THE DECLINE OF INFANT MORTALITY IN ENGLAND AND WALES 1871-1948: A MEDICAL CONUNDRUM. MICRO LEVEL STUDY OF BEXLEY URBAN SUB-REGISTRATION DISTRICT 1893-1898.

Thesis

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THE DECLINE OF INFANT MORTALITY IN ENGLAND AND WALES 1871-1948 : A MEDICAL CONUNDRUM

MICRO LEVEL STUDY OF BEXLEY URBAN SUB-REGISTRATION DISTRICT 1893 - 1898

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ABSTRACT

It is the aim of this thesis to examine the infant mortality rate within the Bexley Sub-Registration District in the years 1893-1898, in order to test the theories put forward by other writers, as to the factors bearing upon it. Whereas the statistics produced by the Registrar General are only available down to the sub-registration district or town level, this research uses vaccination, parish and cemetery registers to identify the actual individuals concerned and the streets and houses in which they lived. The births and infant deaths are considered by sex, legitimacy, social status, locality and such external factors as sewerage and water supply, in order to examine whether or not there is a direct link between any or all of these factors and the infant mortality rate.

The key conclusion from this research is that there is no single factor accounting for levels and changes in the infant mortality rate, rather it is affected by a combination of different factors. Certainly children born outside marriage consistently experience a higher infant mortality rate than those born within it, possibly because single parents (almost invariably women) have reduced incomes with implications for diet, housing, sanitary conditions etc. Social status and locality do not appear, from this study, to influence the infant mortality rate greatly. The infant mortality rate amongst male children is, however, consistently higher than that for females. My main contention is that sanitary conditions and water supply were the most important factors, a contention supported by both the statistical and documentary evidence available at this micro-level.

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INTRODUCTION

Much work has already been undertaken on the subject of infant mortality, with a particular focus on the period from the second half of the nineteenth century (Bell & Millward 1998, Garrett & Reid 1995, Haines 1995, Lee 1991, McKeown, Record & Turner 1975, Mooney 1994, Woods, Watterson & Woodward 1989 and others). This work was made possible by the introduction of Civil Registration in 1837 : the official recording of all births, marriages and deaths. The data showed that, in England and Wales, as a whole, the infant mortality rate (deaths under one year per 1000 live births occurring in the same year) appears to have been relatively constant from 1837 until the end of the nineteenth century (see Appendix 2). From the beginning of the twentieth century this infant mortality rate began to fall with the greatest reduction taking place in the first half of the century. Many previous researchers have analysed the available data and tried to explain the reasons for the declining mortality rate and a number of theories have emerged which will be discussed later. The major problem with the data previously used is that they were only available for whole registration districts which meant that generalisations had to be made eg, the whole district had to be classified as urban or rural, and the population as having a particular social mix, e.g. industrial or agricultural This did not take account of variations within the district.

Dartford Registration District comprises 3 Registration sub-districts : Bexley, Dartford and

Farningham. It is the intention of this thesis to analyse the data for Bexley sub-district, for the years 1893 to 1898 in more detail. These particular years were chosen because the infant deaths within the district rose slightly each year throughout the years 1893 to 1897 to be followed by a large peak in 1898. It was hoped that the contrast between a stable period of time and a peak year would highlight the particular factors affecting mortality. This period also allowed me to make use of a report by Dr Deane Sweeting to the Local Government Board in 1900 which gives a detailed description of the villages as will be detailed below. Within the Bexley sub-district were two sanitary districts, Bexley Urban District and Erith Urban District. Bexley Urban District comprised the ecclesiastical parishes of Bexley, Bexley Heath, Crayford and Lamorbey whereas Erith Urban District comprised Erith and Belvedere. Some of the data relate to the entire sub-district but some tables provide data by sanitary district. By separating the data by parish within the sub-district and by looking at the five largest parishes the hypotheses relating to urban and rural infant mortality can be tested at a micro level. For example, by looking at the social status of each of the families having infant births and deaths it can be ascertained if social status was a contributing factor.

BEXLEY SUB-DISTRICT

Bexley is now a London Borough and as such is visually inseparable from the rest of outer London. This was not the case 100 years ago when the district mainly comprised a number of small villages and hamlets separated by large areas of agricultural land, heathland and woodland. The whole area is bordered on the north by the River Thames and is relatively low lying with the highest point being in Bexley Heath at about 50 metres above sea level. This thesis considers the topography of the area alongside sewerage and sanitation to consider whether low lying areas which cannot use gravity to dispose of sewage have a higher level of infant mortality. I will focus on five parishes within the sub-district namely

Bexley, Bexley Heath, Belvedere, Crayford and Erith. These particular parishes were chosen for two main reasons. Firstly, each of these parishes yielded at least fifty infant births per annum. Therefore the infant mortality rate would be statistically more significant at a parish level than for smaller villages. Also, there is much variety within the district as to the nature of each parish, sewerage and sanitation arrangements, its locality and its inhabitants and these five parishes are each different enough to afford a useful comparison with one another. It is my intention to examine the changes in infant mortality rates between the parishes with special consideration being given to the nature of the local environment (small agricultural village against small town), the social class of the families concerned, proximity to good sewerage/sanitation, sex, and legitimacy.

Bexley is a long established village even now only at the edges of London's boundary and close to the countryside which had been a feature of its history. In the early part of the nineteenth century a small amount of development began in the form of a few cottages, a school and a pub but there was little further development until 1866 when the railway line was opened with a station in the heart of the village on a line which joined neighbouring Dartford with London. Housing estates followed shortly after including finer dwellings aimed at the middle classes and professionals and attracting city commuters. This growth is marked by the building of a second church in the village in 1882. Bexley stands directly on the River Cray (see map of district in Appendix 1) as it flows down to join the River Thames and is at a height of approximately 20 metres above sea level.

Bexley Heath was, at the start of the nineteenth century, little more than a dozen cottages built on the wild heathland above Bexley village. It was initially known as Bexley New Town in view of its close proximity to Bexley, being only a mile away. By the end of the nineteenth century Bexley Heath was established as a town with a resident population that

worked in neighbouring areas either in agriculture to the south or in the industrial area to the north. The housing by the end of the century was largely in terraced streets aimed at the working and lower middle class. As mentioned earlier, Bexley Heath marks the highest point of Bexley sub-district and commands a view of the whole district on all sides. The railway line through Bexley Heath, also linking Dartford with London, only arrived in the town in 1895 and as such was not a major factor in the development of the town until the twentieth century.

Belvedere lies in the far north of the district and began to take form in the mid-nineteenth century with the enclosure of heathland. Development was accelerated by the arrival of the railway in 1859, forming another line linking Dartford and London. There was a mix of more substantial housing in one part of the village and working class housing in another, for employees of the nearby factories. Belvedere lies at a height of about 25 metres above sea level and north of the village the level drops down to Erith Marshes by the side of the Thames at little above sea level.

Crayford is another long established village situated at the point where the old London to Dover road forded the River Cray. It was one of the more industrialised villages in the area with local businesses including calico and printing works. The River Cray is joined by the River Shuttle between Bexley and Crayford and itself feeds into the River Thames shortly after passing through the centre of Crayford. Most of Crayford only lies at 10-15 metres above sea level, and is very close to the Crayford and Dartford marshes which flank either side of the River Cray, just before it reaches the Thames.

