* 16 pp. 183-197

Matossian M K (1989) *Poisons of the past: molds epidemics and history* Yale University Press New Haven and London

Moldenke H N and Moldenke A L (1952) *Plants of the bible* Chronica Batannica Co Waltham Mass

Rang H P and Dale N M (1991) 2nd edition *Pharmacology* Churchill Livingstone Edinburgh

Rathlauw J P (1947) a paper in Danish cited by Barger G (1931) pp.12-13

Richmond L Stevenson J Turton A editors (2003) *The pharmaceutical industry: a guide to historical records* Ashgate

Robson J M Lewis T L T (1952) Ergot and its derivatives in clinical practice *The Practitioner* Current Therapeutics volume169 Sept pp. 294-298
Scott P M and Lawrence G A (1982) Losses of ergot alkaloids during making of bread and pancakes *Journal of Agriculture and Food Chemistry* 30 pp. 445-450
Shelesnyak M C (1961) Further studies on the mechanism of ergocornine interference with hormonal requirements for decidualization and nidation *Bulletin de la Societe Royale Belge de Gynecologie et d'Obstetriqu*e volume 31 pp. 375-379
Shelesnyak M C Lunenfeld B and Hoig B (1963) Studies on the mechanism of ergocornine interference with decidualization and nidation *Life Sciences* number 1 pp. 73-79
Stoll A (1952) *Ergot through the ages* Lecture delivered at the Indian Science Congress Calcutta January
Stoll A (1965) Ergot - a treasure house for drugs *The Pharmaceutical Journal* 194 pp. 605-613
Thompson C J S (1929) *The mystery and art of the apothecary* John Lane, The Bodley Hend Ltd London
Tyler V E (1961) Biosynthesis of the ergot alkaloids *Journal of Pharmaceutical Science* 50 pp. 629 - 640
Van Rensburg S J and Altenkirk B (1974) Claviceps Purpura- Ergotism in Purchase IFH *Mycotoxins* Elsevier Scientific Publisher Amsterdam Chapter 3 pp. 69-96
WHO International programme on chemical safety (IPCS) (1990*) Environmental Health Criteria 105* Selected Mycotoxins: Ochratoxins trichothecenes ergot http://www.inchem.org/documents/ehc/ehc/ehc105 Accessed on 25/02/2005
Wilkinson L (1990) Book review *Medical History* 34 pp. 446-447

Twenty-first century

Allen H C (2005) *The material medica of the nosodes secale corn*utum On line http:// www. Homeoint.org/books1/allennosodes/secalcorntutum.htm 4/4 Accessed April 2005
Assured UK Malt Standard (2008) *The assured UK malt standard* - version 3.4 January section 2.3.1 p. 14

Bangh S A Hughes K A Roberts D J Kovarik S M (2005) *American Journal of Perinatology* 22: 5 pp. 239-43

Christopoulos S Szilagyi A and Kahn S R (2001) Saint-Anthony's fire *The Lancet* volume 358 November 17th p. 1694

Dillon P (2002) *The much lamented death of Madame Geneva - The eighteenth century gin craze* Headline books review London

European Mycotoxin Awareness Network (EMAN) (2000) website e-mail eman@leatherheadfood.com, http://www.lfra.co.uk/eman2/fsheet14.asp Accessed Feb 2005

Tansey E M (2001) Ergot and Ergometrine: An obstetric renaissance in Conrad L Hardy A *Women and modern medicine* Chapter 9 pp. 195-216 Rodopi Amsterdam

World wide words-on line Accessed June 2006

Yarham D J (1993) Ergot of cereals: a literature review and survey of incidence in traded grain *Home grown cereal authority research* review 25 http://www.hgca.com/cms_publications output Accessed on 2 /5/2008

Young J C Chen Z (1982) Variability in the content and composition of alkaloids found in Canadian ergot III Triticale barley and rye *Journal of Environmental Science and Health* B17:2 pp. 93-107

Young J C Chen Z Marquardt RR (1983) Reduction in alkaloid content of ergot sclerotia by chemical and physical treatment *Journal of Agriculture and Food Chemistry* 31 p. 413

Young J C (1981a) Variability in the content and composition of alkaloids found in Canadian ergot I Rye *Journal of Environmental Science and Health* B16:1 pp. 381-393

