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Population Change in Eighteenth-Century England. *A Reinterpretation*

BY P. E. RAZZELL

There have been two traditional explanations of the acceleration in population growth which occurred during the middle of the eighteenth century: (1) the Malthusian view that it was a consequence of the Industrial and Agricultural Revolutions through an improved standard of life; (2) that it was the result of various medical innovations independent of these Revolutions. The problem posed by these competing interpretations is central to English economic and social history: did the Industrial and Agricultural Revolutions create their own future labour force and expanding numbers of consumers, or were they themselves children of a Population Revolution which preceded them?

Economic historians have attempted to answer this question by estimating population, birth- and death-rates at decennial intervals throughout the eighteenth century. Professor Krause, however, has questioned the validity of the traditional method for the period before 1781 when aggregate statistics of Anglican baptisms and burials are available only for every tenth year from 1700 to 1780. He has pointed out that the use of one conventional assumption about English demographic data with reference to Sweden would exaggerate the amount of actual increase of population in that country between 1750 and 1780 by over 61 per cent.¹ Krause has attempted to use the statistics of annual baptisms and burials from 1780 onwards by making certain questionable assumptions about changes in the baptism/birth and burial/death ratios during the period 1781–1850. He concluded that a rise in the birth-rate rather than a fall in the death-rate was ‘the major variable in English demography’.²

This has led the medical historians McKeown and Record to state that ‘the data (on mortality and natality) are so treacherous that they can be interpreted to fit any hypothesis, and it seems preferable to rely on assessment of the sensitivity of the birth-rate and death-rate, and their relative effectiveness, in a period when both rates were high’.³ This they had done in their own work and after reviewing the history of all the major diseases and preventive measures taken against them, concluded that the ‘fall in the death-rate during the eighteenth and nineteenth centuries was not the result of medical treatment as Griffiths and others had supposed. Only in the case of vaccination against smallpox is there any clear evidence that specific therapy had a substantial

¹ J. T. Krause, ‘Changes in English Fertility and Mortality, 1781–1850’, *Economic History Review*, 2nd ser. XI (1958–59), p. 53.

² *Ibid.* p. 69.

³ T. McKeown and R. G. Record, ‘Reasons for the Decline of Mortality in England and Wales during the 19th Century’, *Population Studies*, XVI (1962), pp. 94–95.

effect on the prevention or cure of disease earlier than the twentieth century. The decline in mortality from diseases other than smallpox was due to improvement in living conditions, and to changes in virulence and resistance upon which human effort had no influence.¹

Krause, however, has pointed out that vaccination did not become really widespread until the 1840's and has argued that the average standard of living probably deteriorated slightly between 1780 and 1821 when population was increasing very rapidly.² Chambers, in his study of the Vale of Trent region, examined the relationship of food-supply to mortality-rates and concluded that population 'was vulnerable to disease, but not as a result of famine. Epidemics could do their own work without its aid, nor, it would seem, did they require the assistance of gin.'³ A similar conclusion was reached by Pickard after analysing the relationship between food prices and changes in mortality and natality in eighteenth-century Exeter.⁴ It should also be remembered that from 1838 to 1875, when the standard of living was undoubtedly rising rapidly, the overall death-rate was virtually constant.⁵ It is in the light of all these contradictory facts that McKeown and Record have been reduced to making the following desperate statement: 'When we have eliminated the impossible (medical explanations of population growth), whatever remains (economic explanations), however improbable, must be the truth.'⁶

I

This paper is intended as a summary of research to date on the cause of the increase in population in eighteenth-century England.⁷ Before discussing these causes it is necessary to estimate the size of population during the eighteenth and early nineteenth centuries, in order to appreciate the magnitude of change during this period. The estimates of population used in this paper are those derived from the returns of marriages made from several thousand parishes which were published by Rickman in 1841.⁸ These estimates have several advantages: (1) unlike baptisms and burials, the overwhelming majority of dissenters' marriages took place in the Anglican church.⁹ (2) The registration of marriage is generally considered to have been the most reliable.¹⁰ (3) The

¹ T. McKeown and R. G. Brown, 'Medical Evidence Related to English Population Changes in the 18th Century', *Population Studies*, IX (1955), p. 139.

² Krause, *op. cit.* pp. 63-65.

³ J. D. Chambers, 'The Vale of Trent, 1670-1800', *Econ. Hist. Rev.* Supplement 3, p. 29.

⁴ R. Pickard, *Population and Epidemics of Exeter* (Exeter, 1947), p. 67.

⁵ See B. R. Mitchell and P. Deane, *Abstract of British Historical Statistics* (Cambridge, 1962), pp. 36, 343-58.

⁶ McKeown and Record, *op. cit.* pp. 94, 95.

⁷ The paper is really a series of hypotheses illustrated occasionally by statistical and other evidence. It is hoped to incorporate detailed evidence into a monograph at a later date.

⁸ Rickman's figures for marriages were generally derived from over 4,000 parish registers. See G. Talbot Griffiths, 'Rickman's Second Series of Eighteenth Century Population Figures', *Journal of the Royal Statistical Society*, 92 (1929), p. 263.

⁹ The best confirmation of this is to be found in the *Report on Non-Parochial Registers*, P.P. 1837-38 (28) where it is seen that there were virtually no non-Anglican marriage registers kept for the eighteenth century.

¹⁰ See J. C. Cox, *The Parish Register of England* (1910), p. 76. W. E. Tate, *The Parish Chest* (Cambridge, 1946), p. 65. G. Talbot Griffiths, *Population Problems of the Age of Malthus* (Cambridge, 1926), p. 33.

estimates are based on three-year clusters of returns rather than single years, a procedure which is much more likely to reduce fluctuations of the marriage-rate from one time to another.¹ The basis of Rickman's own estimate was the assumption that the ratio of the number of marriages to total population in 1800, was the same for the periods 1699-1701 and 1749-51, i.e. that the marriage-rate was constant between 1700 and 1800. It is impossible to test this assumption in any detail, although there are a few scattered statistics available to suggest that it is not too unreasonable.

The Marriage-Rate throughout the Eighteenth Century

Place	Total population	Approximate period	Marriage-rate/1,000 population
7 Market towns ²	27,043	1724-36	8.7
54 Villages ²	19,607	1724-36	8.4
11 Towns ³	37,541	1770's	8.5
England and Wales ⁴	8,892,436	1795-1805	8.8

These figures must not be taken too literally as they refer to places of different sizes and locations; the figure for 1795-1805 is somewhat arbitrary because of the flaws in the registration of both marriages and population.

Be that as it may, the figures for marriage-rates indicate that there were no marked long-term changes in the marriage-rate throughout the eighteenth century. This conclusion is confirmed by at least one local study of population change during the same period.⁵ The estimates of population size from the returns of the number of marriages are as follows:⁶

¹ An examination of the Swedish statistics for the eighteenth century, for example, shows that three-yearly clusters fluctuated far less than single years in terms of the marriage-rate. See *Historical Statistics of Sweden, 1720-1950* (Stockholm, 1955), pp. 39-41. The long-term marriage-rate in Sweden was remarkably stable between 1751 and 1825. See G. Sundbärg, *Sweden, Its People and Its Industry* (Stockholm, 1904), p. 96.

² Thomas Short, *New Observations On Bills of Mortality* (1751), p. 133.

³ J. Howlett, *Observations On the Increased Population... Of Maidstone* (Maidstone, 1782), p. 82.