During the late nineteenth century **Erith** probably underwent the greatest transformation of all the villages in the district. In the mid-nineteenth century the village was a part middle class suburb, part industrial, with working class housing, and part riverside leisure resort,

although the latter was never very successful and the pier and hotel on the river were sold in 1874 to become offices and a coal wharf. Tourist literature of time promotes the healthy aspects of the air at Erith on the banks of the Thames however the industrial nature of the locality coupled with one of the main sewage outfalls into the Thames at Crossness a short distance away makes these claims somewhat dubious. Following the arrival of the railway in 1849, the population of Erith rose, which in turn gave rise to industrial expansion of the area. Few of the residents were London commuters, since only a small proportion of the trains from London travelled as far down the line as Erith. Lying on the south bank of the River Thames, the river was also a major factor in Erith's industrial development. During the period 1891 to 1901 the population of Erith Urban Sanitary district expanded from 13,414 to 25,296 and carried on growing into the twentieth century.

Population Growth and Overcrowding

The whole of the Bexley sub-registration district grew in population during the period 1891 to 1901. This was largely due to the expanding industry and town of Erith as well as the further establishment of Belvedere as a residential area for people working in both London and Erith. The population growth during this decade is shown in Table 1 below :-

Table 1 : Population growth within Bexley Sub-District between 1891 and 1901

		Population	
	1891	1901	Growth
Bexley + Bexley Heath	10605	12918	21.80%
Crayford	5268	6572	24.80%
Erith + Belvedere	13414	25296	88.60%
Total	29287	44786	52.90%

Source : 1901 Census of England and Wales (Table 9)

Did this population expansion lead to overcrowding? The 1901 Census of England and Wales provides us with details of the population within each ecclesiastical parish as well

as the number of inhabited houses, as shown in Table 2 below :-

Table 2 : Average number of persons per inhabited house within each parish

Parish	Inhabited houses	Population	Average persons per house
St Mary, Bexley	720	3578	5.0
Christchurch, Bexley Heath	1655	8237	5.0
All Saints, Belvedere	1671	9826	5.9
St Paulinus, Crayford	1064	5393	5.1
Christchurch, Erith	761	4215	5.5
St John the Baptist, Erith	2067	12434	6.0
Total of both Erith Churches	2828	16649	5.9

Source : 1901 Census of England and Wales (Table 5)

Whilst this clearly shows that Erith and Belvedere have more persons per house than other parishes, it cannot be assumed there is overcrowding in these parishes since it is not stated how large the houses are in each area. However, the census can give us some indication of how overcrowded some of the housing was, since this information is available for tenements at urban district level as shown below in Table 3 :-

Table 3 : Number of occupants per tenement in Bexley Urban District

Bexley Urban District (Includes Bexley Heath and Crayford													
Rooms	Number	% of total	Number of residents										
		tenements	1	2	3	4	5	6	7	8	9	10	11	12+
1	61	9.5	43	16	2	0	0	0	0	0	0	0	0	0
2	91	14.1	28	31	20	6	5	0	1	0	0	0	0	0
3	115	17.8	10	30	26	22	14	10	2	1	0	0	0	0
4	378	58.6	13	60	64	71	54	42	32	19	13	9	1	0

Source : 1901 Census of England and Wales (Table 20)

Of the 2758 tenements, 645 (23%) had fewer than 5 rooms. The data in the above table can be analysed further to show whether there is any evidence of overcrowding in these smaller tenements :-

Table 4 : Table to show the occupancy of tenements in Bexley Urban District

Rooms in tenement	Max. no. of persons	Average number of residents per dwelling
1	3	1.3
2	7	2.3
3	8	3.4
4	11	4.6

Source : 1901 Census of England and Wales (Table 20)

In each size of dwelling there was on average slightly above 1 person per room which seems quite comfortable. The greatest example of overcrowding was in one of the 2 room dwellings which was occupied by 7 persons ie, 3.5 persons per room.

The other two villages, Erith and Belvedere, fall within the area of Erith Urban District. Details of small tenement occupation in this district is as shown in the following table :-

Table 5 : Number of occupants per tenement in Erith Urban District

Erith Urban District (includes Belvedere)														
Rooms	Number	% of total	Number of residents											
		tenements	1	2	3	4	5	6	7	8	9	10	11	12+
1	95	4.7	53	24	13	4	1	0	0	0	0	0	0	0
2	370	18.5	41	129	115	44	26	8	5	2	0	0	0	0
3	565	28.3	10	130	163	119	73	38	19	8	3	1	1	0
4	969	48.5	16	120	181	198	153	131	79	55	18	15	1	2

Source : 1901 Census of England and Wales (table 20)

Of the 5135 tenements in the Erith Urban District, 1999 (39%) had less than 5 rooms. This compares with 23% in the Bexley Urban District showing that there were significantly more smaller tenanted properties in the Erith area. This is not surprising since Erith was more an urban area with space being at a premium whereas the majority of the Bexley district was rural. The data in the above table can be analysed further as shown below (Table 6) :-

Table 6 : Table to show the occupancy of tenements in Erith Urban District

Rooms	Max. no. of persons	Average
1	5	1.7
2	8	2.8
3	11	3.7
4	12+	4.6

Source : !901 Census of England and Wales (Table 20)

The average number of persons per dwelling is only slightly higher than for the Bexley district with the average not reaching 2 persons per room for any size dwelling. However, the maximum number of persons per room is consistently above the 3.5 persons maximum as found in the Bexley district for every size of dwelling. One of the one room tenements was actually shared by five persons which must have provided very cramped conditions for living, eating and sleeping.

Occupation Profile

The two sanitary districts had a different employment profile, as can be seen by considering the three largest male and female occupational groups from the 1901 census reports on each part of the area :-

Table 7 : Largest occupational groups by urban district

Bexley Urban District (includes Bexley Heath and Crayford)

	Number of persons	% of those in employment
Male		
Building and construction works	615	16.7%
Agriculture	525	14.3%
Food, tobacco, drink, lodging	340	9.2%
Female		
Domestic indoor servants (not hotels)	933	58.8%
Laundry and washing services	129	8.1%
Tailoresses, milliners, dressmakers, shirtmakers and seamstresses	114	7.2%

Erith urban district (includes Belvedere)

	Number of persons	% of those in employment
Male		
Engineering and machine making	2712	26.4%
Conveyance of men goods and messages	982	9.6%
Building and construction works	887	8.6%
Female		
Domestic indoor servants (not hotel)	658	44.7%
Other unspecified occupations	245	16.6%
Tailoresses, milliners, dressmakers, shirtmakers and seamstresses	201	13.6%

Source : 1901 Census of England and Wales

A comparison of these two districts suggests both similarities and differences. Within both districts, one of the largest occupational groups for men was building and construction. This was probably due to the expansion of the whole area, it being part of the London commuter belt, as well as expanding local industries, both of which attracted migration into the area. As expected, agriculture featured as a large occupation group in the Bexley district employing 14.3% of men whereas in the Erith area it did not feature as a major occupation group only employing 2.2% of the working male population. In Erith the two largest occupational groups for men were engineering and machine making (26.4%) and conveyance of men goods and messages (9.6%) both of which reflect the character of the area as an industrial and commercial centre with a lot of movement of goods and people and extensive river trade via the River Thames. The comparable percentages of the working male population for the Bexley district were 5.9% and 8.4% respectively showing that this was a much smaller feature in what was a mainly rural economy.