Young J C (1981b) Variability in the content and composition of alkaloids found in Canadian ergot II Rye *Journal of Environmental Science and Health* B16:4 pp. 83-111

SECONDARY SOURCES

Agriculture and food

Ashley W (1921) The place of rye in the history of English food *The Economic Journal* 123 volume xxxi September pp. 285-308

Ashley W (1928) *The bread of our forefathers: an inquiry in economic history* Clarendon Press Oxford

Bowden P J (1985) Agricultural prices wages farm profits and rents pp. 1-117 in Thirsk J *The agrarian history of England and Wales* volume 5 1640-1750 Cambridge University Press Cambridge

Brunt L (2003) Mechanical innovation in the industrial revolution: the case of plough design *Economic History Review* volume 56 number 3 pp. 444-477 August

Burnett J (1989) 3rd edition *Plenty and want- a social history of food* Routledge London

Drummond J C and Wilbraham A (1958) *The Englishman's food* Jonathan Cape London

Fay C R (1923) The miller and the baker: a note on commercial transactions 1770-83 *Cambridge Historical Journal* volume 1 pp. 85-91

Geissler C and Oddy D J (1993) Food diet and economic change Leicester University Press Leicester

Gras N S B (1915) *The evolution of the English corn market from the 12th to the 18th century* Harvard Press Cambridge

Kent N L (1984) *Technology of cereals* 3rd edition Pergamon Press Oxford

Kerridge E (1967) *The agricultural revolution* A M Kelley London

Jenkins H M (1869) The Lodge Farm Castle Acre Norfolk in the occupation of Mr John Hudson *Journal of the Royal Agricultural Society of England* 2nd series volume 5 pp. 460-74

Lamb H H (1969) Climatic Fluctuations General Climatology 2 *World survey of climatology* volume 2 editor H Flohn Elsevier Publisher pp. 173-244

Lamb H H (1977) *Climate present and past and future* volume 2 Methuen London

Mellanby E (1950) *The story of nutritional research: the effect of some dietary factors on bones and the nervous system* The William and Wilkins Company Baltimore

Neeson J M (1993) *Commoners: common right, enclosure and social change in England 1700-1820* University of Cambridge Press Cambridge

Overton M (1989) Climate Agriculture and History *Agricultural history* volume 63 number 2 Spring pp. 77-88

Overton M (1996) *Agricultural revolution in England* Cambridge University Press

Oxford English Dictionary and Thesaurus (1987)

Passmore J B (1930) The English plough in *The handbook of the collections illustrating agricultural implements and machinery* H M Stationery Office London

Prothero R E (1888) *The pioneers and progress of English farming* Longman and Co London

Rogers A G L (1922) Was rye ever the ordinary food of the English? *The Economic Journal* volume 32 number 125 March pp. 119-124

Rogers AGL (1902) *History of agriculture and prices* volume 7 pt 2 Clarendon Press Oxford

Rogers J E T (1866) *History of agriculture and prices* volume 1 Clarendon Press Oxford p. 26-27 and volume 7 1703-1793

Rogers J E T (1866-1902) *History of agriculture and prices* Clarendon Press Oxford

Rogers J E T (1884) *Six centuries of work and wages* Swan Sonnenschein's and Co London

Rogers J E T (1908) *Six centuries of work and wages* Swan Sonnenschein's and Co London

Salaman R (1989) *The history and social influence of the potato* Cambridge University press Cambridge

Riches N (1967) *The agricultural revolution in Norfolk* Frank Cass and Co Ltd London

Spencer A J and Passmore J B (1930) *Handbook of the collections illustrating agricultural implements and machinery* HMSO London

Stratton J M (1969) *Agricultural records AD 220-1968* editor R Whitlock John Baker London

Stratton J M (1978) *Agricultural records A.D. 220-1977*

Thirsk J (1967 1984 1985) *Cambridge agrarian history* volumes 4 and 6 and 7 Cambridge

Thirsk J (1987) *England's agricultural regions and agrarian history 1500 - 1750* Macmillan Basingstoke

Thirsk J and Cooper J P (1972) *Seventeenth century economic documents* Cambridge Press Oxford

Tooke T (1838*) History of prices* volume 1 Printed for Longman Orme Brown Green and Longman

Trumbach R (1978) *The rise of the egalitarian family, aristocratic kinship and domestic relations in the Eighteenth Century* Academic Press New York London