⁴ I have excluded from this population figure the numbers in the army and navy; also I have not corrected for under-enumeration as a few marriages were also not registered because of the non-Anglican marriage of Quakers, Jews and Roman Catholics, as well as various illicit marriages in sea-ports and elsewhere. For the source of the population figure see *Census of Great Britain, 1851*, pp. xxiii, xxvi.

⁵ Chambers, *op. cit.* pp. 54, 55.

⁶ These estimates are re-computations of Rickman's figures. The following adjustments were made: (1) 5 per cent was added to the 1801 enumerated population because of estimated under-enumeration. See Krause, *op. cit.* p. 60. (2) Rickman took the number of marriages in the single year 1800 as the basis of his marriages/population ratio. This has been re-computed on the basis of the years 1800-02 so that the basic ratio is derived from a three-year cluster of marriages like all the previous periods. The original estimates are those Rickman arrived at by treating England and Wales as one unit and may be found in Griffiths's article in *Journal of the Royal Statistical Society*, 92 (1929), p. 263. See also J. Rickman, *Parishes Possessing Registers Extant 1570 and 1600 with their Population in 1801*, Document M. 74.10 in the General Register Office Library. (3) No allowance was made for the numbers in the armed service. The population figures are not intended as exact estimates, but rather as indications of the magnitude of change in the size of the population during the eighteenth and early nineteenth centuries. For the source of the 1801 and 1851 figures, see *Census of Great Britain, 1851*, pp. xxii, xxiii, xxvi.

Period	England and Wales Estimated population (nearest 1,000)	Average annual rate of change, per cent
1700	5,307,000	
1750	5,895,000	+ 0.2
1801	9,337,000	+ 1.1
1851	17,719,000	+ 1.8

Although we have indicated that the marriage-rate was only stable during the eighteenth century, it is possible to check the earlier population estimates with estimates derived from independent source. Gregory King estimated the population of England and Wales to be 5.5 millions in 1695, an estimate which Professor Glass thinks may be slightly too high.¹ King's estimate was based on hearth-tax returns and local censuses conducted in connection with the tax on marriages etc.; it is similar to the one we have made for 1700 on the basis of the marriage returns.

The population increased relatively slowly up to 1750, after which it increased rapidly and steadily right through to the end of the nineteenth century. It is the causes of this rapid and consistent increase which is the subject of this paper.

The Age at Marriage of Spinsters, 1615-1841

Period	Region	Mean age at marriage	Number in sample
1615-21	Wilts., Berks., Hants and Dorset ²	24.6	280
1662-1714	Yorkshire ³	23.76	7,242
1701-36	Nottinghamshire ⁴	24.5	865
1741-45	Surrey ⁵	24.9	333
1749-70	Nottinghamshire ⁴	23.9	700
1796-99	Sussex ⁶	24.1	275
1839-41	England and Wales ⁷	24.30	14,311

Ideally, we should want to analyse the aggregate birth- and death-rates, age-specific fertility and mortality-rates, etc. Unfortunately, the paucity of accurate information means that we can only collect data of a piecemeal kind, which at least points in the direction of certain conclusions. It has already been indicated that the aggregate marriage-rate changed but little during the eighteenth century. This conclusion is consistent with the fact that the age at marriage of spinsters was virtually constant during the same period. Our findings indicate that the population explosion in the eighteenth century was

¹ D. V. Glass, 'Gregory King's Estimate of the Population of England and Wales, 1695', *Population Studies*, III (1950), p. 358.

² Rev. E. Nevill (ed.), *Marriage Licences of Salisbury, 1615-1682*.

³ M. Drake, 'An Elementary Exercise in Parish Register Demography', *Econ. Hist. Rev.* 2nd ser. XIV, (1962), p. 444.

⁴ T. M. Blagg and F. A. Wadsworth (eds.), 'Nottinghamshire Marriage Licences', *The Index Library, British Record Society*.

⁵ A. R. Bax (ed.), *Allegation for Marriage Licences Issued by the Commissary Court of Surrey, 1673-1770* (Norwich, 1907).

⁶ D. Macleod (ed.), 'Sussex Marriage Licences, 1775-1800', *Sussex Record Society*, XXXV (1929).

⁷ *Fourth Annual Report of the Registrar General* (1842), p. 10.

not caused by a lowering of the age at marriage or by an increase in the marriage-rate due to any possible increase in the standard of living, or the level of employment associated with the Industrial and Agricultural Revolutions.

Another source of demographic information is to be found in life-expectancy tables. These were constructed for a group of Northamptonshire and Hertfordshire 'county families'.

*Changes in the Average Age Lived (County Families)*¹

Cohort born	Expectation of life at birth (males)	Number of sample
1681-1730	37 years	138
1731-1780	48 years	130
1781-1830	50 years	162

The results of this study were compared with those published by Hollingsworth in his paper on the demographic history of ducal families,² as well as the results of his unpublished research into the whole of the aristocracy. All these studies point to the same conclusion: that expectation of life for cohorts born from *circa* 1740 onwards rose significantly, the saving of life occurring mainly amongst infants, children and young adults. A more detailed analysis of the 'county family' material illustrates the sharpness of this rise.³

Changes in the Average Age Lived (County Families)

Cohort born	Expectation of life at birth (males)	Number in sample
1680-99	36 years	92
1700-19	38 years	89
1720-39	35 years	86
1740-59	48 years	76

Unfortunately it is impossible to construct similar tables for the general population during the same period.⁴ It is probable that there was a similar rise amongst the general population, for the mean expectation of life at birth derived from Gregory King's life-table for Lichfield in about 1695 was 32.0 years,⁵ whereas according to the English life-table constructed by Farr in 1841 it was 41.2 years.⁶ If these figures are representative, the aristocracy and gentry always had a higher life expectancy than the general population, but managed to increase their relative advantage slightly throughout the eighteenth and early nineteenth centuries.

¹ Samples were taken from the Northants and Herts. genealogical volumes of the *Victoria County History* series published in 1906 and 1907. Figures were computed to the nearest year.

² T. H. Hollingsworth, 'A Demographic Study of the British Ducal Families', *Population Studies*, XI (1957).

³ Hollingsworth's figures for the whole aristocracy, which are based on much larger cohorts, indicate that the rise in life expectancy was somewhat more gradual than this.

⁴ Although Finlaison analysed mortality-rates from annuities and tontines, his findings apply essentially to the aristocracy and gentry. His results confirm those of Hollingsworth's two studies and my own, i.e. there was a very sharp rise in the expectation of life beginning sometime during the middle of the eighteenth century. See 'Report of John Finlaison on the evidence and elementary facts on which the Tables of Life Annuities are founded', Parl. Pap. 1829 (3).

⁵ See Glass, *op. cit.* p. 368, for the reliability of this figure.

⁶ *Fifth Annual Report of the Registrar General* (1843), p. 29.

What are the possible causes of the increase in expectation of life throughout the eighteenth century? For obvious reasons, an explanation in terms of increased food supplies is inappropriate for social groups such as the gentry and aristocracy. The rise in expectation of life was too rapid amongst the 'county families' to be explained in terms of changes in environment. There is, however, one major plausible explanation: the introduction and use of *inoculation* against smallpox during the eighteenth century. Inoculation must formally be contrasted with the nineteenth-century practice of vaccination. Inoculation is the injection of smallpox virus taken from the vesicle of a person suffering from smallpox, whereas vaccination is the injection of cowpox virus. The two injections are conventionally distinguished by the different symptoms they produce. Inoculation is thought of as giving rise to pustular eruptions in different parts of the body as well as at the site of injection and is viewed as a mild form of natural smallpox, inasmuch as it is believed to spread the natural disease from the inoculated person to other unprotected people. Vaccination only gives rise to a vesicle at the site of the injection and is not infectious to other unprotected people.