There is a much greater similarity between the occupations of working females in each district. The largest group in both districts was of domestic indoor servants which accounted for a large proportion of the working women. The category for tailoresses and

related trades also featured in the top three for each district. Both these classes were areas of occupation traditionally within the sphere of female employment. Bexley also had a high population of women involved in laundry duties, another traditional female role. An interesting variation between the two districts was the percentage of women engaged in any occupation which was 28.9% of all females in the Bexley area but only 17.3% of all females in the Erith district. Given the fact that the percentage of the labour force employed as indoor domestic servants was higher in the Bexley area, the overall higher number of employed females would seem to be a reflection of the fact that more houses had servants, presumably because they were generally larger and the families more prosperous in the rural district. However the census was not reliable in recording the occupation of females as it did not record part time or occasional work by women and therefore we must exercise caution as to how much credence we give to these findings.

SOURCES AND METHODS

This study is based principally on the **vaccination birth registers** compiled as a result of Government legislation in 1871. This required the registration of all births for the purposes of compulsory vaccination. These registers record each infant birth in a district (recording the number in the birth register in order to ensure none were missed) along with name and occupation of the parent registering the birth, this being only the mother if the birth were illegitimate. This main occupation detail enables the social status of the family to be ascertained and also whether the child was legitimate or otherwise. If the child died before vaccination the registrar had to record the date of death but there was no requirement for him to do so if the child lived to be vaccinated. Across the five parishes during the six year period 5499 births were recorded which allows sufficient data within each of the sub-divisions to be considered to have statistical validity.

The great strength of these data is that they give the date of individual infant deaths allowing data to be collected for percentages of infant deaths by certain occupations, certain social groups or by legitimate against illegitimate infant deaths. Previous research into infant mortality is based largely on published annual statistics from the Registrar General compiled from returns of births, deaths and marriages. The data are then tabulated to provide a vast amount of statistical information and which is published to be used for reference. Whilst this information is very useful to historians, it relates to a whole area and cannot be broken down further to look at data by street or on specific individuals. Vaccination records, on the other hand, yield continuous data for all infant births wherever these records still survive. These records are partial transcripts of the civil registers and sometimes survive in local archives A vaccination register was compiled for much smaller districts (this report is centred on Bexley Sub-Registration District in Kent) and therefore analysis of these registers enables data to be considered at the level of local district and even house/street/parish level within a district where such detail is recorded. This opens up the possibility of being able to test theories that higher infant death rates were associated with poor housing, sanitation, water supply, social status of family, urbanisation, illegitimacy, etc. By using vaccination registers the data relate to individuals and therefore one can look at the detail rather than rely on assumptions drawn from the aggregate data published by the Registrar General.

As an official source of data compiled by the district registrar, we can expect the vaccination registers to be accurately maintained which is a major strength. There are weaknesses with these registers but these seem minor compared with their strengths. Perhaps the greatest weakness is that research is limited to those registers which survive, as many are no longer extant or cover only a few years, thereby preventing a comparison of changes within a district over a period of time. A similar problem of comparison arises

with the boundary changes between neighbouring districts which makes it difficult to examine changes within the same area over a period of time. Within the Bexley sub-district, vaccination registers exist for the entire period from 1889 to 1921 however a boundary change within the district in 1911 limits the potential for a comparison between the villages after this date.

As partial copies of the register of births, there should be few omissions in the vaccination registers although we cannot be certain how many births were not registered for one reason or another. There appears to have been suspicion about the effects of vaccination and it is possible that births went unregistered to avoid this. Vaccination was first made compulsory by The Vaccination Act of 1853 and the 1867 Vaccination Act introduced fines for non-compliance with the legislation. The Vaccination Act of 1898 modified the existing legislation to allow conscientious objection to compulsory vaccination where the parents had strong feelings against vaccination. This latter Act also extended the maximum time during which an infant should be vaccinated from three to six months.

The greatest asset for the researcher of infant mortality is to find infant death registers for the same period covered by the vaccination birth registers. Infant death registers record not only each infant death but also gives the registration number of the infant from the birth register, thus allowing the record to be linked to an individual in that register. This allows all infant deaths to be easily linked to infant births providing a complete picture of infant mortality for infants who were born and died within the district. However, the picture may not be complete for infants who leave the district and will omit all infants who died within the district but who were born elsewhere. As the infant death register also shows the address at death, this can be used to track migration of the family between birth and death.

Unfortunately, infant death registers do not exist for the Bexley Sub-District during this period and for the purposes of this study it has been necessary to cross-reference all infant burials from the local parish burial registers with each individual infant in the vaccination register to ensure the infant deaths before and after vaccination were recorded as far as reasonably practicable.There are many problems involved with using this method. Not all infants were buried in the graveyard of the local parish church, some being buried outside the district and some, belonging to other sects, in other cemeteries. This latter problem was not as significant as it would appear since a public cemetery was open in Erith at this time. The burial records for Erith Cemetery still exist and have been used alongside the vaccination registers and parish burial records. This method of tracing the names of individuals back from the parish burial records to the vaccination records is time consuming given the number of infant deaths involved in this study. A further problem was also encountered by the lack of records for the church of St John the Baptist in Erith after 1895. However, this problem was overcome by using the actual churchyard register which still recorded the name and age at death of each consecutive burial although omitting the address at death. It is also possible that an infant may have been born into a family that subsequently moved out of the district. In such circumstances, where the infant had not been vaccinated, the vaccination officer would correspond with that of the infant's new district, to ensure vaccination took place and this correspondence between officers has resulted in the register for Bexley recording a number of deaths out of the district. It is possible that the vaccination register and parish registers combined may still not capture all the infant deaths in the area. However, by using both types of register many more infant deaths were found than were noted in the vaccination registers alone, providing a more complete picture of infant mortality within the district.

The vaccination register should record all infant deaths prior to vaccination. The

Vaccination Officer for Bexley Sub-District also recorded many deaths after vaccination making this particular set of records more complete than was actually required. Within Bexley Sub-District most vaccinations took place after the infant was 4 months old which means that the vaccination officers would be tracking many infants up to 4 months of age and beyond noting all deaths prior to vaccination. The following table shows the number of vaccinations by parish by age of infant..

Table 8 : The Number of Vaccinations by age

Age at Vaccination	Belvedere	Bexley Heath	Bexley	Crayford	Erith
0<30 days	3	3	5	5	5
31<60 days	50	57	22	69	169
61<91 days	141	147	67	108	306
92<121 days	187	187	74	113	265
122<151 days	171	170	53	102	282
152<182 days	114	155	37	84	196
183<212 days	109	81	31	60	119
213<242 days	68	57	20	45	64
243<273 days	57	42	17	33	50
274<303 days	37	25	11	16	35
304<333 days	11	11	9	11	18
334<365 days	23	16	11	8	19
365 days +	63	58	12	59	110

Source : Vaccinations for Parishes from vaccination registers for Bexley Sub-Registration District

To test the accuracy of the parish burial registers as a record of infant deaths I have compared both registers by locating the infant deaths from the vaccination register in the parish burial registers.