Tulasne L R (1853) cited by Barger p. 270

Turner M E (1984) *Enclosures in Britain 1750-1830* Studies in economic and social history Basingstoke

Wright T (1838) *Early mysteries and other Latin poems of the 12th and 13th centuries* MARC Link Guardbook conversion

Economic history

Nichols (1700) *History of Leicestershire* part 2 p. 366 cited by Creighton (1894) cited by Creighton(1894) *A history of epidemics in Britain* volume 1 p. 61 but not traced or initial found

O'Gorman F (1997) *The long eighteenth century: British political and social history 1688-1832* Arnold London

Outhwaite R B (1991) *Dearth, public policy and social disturbance in England 1550- 1800* Studies in economic and social history Macmillan Educational Hampshire

Porter G R (1847) *The progress of the nation* new edition 1851 John Murray London

Porter G R (1851) *The progress of the nation* John Murray London

Weber M (1947) *The theory of social and economic organisation* Translated by Henderson A M Parson T The Free Press of Glencoe London

Hawkshead

Cowper H S (1899) *Hawkshead: The Northernmost Parish of Lancashire - its history, archaeology, industries etc* Bemrose and Sons London and Derby

Dickinson W (1876) *Cumbriana or fragments of Cumbrian life* Whitaker and Co London

Fell J (1891) Some illustrations of home life in Lonsdale north of the sands in the 17th and 18th century *Transactions of the Cumberland and Westmorland Society* xi pp. 368-398

Finlay R (1980) Distance to church and registration experience *Local Population Studies* number 24 pp. 26-40

Schofield R S (1970) Perinatal mortality in Hawkshead Lancashire *Local Population Studies Magazine and Newsletter* number 4 Spring page 11-16 Nottingham University Department of Adult Education

Medicine

Porter R (1992) The rise of medical journalism in Britain to 1800 pp. 6-28 in Bynum W F Look S Porter R *Medical journals and medical knowledge: historical essays* Routledge London

Ramsbottom Dr (1839) Medical Intelligence *London Medical Gazette* 15th June

Midwifery

Dunn P M (1997) Dr Percival Willughby MD (1596-1685): pioneer 'man' midwife of Derby *Archives of Diseases in Childhood* 76 pp. 212-213

Dunn P M (1999) Perinatal lessons from the past: The Chamberlen family (1580-1728) and obstetric forceps *Archives of Diseases of Childhood* Fetal neonatal edition volume 81 pp. 232-234 November

Evenden D (2000) *The midwives of seventeenth century* London Cambridge University Press Cambridge

Grundy I (1995) Sarah Stone: enlightened midwife in Porter R *Medicine in the Enlightenment* Rodopi Amsterdam pp. 128-144

Harley D (1990) Historians as demonologists: the myth of the midwife-witch *Social History of Medicine* volume 3 number1 April pp. 1-26
Harley D (1994) Provincial midwives in England: Lancashire and Cheshire 1660-1760 Chapter 2 pp. 27-48 in Marland H *The Art of Midwifery* Routledge London
Hess A G (1994) Midwifery practice among the Quakers in southern rural England in the 17th century Chapter 3 pp. 49-76 in Marland H *The art of midwifery* Routledge London
Johnstone R W (1952) *William Smellie: the master of British midwifery* E S Livingstone Ltd Edinburgh and London
Loudon I (1992) *Death in childbirth (1800-1950): an international study of maternal mortality* Clavendon Press Oxford
Marland H (1994) *The art of midwifery* Routledge London
Paterson J (1838) Interesting midwifery case with remarks *London Medical Gazette* volume 2 series 1837-38 September 8th pp. 935-937
Spiegel F (1971) editor *A small book of grave humour*
Versluysen M C (1981) Midwives, medical men and poor women labouring with child: lying-in hospitals in eighteenth century London pp. 18-49 in Roberts H *Women health and reproduction* Routledge London
Wilson A (1990) The ceremony of childbirth and its interpretation in Fildes V editor *Women as mothers in pre-industrial England* pp. 67-107 Routledge London and New York
Wilson A (1995) *The making of man-midwifery: childbirth in England 1660-1770* UCL London

Population and fertility

Adair RL (1991) *Regional variations in illegitimacy and courtship patterns in England 1538-1754* Unpublished PhD Thesis University of Cambridge
Appleby A B (1973) Disease or Famine? Mortality in Cumberland and Westmoreland 1580-1640 *The Economic History Review* New series volume 26 number 3 pp. 403-432
Berry B M and Schofield R S (1971) Age at baptism *Population Studies* volume 25 number 3 pp. 453- 463