II

Inoculation was originally practised sporadically and on a very limited scale as a part of folk medicine, mainly in Oriental and African countries. It was introduced into England in 1721 when Lady Mary Wortley Montagu had her daughter inoculated in London, although it had been known by report for some years previously. It was only practised on a very limited scale during the 1720's and 1730's, owing mainly to the fact that the very severe technique of inoculation caused several deaths. Between 1721 and 1728 there were 897 people known to have been inoculated, 17 of whom were suspected to have died from inoculated smallpox. In the early 1740's the practice was revived again mainly as a result of the use of a safer technique involving milder injections of virus. However, because the medical profession had elaborated inoculation from its original simplicity into a very complex operation involving both a fortnight's preparation and convalescence, often in a special isolation hospital, the practice became very expensive and was consequently restricted to the rich. Although the London Smallpox Hospital was founded in 1746 to offer charitable inoculations to the poor, most of its clients in the early period tended to be servants of the subscribers to the foundation of the hospital.

During the 1750's the overseers of the poor began to pay the cost of inoculation for all the poor within their parish; this usually took place as a response to the threat of a smallpox epidemic which provoked mass inoculation amongst all members of the parish. In addition to these mass inoculations there were many individuals who were inoculated at their own expense. Thus Kirkpatrick wrote in 1754: 'But since we have certain accounts that the populace, who were at first strongly predisposed against this practice, and who so rarely stop at the Golden Mean, are rushing into the contrary extreme; and go promiscuously from different distances to little Market Towns, where without any medical

advice, and very little consideration, they procure inoculation from some operator, too often as crude and thoughtless as themselves. . . .¹ This popularization of inoculation was made possible by its cheapness through the activities of local surgeons and apothecaries.²

However, inoculation did not become really widespread until after the 1760's for, according to one source, only 200,000 people had been inoculated in England by 1766.³ The main reason why inoculation was not more widespread was the occasional mortality still associated with the operation. This situation was changed in the 1760's when the Sutton family began to inoculate by injecting the minimal amount of virus into the arm with the very lightest of scratches. The result was that 'if any patienth as twenty or thirty pustules he is said to have the smallpox very heavy',⁴ thus ensuring a negligible risk of death. The Suttons claimed in 1768 'that about fifty-five thousand had been inoculated by them since the year 1760; of which number only six had died'.⁵ The 'Suttonian Practice' consisted of Robert Sutton, an apothecary and surgeon at Framlington Earl, Norfolk, and several of his sons, as well as a very large number of non-family partners; the practice extended to most counties and several foreign countries.⁶ The most famous son was Daniel Sutton who, because of his very spectacular feats of inoculation,⁷ was chiefly responsible for popularizing the Suttonian method. By the end of 1776 they claimed to have inoculated 300,000 people,⁸ a claim which is very plausible in the light of the very large number of partners they had. They offered to inoculate the rural poor *gratis* on the condition presumably that the rest of the parish were also inoculated by them; certainly the Suttons appear in the account books of innumerable overseers who paid them for mass inoculations in their parishes.

The Suttonian method was soon taken up by the rest of the medical profession, as well as by amateur inoculators who began to proliferate very rapidly. Thus Houlton wrote in 1768 'that in every county of England you meet advertisements of these pretenders and itinerants. . . . Some of them as before observed, advertise that they inoculate according to the *Sutton method*; while others have the modesty to deck their imposition with the style of "*The Suttonian art improved*". . . .'⁹ Some of these 'pretenders and itinerants' were undoubtedly professional surgeons and apothecaries such as Dimsdale who was converted to the Suttonian method by its superiority over the older technique;

¹ J. Kirkpatrick, *The Analysis of Inoculation* (1754), pp. 267, 268.

² This was achieved through the simplification of inoculation, culminating in the abandonment of preparation and convalescence by Lewis Paul Williams (a Leicestershire surgeon) in 1763. See *Northampton Mercury*, 15 Dec. 1768; *The British Medical Journal*, 11 (1910), pp. 633-34.

³ See A. C. Klebs, 'The Historic Evolution of Variolation', *Bulletin of the Johns Hopkins Hospital*, XXIV (March 1913), 82. The basis of this estimate is unknown.

⁴ Creighton, *op. cit.* p. 476.

⁵ R. Houlton, *Indisputable Facts, Relative To The Suttonian Art Of Inoculation* (Dublin, 1768), p. 10. The negligible risk of death from inoculation after the 1760's is confirmed by a great deal of evidence.

⁶ *Ibid.* pp. 21-23.

⁷ During a mass inoculation at Maldon, Essex, he inoculated 487 people in one day, none of whom died.

⁸ W. R. Clayton, 'Notes on the history, incidence and treatment of smallpox in Norfolk', *Norfolk Archaeological Society*, XXX 7.

⁹ Houlton, *op. cit.* p. 24.

another professional medical practitioner who later inoculated with the Suttonian method before discovering vaccination was Edward Jenner, who had been inoculated in the old method as a boy during the mass inoculation at Wootton-under-Edge in 1756. Others of the imitators of the Suttonian method were 'a certain tribe of empirics and other unexperienced Practitioners',¹ such as the livery servant who left his employment in about 1768 to become a full-time inoculator² and the farrier and blacksmith who inoculated 170 people in the neighbourhood of Norwich in 1769.³ The occupations of the amateur inoculators ranged from farmer to customs-officer, and some set up schools in their own method of inoculation.

Inoculation was practised much more extensively and earlier in rural areas and small towns than in large towns and cities. Haygarth, writing in 1780, stated that 'whole villages in this neighbourhood (Chester) and many other parts of Britain, have been inoculated with one consent. And it cannot be supposed that the inhabitants of towns are more ignorant or more obstinate. There is not a reasonable doubt that our poor fellow citizens would eagerly and universally embrace a proposal to preserve their children from death and deformity, if the intelligent and the opulent would humanely exert their influence and assistance to carry it into execution'.⁴ Although the relative lack of provision of charitable inoculation was one of the major reasons why it spread only slowly in the large towns, another reason was because of the differing structure of smallpox epidemics in town and countryside. In the large towns where the disease was endemic all smallpox deaths were of infants and young children; this tended to engender a fatalistic attitude about the inevitability of catching the disease. This was recognized by Haygarth when he wrote that 'the lower class of people (in Chester) have no fear of the casual (natural) smallpox. Many more examples occurred of their wishes and endeavour to catch the infection, than to avoid it. This . . . prejudice . . . probably prevails in other large towns, especially in those which are so large as perpetually to nourish the distemper, by so quick a succession of infants as constantly to supply fresh subjects for infection . . .'.⁵ This he contrasted with 'small towns and villages, especially where placed in remote situations, the young generation grow up to have a consciousness of the danger before they are attacked by the dreadful disease'.⁶ This consciousness was also based on the greater fatality of smallpox in isolated areas. One of its results was seen at Blandford, Dorset, in 1766 when a very malignant epidemic of smallpox broke out and 'a perfect rage for inoculation seized the town'.⁷ In the small town or village it was possible for everybody to compare the spectacular differences in mortality of the inoculated and uninoculated during a smallpox epidemic, whereas in a large town it was very difficult to familiarize the poorer classes

¹ M. G. Hobson, *Otmoor and its Seven Towns* (Oxford, 1961), p. 20.

² W. Watson, *An Account . . . of Inoculating the Small Pox* (Dublin, 1768), pp. 71, 72.