Table 9 : The Percentage of Deaths not Found in Parish Registers

Parish	Deaths in Vaccination Register	Number of Deaths not in Burial Register	Missing burial register as % of vacc. register	No. of missing burials <= 14 days	Missing burials <= 14 days as % of all missing burials
Bexley	30	7	23.3%	3	42.9%
Belvedere	109	36	33.0%	30	83.3%
Bexley Heath	98	42	42.9%	27	64.3%
Crayford	79	24	30.4%	16	66.7%
Erith	191	50	26.2%	35	70.0%
Total	507	159	31.4%	111	69.8%

Source : Deaths for Parishes from vaccination registers for Bexley Sub-Registration District as amended by parish and churchyard burial registers

Table 9 above aims to assess the extent to which the data in the vaccination registers are found in the parish and local cemetery burial registers. At first glance it appears that there is a wide disparity between the known deaths in the vaccination registers and the information in the burial records. However, on further analysis, this may not be altogether surprising. Possible reasons for not being able to locate the burials would be age (very young infants may be buried in common or unmarked graves meaning burials are not recorded), out migration, burial in another locality, or illegitimacy which may have ruled out a Christian burial. During the six years investigated, across all parishes, the burial registers only recorded 23 burials (3.3% of all entries) where the child was aged 14 days or less. Of these 23, only 9 (1.3% of all entries) were in the first week of life which seems to indicate that very young infant deaths or stillbirths were not normally recorded in the burial registers.

Of the 7 Bexley infant deaths not in the parish registers, one is known to have died in London and three more died on the day of birth. If these 4 are discounted(1 being out of district and 3 being unlikely to be mentioned in parish burial records due to the age at death), this leaves 3 of the total of 30 infant deaths (10%) unaccounted for.

In Belvedere 36 of the 109 deaths recorded in the vaccination registers (33%) could not be

located in the burial registers. Of this 36, 30 (83%) were under 14 days old which leaves 6 of the original 109 deaths (5.5%) still missing. This would seem to bear out the theory stated above that infants who were less than 14 days old when they died are unlikely to appear in the burial registers.

Bexley Heath had 42 deaths missing from the burial registers of the 109 deaths recorded in the vaccination registers. 27 of the 42 (64%) were 14 days old or less and of the older deaths, one is recorded as having died in London, one was illegitimate and one had a musician for a father and possibly may therefore have been travelling through at the time the birth was registered. If these are discounted then only 12 of the original 109 deaths (11%) cannot be found. As Bexley Heath was a new town, there is a possibility that this larger number of missing burials may be a reflection of a transitory population who either moved out of the district following the birth or who had their infant buried in a family cemetery which may have been in another parish.

Crayford had 79 deaths noted in the vaccination registers of which 24 (30%) could not be found in burial registers. Of these 24, 16 were aged 14 days or under which leaves 8 older infants of the original 79 (10%) still missing.

Of the 191 deaths in Erith from the vaccination registers, 50 (26%) were not found in burial registers. Of this 50, 35 were aged 14 days or under and another 3 of the older infant deaths were illegitimate which may have led to an unrecorded burial if the mother and child were excluded from the religious community on moral grounds. If these are discounted then only 12 of the original 191 deaths (6%) were not found in burial registers.

The above analysis would seem to indicate that the burial records incorporate the majority of all older deaths in the district (over all parishes and the six year period). Less than 10% are missing. For the younger deaths, whilst this data are normally missing from the burial

registers, the vaccination registers are likely to accurately record the information as such young children were unlikely to have been vaccinated. Whilst the IMR referred to by this study will be slightly lower than the actual rate due to the slight discrepancy described above, I am confident that the margin is not great and that the results detailed below will still be indicative of the true rate.

The vaccination registers record for every birth, the parish of the infant birth and often also give a full address of house name/number and street. This enables the data to be sorted into infant births and deaths by parish and street.

The family of each infant born during the period studied in one of the five parishes has been allocated a social classification based on the occupation of the father given in the vaccination register (or mother if the birth was illegitimate). There were very few instances where an occupation was not given. The classifications are based on Alan Armstrong's study of York in 1851 (Armstrong, 1972, pp.215-23). Although there are other possible social structures which could have been used I have chosen Armstrong's classifications for two reasons. Firstly, this thesis is one of a number of micro level studies into infant mortality and it was generally agreed that the researchers would use one familiar classification in order that the findings of these separate studies could be compared to each other. Secondly, these classifications were useful in that since they pre-date this study by only 40 years, many of the occupations found in the vaccination registers were noted by Armstrong in York. However, certain occupations were obviously rarer and related to more unusual industries in the Bexley Sub-District eg, flusher at the new Victorian sewage works west of Erith. I am confident in the accuracy of the majority of the classifications other than that of labourer, since the vaccination registers do not always distinguish between an agricultural labourer and a general labourer,

the former having a higher social status according to Armstrong's classifications. I have therefore marked all entries showing 'labourer' at the lower classification but it should be borne in mind that in those villages having a largely rural economy, the statistics will show a slightly higher proportion of families in the lower group than probably would be the case. A summary of Armstrong's occupational classifications can be found in Appendix 6.

The description of the areas are drawn from local histories of each of the parishes and also from Ordnance Survey Maps of each of the villages (dates vary between villages but all from 1890s). These maps show clearly the proximity of the villages to the countryside and the amount of green fields or woodland which existed between each of the inhabited areas indicating that each village during this period was separate from its neighbours. These maps additionally show the sites and buildings of local industries and in many cases indicate the particular business involved eg, the corn and flour mill in Bexley, the brick, tile and pottery works at Bexley Heath, etc.

A further report which forms a major basis for this study is that compiled by Dr R Deane Sweeting for the Local Government Board reporting on the general sanitary circumstances in the district as a consequence of the prevalence of diptheria in the years preceding the report (Deane Sweeting,1900). The report was compiled in 1900 and provides a graphic commentary of the water supplies and sewage disposal methods in each of the parishes under consideration. Dr Deane Sweeting conducted his investigations for this report in November and December of 1899 and therefore less than a year after the end of my period of study. This report was ordered in consequence of the persistent prevalence of diptheria in the district. The details of this report will be discussed further below.

From the vaccination registers, parish death registers and churchyard registers the infant mortality rate has been calculated using the formula

$$\text{Infant Mortality Rate (IMR)} = \frac{\text{total infant deaths}}{\text{total births}} \times 1000 \text{ in any one year}$$

This formula provides mortality in the first year of life per 1000 births. Using this formula I will compare the variations in mortality rate between each of the neighbouring parishes and also between socio-economic classes within each parish. This data will also be compared with the infant mortality rate for the whole of Bexley District ie, including all the smaller hamlets and parishes, and for the whole of England and Wales. Using the work of others who have researched these subject areas and also local histories, maps and reports I shall suggest possible causes for the differences in infant mortality.

It is the contention of this thesis that the major cause of the declining infant mortality from the later Victorian period into the twentieth century is the implementation of mains sewerage and a constant water supply. However this is unlikely to be the only factor and I intend to summarise the work to date of other researchers on a number of specific topics and compare their findings to the results for the Bexley Urban District to ascertain which factors are at play and the extent of their influence.

PREVIOUS RESEARCH ON INFANT MORTALITY

Interest in infant mortality is not a product of purely recent research but has been evident throughout the twentieth century. Between 1910 and 1916 Sir Arthur Newsholme, as Medical Officer of the Local Government Board, produced five reports in which he commented on infant mortality (Newsholme, 1910-16). No doubt drawing upon his earlier experience as Medical Officer of Health for Brighton (1888-1908) Newsholme attributed the infant mortality rates to the following factors (source, Woods, Watterson & Woodward 1989, p114, Table 6) :-

Mother : age, work, family size, illegitimacy

Of mother : ante-natal, post-natal, maternal mortality

Of child : midwifery, care and advice, feeding

Poverty : housing, unemployment, wife's work, other children's work

Housing : type, overcrowding

Sanitary conditions : pure water, sewage disposal, scavenging, paving

It is not stated on what data Newsholme based his findings. It is likely that these findings were based on Newsholme having drawn conclusions about the circumstances of particular infant deaths brought to his attention which may have led him to believe that a particular factor was significant. Without the statistical evidence to prove that existence of a factor significantly affected the infant mortality rate when compared with the non-existence of that factor, Newsholme's conclusions are at best circumstantial. Probably Newsholme's greatest contribution to the debate was to suggest many possible factors that could be examined further by future researchers of the subject, many of whom refer back to the work of Newsholme as a starting point for their work.