Bongaarts J (1980) Does malnutrition affect fecundity? A summary of evidence *Science* 208 p. 564

Bongaarts J and Menken J (1983) The supply of children: a critical essay in Bulatao R A and Lee R D editors 1983) *Supply and demand for children* volume 1 Academic Press New York pp. 27-60

Confidential Enquiry into Maternal and Child Health (CEMACH) (2008) Perinatal mortality 2006: England Wales and Northern Ireland CEMACH London

Cross H E and McKusick V A (1970) Amish demography *Social Biology* volume 17 number 2 pp. 83-101

Dobson M J (1989) The last hiccup of the old demographic regime: population stagnation and decline in late seventeenth and early eighteenth-century England *Continuity and Change* volume 4 issue 3 pp. 395-428

Eaton A and Mayer J (1953) The social biology of very high fertility among the Hutterites *Human Biology* volume 25 pp. 206-264

Flinn M W (1970) *British population growth 1700-1850* Studies in economic and social history Macmillan Press Ltd London

Floud R Wachter K and Gregory A (1990) *Height, health and history: nutritional status in the United Kingdom 1750-1980* Chapter 5 Cambridge University Press Cambridge

Fogel R W (2004) *The escape from hunger and premature death 1700-2100* Cambridge University Press Cambridge

Frisch R E (1977) Population food intake and fertility *Science* volume 199 6th January pp. 22-30

Frisch R E (1983) Population nutrition and fecundity: significance for interpretation of changes in fertility in Eberstradt E editor *Fertility decline in less developed countries* pp. 319-336 Praeger New York

Gray R (1983) The impact of health and nutrition on national fertility in Bulatao R A and Lee R D editors volume 1 *Supply and demand for children* Academic Press New York pp. 139-162

Habakkuk H J (1965) English population in the eighteenth century pp. 269-284 in Glass D V and Eversley D E C *Population in history* Edward Arnold London Originally published in *Economic Review* 2nd series volume 6 1953 pp. 117-133

Habakkuk H J (1971) *Population and economic development since 1750* Leicester University Press Leicester

Hart N (1993) Famine maternal nutrition and infant mortality: a re-examination of the Dutch Hunger *Population Studies* Winter volume 47 pp. 27-46

Hart N (1998) Beyond infant mortality: gender and still birth in reproductive mortality before the twentieth century *Population Studies* volume 52 number 2 pp. 215-229

Henry L (1961) Some data on natural fertility *Eugenics Quarterly* 6 pp. 81-91

Hinde A (2003) *England's population: a history since the doomsday survey* Hodder Arnold London

Knodel J (1988*) Demographic behaviour in the past: a study of fourteen German populations in the eighteenth and nineteenth centuries* Cambridge University Press Cambridge

Landers J (1993) *Death and the metropolis* Cambridge University Press Cambridge

Laslett P (1980) Introduction: comparing illegitimacy over time and between cultures in Laslett P Oosterveen K and Smith RM *Bastardy and its comparative h*istory Edward Arnold Publisher for Cambridge Group for the History of Population and Social Structure

Laslett P Oosterveen K and Smith R M editors (1980*) Bastardy and its comparative history: studies in the history of illegitimacy and marital nonconformism in Britain* etc Edward Arnold London

Laxton P and Williams N (1989) Urbanisation and infant mortality in England: a long term perspective and review in Nelson M C and Rogers J *Urbanisation and the epidemiological transition* Uppsala University Press pp. 109-135

Leridon H (1977) Human fertility: the basic components University of Chicago Press Chicago

Levene A (2005) The estimation of mortality at the London Foundling Hospital 1741-99 *Population Studies* volume 59 number 1 pp. 87-97

Levine D and Wrightson K (1980) The social context of illegitimacy in early modern England in Laslett P Oosterveen K and Smith R M (1980*) Bastardy and its comparative history* Edward Arnold Publisher for Cambridge Group for the History of Population and Social Structure

Lewis G (2007) editor *Saving mothers' lives: reviewing maternal deaths to make motherhood safer 2003-2005 - The seventh report of confidential enquiries into maternal deaths in the United Kingdom* CEMACH London