³ *Gentleman's Magazine*, XXXIX (1769), p. 167.

⁴ J. Haygarth, *An Enquiry How To Prevent The Smallpox* (Chester, 1785), p. 164.

⁵ J. Haygarth, *A Sketch of A Plan to Exterminate the Casual Smallpox* (1793), p. 186.

⁶ *Ibid.* p. 186.

⁷ Creighton, *op. cit.* p. 513.

with the benefits of inoculation owing to the dispersed and piecemeal nature of smallpox mortality.

The relatively slow spread of inoculation in the large towns must not be exaggerated in importance, for only a small minority of the total population lived in such areas. Also it appears that inoculation was making rapid headway in the large towns by the very end of the eighteenth century.¹ In the small towns and villages inoculation appears to have been universally practised well before the end of the century. There are innumerable references to mass inoculations in local histories and medical writings for every decade from about 1750 onwards.² One of the reasons why parish authorities were so willing to pay for inoculation of their poor was because of the great expenses involved in isolating and nursing the sick during an epidemic of the natural smallpox. The costs were sufficiently great to make many parishes *compel* everyone within their jurisdiction to be inoculated.³

One observer noted in 1771 'that inoculation, which was heretofore in a manner confined to people of superior ranks, is now practised even in the meanest cottages, and is almost universally received in every corner of this kingdom'.⁴ According to Dimsdale, writing in 1776, 'in the county of Hertford, there have been two methods of public or general inoculation; one to inoculate, at a low price, as many of the inhabitants of any small town or village, as could be persuaded to submit to it, and at the same time were able to pay, refusing all those who had it not in their power to procure the money demanded. The other method has been, where the inhabitants of a town, or a district, of all denominations, have agreed to be inoculated at the same time, the parish officers or some neighbouring charitably disposed persons, having first promised to defray the expense, and provide subsistence for such of the poor, as unable to pay for themselves.'⁵ To some extent the emergence of the amateur inoculators served the needs of the poor who were unable to afford the price of professional inoculation and whose parish was unwilling to pay for a mass inoculation. A supporter of inoculation summed up the extent of the practice by writing in 1805 that 'smallpox inoculation was a well-known, proved, and absolute prevention from receiving the *natural Smallpox* infection, as millions of people who living can testify'.⁶ Inoculation did not disappear with the introduction of vaccination. On the contrary it remained very popular, especially with the poorer classes who were very prejudiced against vaccination. Ironically, inoculation and vaccination appeared to have supplemented one another in that virtually all of the population during the first half of the

¹ Many of these large towns founded dispensaries during the late eighteenth century which provided charitable inoculation. Although the London Smallpox Hospital only inoculated 36,378 people between 1746 and 1805, practitioners such as Daniel Sutton specialized in the inoculation of 'the families of artificers, handicraftsmen, servants, labourers, etc.' in the Metropolis.

² See the Appendix.

³ See S. and B. Webb, *English Local Government - English Poor Law History*, I (1927), 306. M. F. Davies, *Life in an English Village* (1909), p. 74. E. G. Thomas, *The Parish Overseer in Essex, 1597-1834* (London M.A. Thesis, 1956), p. 394.

⁴ *Medical Transactions*, II (1772), p. 279.

⁵ T. Dimsdale, *Thoughts On General and Partial Inoculations* (1776), p. 29.

⁶ W. Rowley, *Cowpox Inoculation no Security Against Smallpox* (1805), p. 4.

nineteenth century were protected by one injection or the other, sometimes by both.¹ Inoculation was eventually banned by law in 1840 at the instigation of the supporters of vaccination who accused inoculation of spreading natural smallpox to the unprotected.

Inoculation was very extensively practised in other countries, several of which encouraged it by legal enactments during the latter half of the eighteenth century, e.g. Sweden, Russia and Austria. It appears to have been particularly popular in Ireland where itinerant tinker inoculators proceeded 'from village to village several times during the year for the purpose of *inoculating* the infantile population'.²

III

In order to determine the significance of inoculation it is necessary to discuss the history of smallpox mortality before its effective introduction. By smallpox mortality we mean the proportion of every 100 children born who died from the disease during their lives. There are two methods of estimating such smallpox mortality: (1) multiplying the extent of the disease by its case-fatality rate (allowing for children who would have died before they had a chance to catch the disease); (2) counting the number of smallpox deaths and expressing it as a proportion of the number of births, such information being occasionally found in parish registers – in a period of static population growth the proportion of smallpox deaths to all deaths will approximate the ratio of smallpox deaths per number of births. In order to estimate smallpox mortality we will use both methods outlined above. First, however, it is necessary to discuss the problem in interpreting smallpox statistics.

There are five major difficulties in using figures of smallpox mortality: (1) The existence of a type of smallpox, known as fulminating smallpox, which does not manifest the classical pock symptoms because of the rapidity with which it kills its victims. It has only been discovered relatively recently, for as a current medical authority on smallpox has observed, 'this is "sledge-hammer" smallpox, and the diagnosis both clinical and at autopsy is impossible unless smallpox is thought of and unless laboratory facilities are available and used to grow the virus'.³ It is impossible to estimate what proportion of all smallpox deaths were of the fulminating kind; generally it would be highest in very isolated communities which lacked a pool of antibodies derived from frequent epidemics. (2) The variation in fatality of smallpox in different types of area. This was recognized by Lettsom when he wrote 'that in some countries, and even some counties of England, the infection does not appear for the space of some years; but when it does appear, it is more fatal; owing probably to this,

¹ See Dr J. Forbes, 'Some Account of the Small Pox lately Prevalent in Chichester and its Vicinity', *London Medical Repository* (September 1822), pp. 211–15, for an invaluable description of the history of inoculation and vaccination during the first two decades of the nineteenth century. Vaccination was not introduced into the area until 1812, although all the population appeared to have been protected by inoculation at least as early as the beginning of the nineteenth century.

² W. Wilde, 'Report on Tables of Deaths', *Population Census of Ireland 1851*, P.P., 1843 (24), p. xii.

³ C. W. Dixon, *Smallpox* (1962), p. 9.

that in great towns the infection being always prevalent, it is caught without the accumulated changes of air peculiarly favourable to epidemics; whereas, when it comes at stated periods, its malignity seems to be augmented by some unknown but deleterious state of the atmosphere.¹ This, we now know, was due to the creation of a pool of antibodies in the large towns through constant recurrence of smallpox epidemics, which it has already been noticed occurred to a lesser extent in isolated areas. (3) A large number of smallpox deaths were unregistered for other reasons. Lettsom, who had a great deal of experience with the health of the poor in London, estimated that smallpox mortality was nearly twice that recorded in the Bills of Mortality, 'the genetic article "convulsions" having swallowed up, in his opinion, a large number of the smallpox deaths of infants'.² Very young infants are known to be vulnerable to fulminating smallpox³ – and it appears that this could be partly the explanation of this mis-registration.⁴ Lettsom also pointed out that from smallpox 'some have been deprived of sight; many have been afflicted with the evil and scrofulous complaints, to which they had previously been strangers; many have been disabled in their limbs . . . at length, emaciated and debilitated, they have sunk under their miseries, and filled up the amazing list of consumptions; many of which originated from the violence of Natural Smallpox'.⁵ Smallpox mortality was also much higher when the disease converged with epidemics of other diseases; some of the increased mortality would be ascribed to the other disease. (4) Pregnant women are particularly vulnerable when attacked by smallpox,⁶ the great majority of their children dying because of such an attack. According to Dixon 'in forty-six cases where the infant's condition is recorded (when the mother has been attacked by smallpox), twenty-six were stillborn, and of the twenty born alive, eleven died later'.⁷ Most of the stillborn children and many of those infants which died soon after birth were probably not recorded in the parish registers as they would not have been baptized; those deaths which were recorded were probably attributed to some causes other than smallpox, e.g. convulsions. Also according to a doctor of the Bristol Royal Infirmary during the middle of the eighteenth century, 'the female sex whose cases from about 12 years of age to 50 become more dangerous on account of their menstrual discharges, which sometimes coming on in the beginning or State of the Disease proves fatal'.⁸ Thus the group of potential mothers was particularly vulnerable to death from smallpox, a fact that we shall discuss later in connexion with changes in the birth-rate. (5) Many people who died of smallpox appear to have been buried in non-consecrated

¹ T. J. Pettigrew, *Memoirs of the Life and Writings of the late John Cockley Lettsom* (1817), II 121, 122.