It is the purpose of this study to focus on a number of Newsholme's suggested factors with specific reference to the Bexley Sub-District in the 1890s to see whether these are statistically significant in improving or worsening the infant mortality rate. The factors concentrated on in this study are as follows :-

1. Sanitary Conditions including access to a supply of pure water.
2. Relationship of infant mortality rate to the work of father/mother by analysis of the socio-economic status of the family.
3. Illegitimacy.
4. Type of district in which infant was born ie, rural, urban, industrial, suburban, etc.
5. Sex of the child.

This last two factors are not mentioned in Newsholme's research but has been examined by subsequent researchers, many of whom believe them to be significant. Each of these factors will be considered separately below.

SANITARY CONDITIONS/WATER SUPPLY

In *The Modern Rise of Population* (1976), Thomas McKeown examined the number of deaths of children under 5 years and of the population aged 5 years and over caused by diarrhoea and dysentry, these being water-borne or food-borne diseases. He found that in the older population there was a steady decline in deaths from these causes whereas in the younger age group there were large peaks in 1901 and 1911 after which there was a decline in the mortality rate. He attributed the peaks in these years to the unusually warm summers and the difference between the two sets of data to the fact that gastro-enteritis was a common cause of death in the first year of life. McKeown stated "From the evidence it is clear that the death rate from water- and food-borne diseases declined continuously from the second half of the nineteenth century.....There is no doubt that the fall of mortality from these diseases was due to reduced exposure brought about by improvements in hygiene.....Their spread is due to defective sanitary arrangements, and their decline coincided with advances in hygiene, particularly, in the nineteenth century, purification of water and sewage disposal" (McKeown, 1976, p121).

Although diarrhoeal deaths may be attributed to water borne and food borne diseases, it is also a symptom of many other diseases or illnesses. Medical knowledge at the time these deaths were recorded would not have been sufficient to identify all the diseases we know today. McKeown's work is based on the assumption that all deaths caused by diarrhoea must be a symptom of a water-borne or food-borne disease and therefore must be caused by poor sanitation and hygiene. The argument is flawed in that it does not acknowledge

the possibility of any other infectious disease which may cause death with diarrhoea being a symptom. McKeown's research is based on statistics released for every tenth year and therefore may mask what was happening in the interim period. The data are also on a national level and therefore do not allow a study of the variances by locality to test whether the mortality rate were higher in areas with poor water supplies and sewage disposal. A further problem exists in the age groupings of the data in that McKeown states "The deaths in infancy, particularly in the first year of life, were largely due to gastro-enteritis, which differs from the diseases associated with diarrhoea at later ages" (McKeown, 1976, p 121) but as he only has data for deaths at ages 0-4 he cannot prove this. In view of the above, McKeown's work can only be considered as an hypothesis based on an apparent relationship between deaths of young children from diarrhoea, the relationship between hot summers, diarrhoeal deaths and the knowledge that hygiene and sanitation had been improving during the same period.

McKeown also co-wrote an article in 1975 'An Interpretation of the Decline of Mortality in England and Wales During the Twentieth Century' (McKeown, Record and Turner, 1975) which attributes the decline of diarrhoea and dysentry between 1911 and the 1930s to improved hygienic measures such as water purification, better sewage disposal, refuse removal, sterilization/pasteurization of milk, supervision of food handling, etc. Woods, Watterson and Woodward (1989) in their 'The Causes of Rapid Infant Mortality Rate Decline in England and Wales 1861-1921' criticized this work in three respects :-

- the analysis is cause-specific and does not investigate by age, place or social group
- the period used misses out the period of dramatic change
- the emphasis is placed on tuberculosis and nutrition, thus focusing too much on adult mortality

Woods, Watterson and Woodward note that infant mortality was much higher in densely populated urban districts, possibly due to poverty, population density and social divisions. They refer to this as the 'urban effect' and note that this does vary between urban areas. They conclude "The most likely reason for the 'urban effect' is that climactic conditions, especially during the third quarter of the year, interacted with poor urban sanitary environments which resulted in high levels of diarrhoea and dysentry among infants, particularly those aged between 1 and 11 months" (p 360). Their conclusion is that the "coincidence of dry and hot summers during the late 1890s appears to have been sufficient, given the nature of the urban environment, to have increased the infant mortality rate from diarrhoea" (p 362). Being a study on a national level, the authors were unable to test their hypotheses against local data on actual sanitary conditions etc.

Robert Woods (2000) in 'The Demography of Victorian England and Wales' has examined the affect of diarrhoeal deaths on the overall IMR over the period 1871 - 1911 and comments "It is obvious ....how important the diarrhoeal diseases were for infant mortality in the 1890s and how, once the effects of these causes have been removed, infant mortality appears to be in a steady decline from at least the late 1880s" (p271). By comparing the IMR with old age mortality rates from diarrhoea and dysentry in densely populated areas Woods considers the effects of water on IMR and notes that in the 1890s "a handful of ...London districts were able to sustain lower than might me expected mortality while, in the remainder of the urban system, rates increased" (pp330-1). As old age mortality rates do not show the same pattern as IMR he therefore concludes that there are complex factors surrounding sanitary environments and their affect on mortality rather than a direct relationship between the existance of favourable sanitary conditions and a low IMR. However, the least skilled are more vulnerable to diarrhoea and enteritis which pushes up

the mortality rate in these classes in bad years (p267). Within Bexley 1898 was a bad year for IMR and therefore we can examine from the data whether the overall peak can be attributed largely to the families of the unskilled workers.

Graham Mooney (1994) in 'Did London Pass the "Sanitary Test"? Seasonal Infant Mortality in London 1870-1914' has studied the sanitary conditions in London during the period 1870-1914 with reference to seasonal variations in infant mortality. This article is based on the work of Newsholme discussed above and also on the Quarterly Returns of Births, Deaths and Marriages compiled by the Registrar General of England and Wales from 1870-1911. They were available by Registration Sub-District. The author recognises problems with these quarterly returns as follows :-

- there are frequent boundary changes between districts over the period
- deaths in workhouses and hospitals may distort data for a particular district
- the greater the number of administrative districts, the more likely it will be that sick people will move across them to die

Mooney found that in 1899, 40% of all infant deaths in London were in the 3rd quarter of the year mainly due to the annual diarrhoeal epidemic. He states "Two factors which greatly influence IMRs [infant mortality rates] are particularly important for a discussion of seasonality : breast feeding and environmental management" (Mooney, 1994, p165). Mooney does not investigate the former of these further nor any other causes but proceeds to consider environmental conditions and repeats Newsholme's views on water closets removing "massive infection" whilst pointing out disease could also be transferred via dustbin or ashpit, imperfectly scavenged streets, flies, etc (Mooney, 1994, p165).

The author states "The effects of poverty were exacerbated each time the temperature of the summer months was particularly high" (Mooney, 1994, p165). Based on Newsholme's

assertion that adverse conditions beyond the control of individuals resulted in infant mortality, Mooney asserts that high seasonal peaks occurred mainly in the poorer classes. He concludes by recognizing the need to compile data at household level to investigate poverty, mortality and public health measures on an individual scale.