Lewis G and CEMACH (2006) *Why mothers die 2000-2002 The sixth report of confidential enquiries into maternal deaths in the United Kingdom* CEMACH London

Lumey L H and van Poppel F W A (1994) The Dutch Famine of 1944-45 Mortality and morbidity in past and present generations *Social History of Medicine* Number 7 Volume 2 August pp. 229-46

McKeown T (1976) *The modern rise of population* Arnold London

Magpie Trial Co-ordinating Centre (2004) *The Magpie trial follow up study Pregnancy and Childbirth* 4:5 Oxford

Oosterveen K Smith R M (1980) Bastardy and the family reconstitution studies of Colyton Aldenham Alcester and Hawkshead in Laslett P Oosterveen K and Smith R M (1980*) Bastardy and its comparative history* Edward Arnold Publisher for Cambridge Group for the History of Population and Social Structure

Rabb T K and Rotberg R I editors (1985) *Hunger and history: The impact of changing food production and consumption patterns on society* Cambridge University Press Razzell P (1998) The conundrums of eighteenth century English population growth *Social History of Medicine* volume 2 number 3 pp. 469-500

Razzell P (2007) *Population and disease: transforming English Society 1550-1850* Caliban Books London

Santow G (1995) Coitus interruptus and the control of natural fertility *Population Studies* volume 49 pp. 19-43

Schofield R (1985) English marriage patterns revisited *Journal of Family History* Spring pp. 2-20

Shelesnyak M C (1986) Nidation: a symposium held in honour of Professor M C Shelesnyak editor Series *Annals of the New York Academy of Sciences* v 476 New York Academy of Sciences New York

Smith R M (1980) Family reconstitution and the study of bastardy: evidence from certain English parishes in Laslett P Oosterveen K and Smith R M *Bastardy and its*

comparative history Edward Arnold Publisher for Cambridge Group for the History of Population and Social Structure

Smith R M (1981) Fertility, economy and household formation in England over three centuries *Population and Development* Review 7 pp. 595-622

Smith R M (1999) Relative prices forms of agrarian labour and female marriage patterns in England 1350-1800 in Devos I and Kennedy L Marriage and *Rural Economy Western Europe since 1400* pp. 19-48 Brepols Turnhout

Tietze C (1957) Reproductive span among Hutterites *Fertility and Sterility* volume 8 number1 pp. 89-97

Vernon J (2007) *Hunger* Harvard University Press Cambridge Mass. and London

Weir D R (1984) Rather never than late: celibacy and age at marriage in English cohort fertility *Journal of Family History* 9:4 Winter Special Issue on Spinsterhood pp. 340-354

Woods R (2005) The measurement of historical trends in fetal mortality in England and Wales *Local Population Studies* volume 59 number 2 pp. 147-162

Wrigley E A (1987) *People cities and wealth* Oxford

Wrigley E A (1998) Explaining the rise in marital fertility in England in the long eighteenth century *Economic History Review* volume 51 number 3 pp. 435-464

Wrigley E A (2004) *Poverty progress and population* Cambridge University Press Cambridge

Wrigley E A and Schofield R S (1981) *The population history of England 1541-1871* Edward Arnold London

Wrigley E A and Schofield R S (1989) *The population history of England 1541-1871* Cambridge Group for the history of population and social structure Cambridge University Press Cambridge

Wrigley E A Schofield R S (1989) *The population history of England* Edward Arnold Ltd London

Wrigley E A Davies R S Oeppen J E and Schofield R S (1997) *English population history from family reconstitution 1580-1837* Cambridge University Press

Blaikie N (2001) *Designing social research* Polity Press Cambridge

Blaikie N (2003) *Analyzing quantitative data* Sage Publications London

Landes D S and Tilly C (1971) editors *History as social science* Prentice Hall Englewood Cliffs

Leininger M M (1985) Nature rationale and importance of qualitative research methods in nursing in Leininger M M editor *Qualitative research methods in nursing* Grune and Stratton Inc Orlando

Medawar P B (1964) Is the scientific paper a fraud? in Edge D editor *Experiment* BBC Publications London

Phillips E M Pugh D S (1987) *How to get a PhD* Open University Press Milton Keynes

Polit D F and Hungler (1991*) Nursing research principles and methods* Lippincott Company London

Popper K (1972) *The logic of scientific discovery* 3rd edition Hutchinson London