² Creighton, *op. cit.* p. 534.

³ Dixon, *op. cit.* p. 324.

⁴ See J. Haygarth, *A Sketch of a Plan to Exterminate the Casual Small-Pox* (1793), p. 141: 'The disease most fatal is to infants in convulsions, arising from various causes; one of them is the small-pox. The two circumstances will explain the reason why, under one year old, the proportion of deaths by the smallpox is less than in subsequent periods. . . .'

⁵ Pettigrew, *op. cit.* I, 6.

⁶ Dixon, *op. cit.* p. 326.

⁷ Dixon, *op. cit.* p. 113.

⁸ *Bristol Infirmary Biographical Memoirs*, I, 59.

burial pits near the pest-houses or infirmaries used for isolating those sick of the disease. In the Maidstone parish register the incumbent summarized the burials for the year 1760 with the following entry: 'Total Burials – 223. Of the Small Pox from Dec. 13–59. besides. These carried out of Town 102.' It is quite clear from examining the average number of burials in Maidstone that these 102 smallpox victims were not a part of the total 223 burials, a conclusion confirmed by examining the ages of those buried in the churchyard. It is thought that they were buried out at the pest-house because it was quite common practice in the eighteenth century for hospitals to bury their own dead. Both the Northampton and London bills of mortality had yearly returns of the number of people buried in local infirmaries. People responsible for isolating and nursing smallpox victims were also considered responsible for burying them,¹ and this was because people were so terrified of smallpox that they feared the corpses themselves; there are references in the literature of incumbents refusing to perform the burial rites, and relatives refusing to attend funerals.² The existence of these non-consecrated burial grounds not only poses a problem for the construction of smallpox mortality statistics but also for those demographic studies which assume that burials entered in the parish register represent the total number of deaths.

We are now in a position to estimate total smallpox mortality. As earlier stated, there are two methods in arriving at such estimates, the first being to multiply the extent of smallpox by its case-fatality rate. As to the extent of the disease, most writers regarded it as a universal affliction to which all were subjected at some time or other, e.g. D'Escheray, in his writings on smallpox in England, observed in 1760 that 'this distemper spares neither Age nor Sex, Rich and Poor are equally exposed to its influence. What is the most unaccountable, and so wide from all other fevers, is, that the Difference of Constitution is no preservative against its Attack, insomuch, that very few escape it, at one time or other.'³ This universality of smallpox is consistent with what we know about the nature of the disease; e.g. Dr J. F. D. Shrewsbury, the bacteriologist, has written that smallpox is 'the most highly infectious of the transmissible diseases of man'.⁴ It appears from statistical evidence that smallpox was endemic in London as early as at least the sixteenth century; in fact the disease was so endemic as to be found regularly every week in the bills of mortality during the seventeenth and eighteenth centuries. Smallpox deaths occurred in other large towns during the eighteenth century at least every year. Thus London, and other large towns to a lesser extent, were smallpox reservoirs from which the disease was constantly exported to the countryside.

The case-fatality rate of smallpox may be estimated from a series of smallpox censuses conducted during the 1720's. The figures compiled were for the number of total cases of smallpox sickness with the resulting numbers of deaths

¹ See, for example, W. Le Hardy (ed.), *Calendar to The Herts Session Books, 1752–1799*, VIII (Hertford, 1935), 226.

² See, for example, Document I.C. 1185, 1679 in the Northampton Record Office.

³ D. D'Escheray, *An Essay On The Smallpox* (1760), p. 2.

⁴ Private communication, 1964.

in thirty places. Of the 13,192 cases of people suffering from smallpox, 2,167 died i.e. an average case-fatality rate of 16.5 per cent.¹ This figure must be interpreted in the light of the difficulties in using smallpox statistics that we have already discussed. Three of the difficulties are relevant: (1) the figures would exclude cases of fulminating smallpox, the mortality from which is nearly 100 per cent; (2) large numbers of unregistered deaths would have been excluded, in the ways described by Lettsom; (3) variations in the fatality of smallpox varied from one type of area to another. With reference to the last difficulty, most of the censuses were conducted in market towns, many of them in Yorkshire and centres of industrial activity. These were towns of very frequently recurring epidemics, which consequently had a lower case-fatality rate than places like the isolated villages in Worcestershire studied by Eversley.² He has written that during the smallpox epidemic of 1725–30 in the area of Bromsgrove ‘a conservative estimate of the net loss of population at Hanbury is 164 out of the 716 alive in 1715’.³ This was similar to the epidemics in the Shetland Islands where ‘formerly the smallpox occasioned the most dreadful ravages in these islands frequently carrying off a fifth part of the inhabitants’,⁴ ‘in 1720, the disease was so fatal as to be distinguished by the name of the mortal pox. On this occasion tradition tells us, in the remote Island of Foula, probably inhabited by about two hundred people, it left only four to six to bury the dead’.⁵ This type of spectacular smallpox mortality was to be found in other extremely isolated places where the population had no pool of antibodies to protect them.⁶ It was noted by one contemporary medical observer ‘that when the smallpox is epidemic, entire villages are depopulated, markets ruined, and the face of distress spread over the whole country’.⁷ Certainly epidemics of the fatality of the one in Hanbury occurred quite often.⁸ As about 23 per cent of the total population of Hanbury was wiped out, the case-fatality rate must have been considerably higher than this, for many of the older members of the village must have had smallpox when they were younger. Thus it appears that the case-fatality rate of 16½ per cent derived from the smallpox censuses in the market towns is much too low for the country as a whole. It is impossible to estimate total smallpox mortality for the whole countryside using the present method; suffice it to say that smallpox was a universal disease with a recorded case-fatality rate varying from 16½ to 97 per cent.

The other method of estimating smallpox mortality is to use the parish

¹ For details of the censuses see Creighton, *op. cit.* 518, 519.

² D. E. C. Eversley, ‘A Survey of Population in an Area of Worcestershire’, *Population Studies*, X (1956–57).

³ *Ibid.* p. 267.

⁴ J. Sinclair, *The Statistical Account Of Scotland*, II (1792), 569–70.

⁵ Robert Cowie, *Shetland: Descriptive & Historical* (Aberdeen, 1871), pp. 73–75. See also Sinclair, *op. cit.*: XX (1798), 101, for another description of this epidemic.

⁶ See E. W. and A. E. Stearn, *The Effect of Smallpox on the Destiny of the American Indian* (Boston, U.S.A., 1945); also *Royal Commission on Vaccination*, 1st Report (1889), pp. 109, 110.

⁷ James McKenzie, *The History of Health* (1760).