Bell and Millward (1998) in 'Public Health Expenditures and Mortality in England and Wales 1870-1914 examined the impact of sanitary reform programmes on the infant mortality rate. During the period they examined, sanitary programmes were in force to connect houses to water and waste removal facilities, to clean public streets and to seize unfit foodstuffs. "The fact that infant mortality levels were already declining in towns where very little investment in public health infrastructure had taken place, even by the 1890s, demonstrates that sanitary reform was not a cause of infant mortality per se. Rather it shows that poor environmental conditions in dense urban centres were acting as an inhibitor of a general underlying trend of decreasing infant mortality" (p24). The authors believe that the gradual decline in infant mortality rate during the 1870s and 1880s was due to a combination of factors which "may have included fertility decline, an increase in the rate of breastfeeding and an improvement in the nutritional state of pregnant mothers" (p.25). Bell and Millward's research was based on a sample of 36 towns and they concluded that "The coincident timing between peak sanitary investment and the onset of a general decline in infant mortality is highly suggestive of a causative relationship" (p26). This period of peak sanitary investment relates to the last decade of the nineteenth century when there was major investment in streets and sewerage. If this were to hold true for Bexley sub-district, I would therefore expect to see an overall decline in IMR in all districts but for this to be inhibited by the 'urban effect' in Erith which would therefore have a slower rate of reduction in IMR. I would also expect to see a lower IMR in those areas with both a water supply and mains sewerage.

As can be seen from the above, all work on the hypothesis that water supply or sewage disposal is a significant factor for infant mortality is either on a national level or at registration district level. There is no data at a more local level that attempts to prove or disprove this hypothesis. Using the data from the vaccination registers split into individual parishes and Dr Deane Sweeting's report on sewage and water for each of these districts, I intend to test whether access to clean water and a good system of sewage disposal did yield an infant mortality rate below the average for the whole registration district and the whole of England and Wales. As noted above, previous authors (Newsholme, Mooney, Bell and Millward and McKeown) suggest that a good sewage system, sanitation and access to clean water were factors which significantly influenced infant mortality rates and this will be considered further below.

VARIATIONS IN MORTALITY RATE DUE TO SOCIO-ECONOMIC STATUS OF THE FAMILY

Woods, Watterson and Woodward (1988) comment on socio-economic status as being a significant factor stating that "in many middle-class or suburban districts there was little or no increase in infant mortality during the 1890s" (p 360). Using census data and the eight social groupings defined by the Registrar General, the authors conclude that infant mortality declined in each social class between the late 1890s and 1910. The middle class, however, had a steep continuous decline which widened the gap between them and other classes. Amongst labourers the infant mortality rate was particularly low "as would be expected from their rural origins" (p 363) and declined rapidly after 1905. Their data about infant/child mortality amongst the various social classes was drawn from the Fertility Report of the Census of 1911.

Michael Haines (1995) in his report 'Socio-Economic Differentials in Infant and Child Mortality During Mortality Decline : England and Wales 1890-1911' also examines child

and infant mortality according to social class of parentage. He concludes that "child mortality was lower for women with husbands in occupations of higher socio-economic status" (p 300). However, this conclusion is based entirely on the Census of England and Wales 1911 and the data does not differentiate between child and infant mortality. An infant who had been breast fed would have an immunity to infection which is lost as it is weaned and grows into childhood. Older children may be more prone to summer infections.

Robert Woods (2000) compares adult male (ages 25 - 65) life expectancy with infant life expectancy in 1911 across 5 social groups (professional, white collar, skilled manual, semi-skilled and unskilled). These two groups show a slightly different pattern. The adult figures show a reducing life expectancy from the top to the bottom of the social scale with the exception of the white collar and skilled manual classes which are equal. The infant scale shows a steady and steeper reduction in life expectancy from the professional class through to the semi-skilled families however there seems to be a slight increase in life expectancy between the semi-skilled and unskilled workers. This appears to be an anomalous result and is not treated with any significance due to the small sample size (p245). Woods returns to this issue when considering the affects of the social classes in conjunction with their environment. He finds that "The children of the agricultural labourers were even more protected by their less dangerous rural environment than those of the professionals while those of the least skilled urban classes faced the highest risks from poverty and the environment" (p267). The social classification system I have used in this study makes a distinction in the classification of a rural labourer (class IV) with a non-rural labourer (class V). Whilst it was sometimes omitted whether a labourer is agricultural or otherwise in the records, as far as possible these occupations have been correctly classified and it can therefore be tested whether agricultural labourers did have a

better IMR than their urban contemporaries.

Previous studies agree that there appears to be a direct link between social status of the family and IMR. The results for the Bexley Urban District will be tested against this theory.

ILLEGITIMACY

Woods, Watterson and Woodward (1989) commented that there were substantial differences in infant mortality rates between legitimate and illegitimate births. The infant mortality rate in London in 1902 for illegitimate births was over twice that of legitimate births and in data from a number of rural counties it was found the mortality rate for illegitimate births was 50% over that of legitimate births ie, illegitimacy consistently was a factor which increased infant mortality rate. These data only provide a snapshot in time for a particular year and, as far as the rural data is concerned, an assumption has been made that the whole counties concerned were rural, when, in fact, the deaths among illegitimate births might all have, or most, occurred within the county's towns and therefore be a product of the urban environment.

Woods (2000) notes the ratio between illegitimate and legitimate births being 1.98 : 1 in England and Wales during 1906-10 but notes a regional variation in 1902 between London at 2.07:1 and a selection of rural counties at 1.59:1. He also notes a declining proportion of illegitimate which reduced from 6.7% of all births in 1846-50 to 4% by 1906-10 (p262). In England and Wales during the 1890s the sex ratio at birth (male births per 1,000 female births) was significantly higher for illegitimate than legitimate births. As males have a higher IMR this may affect the overall illegitimate IMR ie, the IMR may be at least partly attributable to the male/female balance rather than the effects of illegitimacy (pp53-54).

The vaccination registers clearly state whether each birth is illegitimate or legitimate by the details given of the parent registering the birth, this only being the mother where the birth was illegitimate. It has therefore been possible to gather the data for Bexley Urban District and divide this to show the variances in infant mortality between legitimate/illegitimate births at parish level. Following Woods Watterson and Woodward (1989) I would expect a higher IMR for illegitimate over legitimate births and for this to be more marked in the industrial parish of Erith which exhibits some urban characteristics whilst not actually being urban per se.

LOCALITY

As mentioned above, Woods, Watterson and Woodward (1988) commented on the 'urban effect', noting that areas of higher population density tended to have higher infant mortality rates when compared with rural areas. The subject is picked up again by the same authors in a subsequent article (Woods, Watterson and Woodward, 1989) where they note the 'Health of Towns' movement, which began in the nineteenth century, had an effect on health issues, mainly regarding the provision of fresh water supplies.

Woods (2000), using the Registrar General's cause of death data, states "there were clear differences between urban and rural places in terms of mortality at early ages and these differences were largely the result of the water' and food-borne diseases (especially diarrhoea and dysentry) in infancy" (p270). Within the Bexley urban district this will be tested by comparing the same social classes within the various parishes where a major differences will be the sanitary environment.