⁸ See the *Parish Register of Burford* in 1758; also *Gentleman's Magazine*, XLII (1772), 542. Many of the mass inoculations suggest that a very large proportion of village populations were vulnerable to smallpox, e.g. at Irthlingborough, Northants, ‘upwards of Five Hundred People’ were inoculated in 1778, whereas the total population was only 811 by 1801.

registers and bills of mortality. Ideally, we would like to express the number of smallpox deaths as a proportion of the number of births. This is not always possible because of the lack of information about births, the deficiencies in registration, etc. When it is not possible, the proportion of smallpox deaths to all deaths will be used, as it will generally approximate the smallpox deaths/births ratio because of the relatively equal number of births and deaths during a period of static population. The smallpox mortality-rate in the eighteenth century varies from 11.6 smallpox deaths per 100 births in London during 1730–39,¹ 20 per 100 deaths in Dublin during the two approximate 30-year periods 1661–90 and 1715–46,² to an extreme proportion of 50 per 100 deaths in Great Chart, Kent, during 1688–1707.³ The majority of records (mainly for towns) yield an average figure of about 15 per cent of all births and deaths due to smallpox during the first half of the eighteenth century. All of the difficulties outlined earlier in the paper apply to these statistics and all of them would tend to increase actual smallpox mortality over recorded mortality, e.g. Lettsom's estimate of the true smallpox mortality in London would raise the figure for 1730–39 from 11.6 smallpox deaths per 100 births to over 20 per 100, this being in an area where smallpox mortality was at its lowest due to the endemic nature of the disease. Once again it is impossible to estimate exactly the magnitude of smallpox mortality, but for the time being it will be sufficient to note that recorded smallpox deaths accounted for between 11.6 and 50 per cent of all those born and dying, and that actual smallpox mortality was possibly twice as large as that actually recorded.

IV

Why has the possibility of inoculation reducing smallpox mortality been rejected by previous historians? The two basic reasons for rejecting the effectiveness of inoculation have been: (1) the argument that inoculation spread natural smallpox to the unprotected; (2) the continuance of smallpox deaths in the bills of mortality of some of the large towns.

There are several reasons why the objection that inoculation spread natural smallpox is spurious: (a) smallpox was already a universal disease before the introduction of inoculation; (b) inoculation had become so widespread by the end of the eighteenth century that only a relatively small proportion of the population was left unprotected; (c) experimental and other evidence is available to show that inoculation did not spread natural smallpox to the unprotected. This conclusion is supported by the fact that *vaccination is in reality a more attenuated form of inoculation*.⁴

¹ J. Marshall, *Mortality of the Metropolis* (1832).

² J. Fleetwood, *History of Medicine in Ireland* (Dublin, 1951), p. 65; Dr J. Rutty, *A Chronological History of the Weather and Seasons, and of the Prevailing Diseases in Dublin* (Dublin, 1770).

³ M. C. Buer, *Health, Wealth, and Population in the Early Days of the Industrial Revolution* (1926), p. 190.

⁴ It is impossible in this paper to document this very controversial statement. The subject is of sufficient importance to warrant a separate paper. Suffice it to say that the inoculators were able to produce a single vesicle at the site of injection identical to that of vaccination, through a process of attenuation. Inoculation was superior to vaccination in that it conferred life-long immunity against further attacks of smallpox, owing to the larger amount of virus injected.

Smallpox did continue to kill substantial numbers of children in some of the large towns during the late eighteenth century, but this has misled medical historians for two reasons: (a) the total population increased very rapidly in these places and if the number of smallpox deaths is expressed as a proportion of the number of children at risk, a marked reduction in smallpox mortality is seen to have taken place; (b) as we have already seen, these large towns were atypical in that inoculation spread much later in them than elsewhere. This was stated quite explicitly by Howlett in 1781: 'It may be thought, at first sight, that the healthiness of London is more increased than that of country towns. . . . But it must be remembered that the diminished mortality in the latter appears to be chiefly owing to the salutary practice of inoculation; whereas in the former, for want of universality, it has hitherto been of little advantage. . . . In provincial towns and villages, as soon as this disorder makes its appearance, inoculation takes place amongst all ranks of people; the rich and poor, from either choice or necessity, almost instantly have recourse to it; and where two or three hundred used to be carried to their graves in the course of a few months, there are now perhaps not above 20 or 30.'¹

*Smallpox Mortality at Maidstone, 1754-1801*²

Period	Smallpox burials	All burials
1752-63	252	1,703
1762-71	76	1,426
1772-81	60	1,549
1782-91	91	1,676
1792-1801	2	2,068

An illustration of this reduction of smallpox mortality is to be found at Maidstone in Kent.

A mass inoculation was conducted by Daniel Sutton in 1776 and its effects were described by Howlett in a pamphlet by him in 1782. 'Upon casting an eye over the annual lists of burials, we see that, before the modern improved method of inoculation was introduced, every 5 or 6 years the average number was almost doubled; and it was found upon enquiry, that at such intervals nearly the smallpox used to repeat its periodical visits. . . . in the short space of 30 years it deprived the town of between five and six hundred of its inhabitants; whereas in the 15 or 16 years that have elapsed since that general inoculation it has occasioned the deaths of only about 60. Ample and satisfactory evidence of the vast benefits the town has received from that salutary invention.'³ There are many other statistical tables which can be produced to prove the effective-

¹ Rev. J. Howlett, *An Examination of Dr Price's Essay on The Population of England and Wales* (Maidstone, 1781), p. 94.

² Taken from the *Parish Register of Maidstone*, lodged in All Saints, Church, Maidstone. Smallpox deaths disappeared from the register after 1797. This gradual decline of smallpox cannot be attributed to a decrease in the virulence of the disease as all the evidence points to the opposite conclusion, i.e. an increase in its virulence, e.g. the case-fatality rates at the London Smallpox Hospital were as follows in 1746-63, 25%; 1775-99, 32%; 1836-1856, 35%. See the *Royal Commission on Vaccination*, 1st Report (1889), p. 74 and the *Royal Commission on Vaccination*, 3rd Report (1890), p. 100.

³ J. Howlett, *Observations On The Increased Population. . . Of Maidstone* (Maidstone, 1782), p. 8.

ness of inoculation,¹ the most detailed being for Boston, U.S.A. during the eighteenth century, from which it is possible to attribute the reduced mortality directly to inoculation.²

The effects of inoculation were described in contemporary literature; e.g. in *She Stoops To Conquer* written in 1773, Mrs Hardcastle says to Hastings: 'I vow since Inoculation began, there is no such thing to be seen as a plain woman. So one must dress a little particular; or one may escape in the crowd.' Arthur Young, writing an essay on population in 1781, wrote: 'In several of these parishes where population had for some periods been rather on the decrease, a great change has taken place lately, and the last ten years are found to be in a rapid state of progression; as considerable drains of men have been made from almost every parish in the kingdom for the public service in that period, I should not have expected this result, and know nothing to which it can be owing, unless the prevalence of inoculation, which certainly has been attended with a very great effect.'³ There are also references to the effects of inoculation on mortality in the reports on agriculture made by local observers to the Board of Agriculture at the end of the eighteenth century, e.g. 'I may further add, that since the year 1782, when these observations were made, the population of this parish has been increasing: most certainly inoculation for the Smallpox. . . has been most essential to population throughout this kingdom'.⁴ Similarly John Holt of Lancashire wrote in 1795: 'One reason, why persons in large manufactories in Lancashire, do not frequently die in great numbers. . . is that they have (in general) been inoculated in their infancy. Inoculation is the most effectual of all expedients for preserving the short lived race of men – many gentlemen pay for inoculation of the children of the poor in their own neighbourhood.'⁵

In 1796 it was observed that 'the increase of people within the last 25 years is visible to every observer. Inoculation is the mystic spell which has produced this wonder. . . before that time it may be safely asserted, that the malady, added to the general laws of nature, did at least equipoise population. It is now 30 years since the Suttons and others under their instructions, had practised the art of inoculation upon half the kingdom and had reduced the chance of death to 1 in 2,000.'⁶ Similarly another gentleman observed later in 1803 that 'one very great cause of increasing population may be ascribed to the

¹ For the sources of these statistics see: the parish registers of Basingstoke (Hants), Calne (Wilts), Milton Ernest (Beds), Whittington (Salop), Selattyn (Salop), Boston (Lincs). For other statistics see 'An Abridgement of the Observations on the Bills of Mortality in Carlisle, 1779–1787' by Dr Heysham in W. Hutchinson, *The History of Cumberland* (Carlisle, 1794), pp. 668–75.

² The number of inoculations in this town increased from 287 in 1721 to 9,152 in 1792, which was the vast majority who had not had smallpox before. Smallpox mortality fell from 175 smallpox deaths per 1,000 living population in 1677–78 to 10 per 1,000 in 1792, and this was in spite of the fact that the virulence of the disease generally increased throughout the period. See J. Blake, *Public Health in the Town of Boston (Mass.), 1630–1822* (Cambridge, U.S.A. 1959), p. 244. H. R. Viets (Ed.), *A Brief Rule to Guide the Common People of New England* (1937) p. xxxv. *Royal Commission on Vaccination*, 6th Report, Parl. Pap. 1896 (47), p. 762.

³ A. Young, *Annals of Agriculture*, VII (1786), 455.

⁴ J. Plymley, *General View of the Agriculture of Shropshire* (1803), pp. 343, 344.

⁵ J. Holt, *General View of the Agriculture of Lancaster* (1795), p. 208, n.2.

⁶ *Gentleman's Magazine*, LXVI, 1 (1796), n. 112.

success of inoculation for the Smallpox. One in four or five, or about 200 to 250 in a thousand, usually died of this loathsome disorder in the natural way of infection . . . so that this saving of lives alone would account for our increasing number, without perplexing ourselves for any other cause.¹

It is necessary to attempt to evaluate the claims that some contemporaries made of the effect of inoculation on population growth. Unfortunately there is virtually no reliable demographic data available with which we can do this. An analysis of the 'county family' life tables suggests that a reduction of about 25 per cent in mortality amongst the younger age-groups could account for the whole increase in expectation of life between 1681-1730 and 1781-1830. The same conclusion probably applies to both the ducal families and the whole of the aristocracy. For the population as a whole there is no data sufficiently reliable to test the hypothesis directly. However, it is possible to construct a simple hypothetical model whose limits are defined by the small amount of reliable information that we do possess. In 1697 Gregory King constructed a 'life table' for Lichfield; Professor Glass has written that 'it would appear that by taking Lichfield as a basis, King began with a collection of statistics which were probably not markedly untypical, and then adjusted more acceptably as an indication of national structure'.² It is possible by using King's 'life table' to construct a hypothetical population reproduction model for our period.

Female Population Reproduction, 1750-1855

		Numbers surviving in the following years							
		1750	1765	1780	1795	1810	1825	1840	1855
Numbers surviving to the following ages (years)	0	1000	1071	1237	1468	1762	2116	2538	3045
	15	620	680	793	952	1138	1366	1640	1967
	30	450	480	559	659	798	956	1146	1376
	45	315	325	357	422	498	603	722	866
	60	190	190	196	215	255	300	364	435
	75	50	50	50	52	57	67	79	85
	90	0	0	0	0	0	0	0	0
Population Index ³		2125	2260	2573	3034	3627	4350	5220	6251

The above model was constructed on the following assumptions: (1) increase in the female population was proportionate to the increase in total population; this ignores the effects of the relationship between the number of males and females, e.g. the proportion of married women who were widowed; (2) of 1,000 female children born before 1750, the numbers surviving to various ages were the same as in King's 'life table'; (3) the population was static before 1750, based on an age-specific birth-rate of 1 female child born for every 13.7625 women living between 15 and 45; (4) the age-specific birth-rate remained constant throughout the whole period; (5) of every 1,000 born, lives were saved in the following manner:

¹ *Gentleman's Magazine*, LXXIII, 1 (1803), 213.

² D. V. Glass, 'Gregory King's Estimate of the Population of England and Wales, 1695', *Population Studies*, III (1949-50), 368.

³ This population index is the sum of the average number of people living in each age-period, i.e. I have not bothered to multiply by 15 throughout.

Ages (years)	Under 15	Period			
		1750-65	1765-80	1780-95	1795-1810
	60	60	20	15	
	15-30	30	30	5	
	30-45	10	10	5	
				0	

In all, it is assumed that 250 lives were saved out of 1,000 born. According to our earlier estimates of population growth, it almost exactly trebled between 1750 and 1851. In our model it does not quite do this, but we assumed that population was static before 1750, whereas according to the earlier estimates it was increasing about 0.2 per cent per annum between 1700 and 1750. If an allowance is made for this pre-1750 growth, population in our model increases by 3.2 times between 1750 and 1851; the greater the allowance made for pre-1750 growth the more the model population increase will exceed that as estimated. The point of the model is not to describe exact changes in the population structure, but rather to estimate the magnitude of lives required to be saved in order to generate the rate of increase in estimated population. The assumptions are thought to be realistic because: (1) the crude birth-rate appears to have been very similar between the 1690's and the 1840's;¹ (2) the saving of life (250 out of 1,000 born) assumed is very similar to that which took place amongst the gentry and aristocracy.

In order for inoculation against smallpox to account for the whole of the population increase, smallpox mortality before inoculation must have been about 310 deaths per 1,000 born, for of the 250 lives saved of every 1,000 born in our model, about 45 would have died of other diseases during the same age-period, while smallpox accounted for about 1½ per cent of deaths of all born during 1838-4,² when civil registration was first introduced. It is impossible to state definitely that smallpox mortality before inoculation was as high as 310 deaths per 1,000 born, but we may conclude from our earlier discussion that this is certainly a plausible figure. It must be remembered that much of this saving of life would have been indirect, inasmuch as the elimination of smallpox attacks probably increased the expectation of life of those who did not die of the disease. Also the vulnerability of mothers and other young adult females to smallpox could have meant that the elimination of the disease led to an increase in the birth-rate; e.g. at Basingstoke (Hants) the average number of baptisms in the ten years before the smallpox epidemic in 1741 was 69.6, whereas in the following ten years it fell to 45.5 (a much greater fall than the average number of deaths and therefore presumably the population), which

¹ The birth-rate was estimated as 34.5 births per 1,000 living during the 1690's by Gregory King and 35.2 per 1,000 during 1841-45 by Professor Glass from civil registration returns. See G. King 'Natural And Political Observation 1696' in George Chalmers, *An Estimate of the Comparative Strength of Great Britain* (1804), p. 44; and D. V. Glass, 'A Note on the Under-Registration of Births in Britain in the Nineteenth Century', *Population Studies*, V (1951), 85. Professor Glass has written about the basis of King's estimate: 'the statistics collected were more comprehensive than any provided previously and, indeed, than any subsequent statistics prior to the establishment of the full mechanism of censuses and civil registration in the nineteenth century'. See D. V. Glass, 'Gregory King and the Population of England and Wales', *Eugenics Review*, 37 XXXVII (1946), 175.