The greatest problem with these data is that they are gleaned from the Registrar General's Annual Reports and Decennial Supplements and are grouped by registration district up to 1905 and by registration county after this date. Data are split to show a separate infant

mortality rate for all urban districts, these being districts having population densities greater than 100 persons per square kilometre in 1891. These districts may well include rural and urban areas side by side therefore distorting the data. For example, Bexley Sub-District was one such registration sub-district which, in view of the majority of the area, may have been classified as a rural, agricultural economy. This ignores the fact that it contained both a thriving, rapidly expanding industrial area of high population density rural and suburban areas. Because such a generalisation has to be made, when using the Registrar General's data, one can only theorise but these theories cannot be tested until the registration district is further sub-divided. Also, as the basis for the area concerned changed in 1905, it becomes very difficult to monitor changes over time since one would be comparing data from different areas. A similar problem is incurred when looking at registration districts since the boundaries of these were also subject to change.

C H Lee (1991) in his 'Regional Equalities in Infant Mortality in Britain 1861-1971', has also worked from the decennial registration returns to analyse regional variations in infant mortality at county level over a longer period of time. Lee used changes in the infant mortality rate as a measure of general health inequality and analysed the regional differences in IMR by county for 1871, 1921 and 1971. He assessed the influence of employment of the population in mining, agriculture, textiles/clothing and heavy industry and concluded that agriculture was not a major influencing factor for any of the years whereas the most influential factor for the 1871 year was heavy industry. For the 1921 and 1971 years, mining had replaced heavy industry as the most influential factor. This work is solely at an aggregate level per county and does not attempt any more detailed analysis or explanation of the data.

Lee also tries to draw conclusions by looking at where his statistics differ from the national average and by trying to link the results to other statistics eg, those for employment,

industry and housing density. Where there appears to be a correlation he makes assumptions that do not appear proven beyond doubt. For example, he claimed that "the divergence in mortality rates, and the slowness of decline in areas such as Scotland, stresses the importance of housing density". The data underlying this study are too general to support its conclusions unaided. They could be a useful pointer for further research but cannot yield conclusions without it.

From the works mentioned above, what is needed is micro-level research to try and establish a definite link between infant mortality rate and sewage/sanitation, socio-economic status of the family, locality and legitimacy. Whilst statistics from larger areas may imply these factors are significant in affecting the infant mortality rate, it is only by examining the actual families and neighbourhoods concerned that the theories of previous researchers can be substantiated.

SEX

Woods, Watterson and Woodward (1989) note there are substantial differences in infant mortality between boys and girls. They state this is to be expected and "partly relates to delivery complications associated with differences in birth weight"(p 352). In 'The Structure of Mortality in Mid-Nineteenth Century England and Wales' (1982, p.390), Woods notes that "... male infant and child mortality is a particularly significant element of the mortality structure in industrial districts in the north and the Black Country..." but this is stated as not being a factor in the south. Unfortunately the data are at such a regional level that detailed analysis within a district is not possible, and assumptions need to be made as to the overall character of the district. The problem with this assumption is that the regional data may mask a great diversity within the district. Woods gives no explanation as to why there is such a difference in male/female IMR other than to make

the link with industrial areas. Woods in 'The Demography of Victorian England and Wales' (2000) notes that the male IMR is constantly 1.21 to 1.23 times higher than the female IMR throughout the Victorian period and apart from making the observation that there were variations in the male : female sex ratio gives little further explanation of this variance (pp257-262).

OTHER FACTORS

A number of recent studies have focused on fertility, employment of mothers and infant feeding practices. Whilst the data I have analysed does not provide further evidence on any of these issues, it is worthwhile bearing in mind that the factors I will consider are not the only ones which may have had an impact on the declining infant mortality rate.

Garrett and Reid (1995) noted that fertility decline was begun by the middle classes in areas where they dominated but was subsequently followed by other classes in the same area. "The similarity in fertility levels across classes within environments suggests to us that cultural rather than economic factors were at work to reduce fertility"(p.97). It is suggested that by adopting various methods to control fertility fewer, more healthy children, were produced due to the mother being in a better physical condition through less child bearing and greater recovery intervals between births. "With time...the idea that small families were better families spread into all areas, apparently first via the middle classes and then down through the working classes"(p.97).

More recently, Eilidh Garrett has worked with the 1911 census, which for the first time gave the number of children born to each woman, to examine any links between social status, employment and infant mortality. In 'Was Women's Work Bad for Babies? A View from the 1911 Census of England and Wales' (1998) Garrett concludes that "'Women's work' in itself does not emerge as bad for babies but having a mother who was employed in

industry increased a child's likelihood of being born into an area which would hold increased perils for infant life"(p32). This link to environmental factors had also been noted in the earlier work by Garrett and Reid (1995) where it was stated that "...children of the lower classes suffered disproportionately because they were more likely to live in noxious environments, not because they were born into the lower social orders" (p.98).

Feeding practices were studied by Valerie Fildes in 'Infant Feeding Practices and Infant Mortality in England 1900 - 1919' (1998). This work examined the effects on IMR of two known changes in practice : the declining use of the long-tube feeding bottle, now known to harbour harmful bacteria, and the introduction of dried milk which became increasingly available at the turn of the century. Whereas previous similar studies had noted baby feeding practices as being the most important factor, Fildes also acknowledged the existence of other factors, namely :-

- nutritional status of the mother
- sanitary conditions of the home and environment
- levels of diseases
- degree of wealth, education and sophistication
- care arrangements of child if the mother works

These factors are very similar to those noted by Newsholme in 1910. Fildes concludes that the changing feeding practices contributed significantly to the decline in infant mortality. However, Fildes' work is based on data from the early 20th century whereas the decline in infant mortality began much earlier in some areas. Therefore, whilst this one factor may have made a contribution to the declining infant mortality rate, it was obviously not the only factor.

Woods (2000) considers the above factors whilst trying to summarise the reasons behind

the decline in IMR from the 1890s or perhaps the 1880s and concludes the following factors were at play (p306) :-

1. Declining fertility by the decreasing number of pregnancies and increasing intervals between births which led to higher birth weights and therefore a higher chance of survival.
2. Increased female education which led to family limitation, improved status of women and a change in how they cared for themselves and their children.
3. Increasing availability of uncontaminated water.
4. Improvement in the milk supply and food quality, better qualified midwives and health visiting.

RESULTS

The infant mortality rate for the whole of England and Wales during the period 1871 to 1909 is shown in the chart in Appendix 2. This chart shows the variations in rate from year to year during this period, by means of a five year moving average which smoothes out the fluctuations of each individual year, the underlying trend. From this it can be seen that the overall rate was relatively constant through the late nineteenth century, increasing slightly in the 1890s before beginning a steady decline from around 1901. The rate mostly ranged between 140 and 160 deaths under 1 year of age per 1000 live births, until its decline took it below this range from 1904 onwards. Peaks in the mortality rate in the years 1893, 1895 and 1898-99 led to an increase in the last few years of the nineteenth century. We have seen above that various researchers have tried to interpret the cause of this increase in what would otherwise be a period of gradual decline, although the various hypotheses have not been tested at a local level.

The chart in Appendix 3 shows comparable data relating to Bexley and Erith ie, the area covered by Bexley Sub-District and incorporating the parishes of Bexley, Bexley Heath,

Belvedere, Crayford and Erith. By comparing the two charts in can be seen that, whilst the infant mortality rate was much lower in the Bexley Sub-District than in England and Wales as a whole, both charts have a similar pattern. Both charts show little variation of IMR in the 1870s and 1880s with a slight rise during the 1890s. England and Wales has a peak in IMR in 1899 followed by a more marked decline whereas the Bexley District shows a greater increase over the 1890s with significant peaks in 1898, 1902 and 1904 before also going into a marked decline. In order to investigate why the peak was high in 1898 I have collected data for this year and the previous five years to provide a continuous run. The table below shows how the infant mortality rate varied between each of the five parishes under consideration and how this compares with Bexley Sub-District as a whole and with the average figure for England and Wales during the same years.