² See Creighton, *op. cit.* This figure includes chickenpox deaths, which is assumed to approximate omissions due to fulminating smallpox, etc.

was possibly due to the fact that one half of the smallpox deaths occurred amongst adults.¹ A rise in the age-specific birth-rate was not allowed for in the population reproduction model for two reasons: (1) simplicity and economy; (2) the very long term stability of the estimated crude birth-rate. Thus any increase in the birth-rate has been absorbed for analytical reasons into a fall in the death-rate.

Although it is not possible to analyse in any detail the history of other diseases, it is possible to draw some conclusions from bills of mortality. For example, in Northampton there was no major epidemic of any disease, other than smallpox, during the hundred-year period after 1736 when records were-kept.² Smallpox epidemics occurred every seven years on average in Northampton before the introduction of inoculation; the listing of diseases and epidemics was very similar in a place like Maidstone; i.e. recurrent severe smallpox epidemics were the only causes of sharp rises in mortality-rates. This would indicate that the sharp peaks in mortality found in many local studies were due to smallpox and that they only disappeared with the introduction of inoculation.

Ideally one would like to trace the history of all diseases in order to evaluate their importance in contributing to total mortality, but unlike smallpox, most other diseases prevalent in the eighteenth century are not sufficiently distinctive to be analysed statistically. Many incumbents in their returns to Sir John Sinclair for the *Statistical Account of Scotland* discussed the history of diseases in their parish. No disease, other than smallpox (due to inoculation), was described as having declined or disappeared, except ague (malaria) which is very frequently mentioned as having disappeared during the latter half of the eighteenth century. Recently, one medical authority has questioned whether malaria was ever endemic in Britain.³

However, the incumbents so consistently mention that the disappearance of ague was linked with the draining of marshes, the reclamation of swamp-land etc., that one is led to suspect that the disease they described was malaria; this is confirmed by any descriptions of the disease that they give. Buer, in her discussion of malaria, maintained that although 'its direct effect on the death-rate was small, its indirect effect must have been great'.⁴ Certainly it rarely appeared in the bills of mortality and parish registers as a cause of death even during the early eighteenth century. Malaria in England is a subject which warrants further investigation.

Although this paper has laid great stress on the importance of inoculation against smallpox as a cause of the population explosion during the eighteenth century, this does not rule out the role of other explanations.⁵ However, while there is no convincing evidence for any of these other explanations we must provisionally reject them, and such a rejection can only be nullified by detailed

¹ See the *Basingstoke Parish Register*.

² See the *Northampton Bills of Mortality* in the British Museum Library.

³ McKeown and Brown, *op. cit.* p. 124, n. 4.

⁴ M. C. Buer, *op. cit.* p. 212.

⁵ For example, the effects of the changing distribution of population between rural and urban areas has not been discussed in this paper.

and plausible evidence to the contrary. Inoculation against smallpox could theoretically explain the whole of the increase in population, and until other explanations are convincingly documented, it is an explanation which must stand as the best one available.¹ Although the Industrial and Agricultural Revolutions did not cause the population explosion, they at least enabled population to grow unchecked. In Ireland where such Revolutions did not take place, the Malthusian check of mass starvation was the result of a rapidly increasing population without concomitant changes in the structure of the economy. The main achievement of the Industrial and Agricultural Revolutions in their earlier phases was the *maintenance* of the standard of living in a period when population was growing for reasons unconnected with the Revolutions themselves.

APPENDIX

In order to indicate the extent of mass inoculation, a sample was taken of those described in local histories, medical commentaries, accounts of the Overseers of the Poor, local newspapers, etc. The following list is in no sense comprehensive or representative, but merely a series of isolated examples culled from the literature, mainly from the South of England. The name of the town is given first, followed by the date of the mass inoculation:

Guildford, Surrey, 1740's. Salisbury, Wilts., 1751-52. Bradford-on-Avon, Wilts., 1752-53. Blandford, Dorset, 1753, 1766. Wootton-Under-Edge, Gloucs., 1756. First Regiment of Foot Guards, 1756. Beaminster, Dorset, 1758, 1780, 1791. Maldon, Essex, 1764. Maidstone, Kent, 1766. Marnham, Notts., 1767. Rye, Sussex, 1767. Neighbourhood of Norwich, 1769. Burton, Lincs., 1770. Berkhamstead and surrounding villages in Herts., 1770. Corsley, Wilts., 1773; Meopham, Kent, 1776. Bedford, Beds., 1777. Ware, Herts., 1777. Great Clivall, Essex, 1778. Irthlingborough Northants, 1778. Villages in the neighbourhood of Carlisle, Cumberland, 1779, 1781. Cricklade, Wilts., 1783. Painswick, Gloucs., 1786. Knowle, Kent, 1787. Weston(?), 1788. Northwold, Norfolk, 1788. Cowden, Kent, 1788. Luton, Beds., 1788. Bozeat, Northants., 1789. Chislehurst, Kent, 1790, 1799. Toddington, Beds., 1790, 1801, 1824. Weston, Norfolk, 1791. Eaton Socon, Beds., 1793, 1800, 1808. Hevingham, Norfolk, 1794. Berkeley, Gloucs., 1795. Hastings, Sussex, 1796-97. Dursley, Gloucs., 1797. Three villages near Gillingham, 1797. Tenterden, Kent, 1798. Rayne, Essex, 1806. Chichester, Sussex, 1806, 1812, 1821.

Under Dimsdale's influence, mass inoculations increasingly became 'general' rather than 'partial'.² General inoculations usually involved a degree of compulsion as was described by Cowper, the poet, in 1788: 'the smallpox has done, I believe, all that it has to do at Weston. Old folks, and even women with child, have been inoculated . . . No circumstances whatsoever were permitted to exempt the inhabitants of Weston. The old, as well as the young, and the pregnant, as well as they who had only themselves within them, have been inoculated . . .'³ An example of the

¹ This is particularly true with respect to the increase in expectation of life of the aristocracy and gentry.

² See, for example, T. Dimsdale, *Remarks on 'A Letter to Sir R. Barner . . .'* (1779), p. 13; and Walker, *op. cit.* p. 467, n.

³ S. and B. Webb, *op. cit.* p. 306, n. 2.

effects of general inoculation is to be found at Calne, Wilts. A local surgeon, Mr Wayte, described in 1795 a general inoculation as follows: 'in September, 1793, when the poor of the parish were inoculated. . . We inoculated six hundred and upwards. . . Besides the poor, I inoculated about two hundred (private) patients. . . Now in inoculating a whole parish, we have no choice of patients, all ages, and the sickly as well as others, were inoculated; but these were mostly children, as I assisted in inoculating the whole parish, about twelve or thirteen years ago.'¹ According to the Calne parish register the number of smallpox deaths declined as follows:— 1723–42 – 205; 1743–62 – 122; 1763–82 – 54; 1783–1802 – 8. The last mention of smallpox deaths is in 1793 when there were 6; previous to this there had been a very minor epidemic in 1782 involving 10 deaths (this was the epidemic which provoked the earlier general inoculation mentioned by Wayte). These late eighteenth-century epidemics should be compared with the major ones in the early eighteenth century, e.g. in 1732 there were 173 people registered as dying from smallpox.

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¹ Thomas Beddoes, 'Queries Respecting A Safer Method of Performing Inoculation' in Don A. De Gimbernat (Beddoes translated), *A New Method of Operating for the General Hernia* (London, 1795), pp. 56–59.