Table 10 : The Infant Mortality Rate of Different Parishes within Bexley Sub-District contrasted with the whole of England and Wales for 1893 to 1898

		1893	1894	1895	1896	1897	1898	TOTAL
BELVEDERE	BIRTHS	164	165	189	203	215	249	**1185.0**
	DEATHS	11	16	17	23	30	42	**139.0**
	IMR	67.1	97.0	89.9	113.3	139.5	168.7	**117.3**
BEXLEY	BIRTHS	62	75	71	70	64	66	**408.0**
	DEATHS	4	8	5	3	14	4	**38.0**
	IMR	64.5	106.7	70.4	42.9	218.8	60.6	**93.1**
BEXLEYHEATH	BIRTHS	182	194	171	218	200	198	**1163.0**
	DEATHS	21	13	17	15	25	32	**123.0**
	IMR	115.4	67.0	99.4	68.8	125.0	161.6	**105.8**
CRAYFORD	BIRTHS	129	139	134	143	136	147	**828.0**
	DEATHS	22	12	17	14	17	24	**106.0**
	IMR	170.5	86.3	126.9	97.9	125.0	163.3	**128.0**
ERITH	BIRTHS	292	279	311	306	323	404	**1915.0**
	DEATHS	28	37	39	38	51	58	**251.0**
	IMR	95.9	132.6	125.4	124.2	157.9	143.6	**131.1**
TOTAL BIRTHS		829	852	876	940	938	1064	5499
TOTAL DEATHS		86	86	95	93	137	160	657
ANNUAL IMR IN FIVE PARISHES		**103.7**	**100.9**	**108.4**	**98.936**	**146.1**	**150.4**	**119.5**
ENGLAND AND WALES		**159**	**137**	**161**	**148**	**156**	**161**	**153.7**
BEXLEY URBAN SUB-DISTRICT		**108**	**114**	**116**	**126**	**125**	**183**	**130.5**

Sources : Births and Deaths for Parishes from vaccination registers for Bexley Sub-District as amended by parish and churchyard burial registers, figures for whole of district and England & Wales from Registrar General's quarterly returns

The data shown in the above table are represented by a bar chart in Appendix 4. The chart shows that whilst the IMR for the whole of Bexley Urban Sub-District does not vary much between 1893 and 1897, this conceals a wide variation in IMR between the individual villages. The whole of England and Wales had peaks in IMR in the years 1893, 1895 and 1898. This pattern is reflected by Bexley Heath and Crayford, both of which show peaks in these three years as well as in 1897. This 1897 peak may be because the national statistics compared the number of infant deaths in a given year with the births in that same year when some of the deaths will actually relate to births in the previous year. Births in 1897 which became deaths in 1898 are recorded within the 1897 year for the purposes of this study. Belvedere has a peak IMR in 1898 with others in 1896 and 1897 whereas Erith has the same as Belvedere plus another peak in 1894 although the 1894 peak is much smaller. Bexley appears to be entirely different to its neighbouring parishes and the national figures by having peaks in 1894 and 1897. However this can possibly be attributed to the fact that this is a small parish with only 68 births per annum on average and where one extra death in a year will seriously skew the statistics. Each village will be considered in more detail below in the light of factors thought to be influential on the rate of infant mortality, to try to establish why such a variety of patterns can occur in such a small geographical area.

SEWAGE AND SANITATION

Thanks to the report of Dr Deane Sweeting to the Local Government Board based on his research in the district in 1899, we have a lot of evidence about the extent of the public water supply and sewage system in the five parishes during the last decade of the nineteenth century. We have, therefore, to rely on the description given by Dr Deane Sweeting. In his research, Thomas McKeown concluded that improvements to sewage disposal and water purification greatly reduced the incidence of water-borne and food-

borne diseases and therefore reduced infant mortality, since, he believed these were a major cause of the diarrhoeal deaths, which accounted for a large proportion of infant deaths (McKeown, 1976, p.59). Mooney also remarked upon this effect and noted that the effects of the long hot summers, which resulted in the diarrhoea epidemics, were mainly felt among the poorer families who could not afford housing with mains water and sewage disposal connected to the sewage network (Mooney, 1994, p.167). If this theory is to be tested against the data for the Bexley Sub-District then those districts with the best sewage disposal system and water supply should have the lower overall infant mortality rate, and should not be affected to the same extent by the epidemics which caused the increased mortality rate in certain years.

Crayford has the second highest average infant mortality rate over the six years investigated at 128.0 deaths per 1000 births. From Dr Deane Sweeting's report we know that this part of the district did not have a constant water supply - the water supply was only turned on for 2-3 hours per day, necessitating storage of the water in tubs by each family. Therefore any family which had stored insufficient water would have been forced to draw water directly from the River Cray, if they were unable to obtain some from a neighbour or friend. There was no mains sewerage disposal system in Crayford at the time. Most of the sewage was discharged into open ditches which honeycombed the area and which drained directly to the River Cray. Where cesspools existed, these also often overflowed into the river. In his report, Dr Deane Sweeting confirms that many of the Crayford residents used water from the River Cray as drinking water (Deane Sweeting, 1900, p.8).

Erith had the highest infant mortality rate of the five parishes at 131.1 deaths per 1000 births on average over the six years. At the beginning of the 1890s Erith was a better class residential area and was provided with water by the Kent Water Company.

However, around this time the area was beginning to decline in status with the middle classes giving way to an artisan population attracted by the new factories. Dr R Deane Sweeting describes an old egg shaped sewer serving the centre of Erith which he suspected strongly of being the cause of the spread of diseases and which he recommended be replaced. He also reported that although a new sewerage system had recently been completed and outfall works established, as of 1899 only 1623 houses out of 3990 (ie, 41%) of houses had been connected to it. His report is mainly focused on the study of recent diptheria epidemics during the period and noted that there was an epidemic of diptheria in Erith during 1898 when 128 cases resulted in 40 deaths. In the early years of the decade there were less than 10 cases per year. Although the number of diptheria cases and deaths relate to the whole population, his report notes that the majority of the victims of the disease were of school age and their families. Therefore it is not inconceivable that infants would have caught the disease from older brothers and sisters. Dr Deane Sweeting, from previous investigations into diptheria epidemics, also noted that epidemics tended to arise in areas where there were sanitary defects. This appears to be disputed by Anne Hardy (1993) who notes in 'The Epidemic Streets : Infectious Diseases and the Rise of Preventative Medicine 1856-1900' that diptheria is spread by droplet infection, close contact, dust and contaminated milk and that there is no evidence of transmission by water (Hardy, 1993,p.90). Sweeting's comments seem to imply that whilst Erith had a sewerage system in place, much work was needed to connect the majority of the district to it. This was probably a result of the large population growth of Erith during the period, the population rising from 13,414 in 1891 to 25,296 in 1901 as a result of the influx of people attracted by the industrialization of the area. This is reflected too in the number of births - in 1893 there were 292, and, 404 by 1898, indicating that the influx of population comprised many young families. This probably overstretched the existing infrastructure,

which may have taken some years to catch up with the population growth. Despite a number of searches in local archives and enquiries having been made to local water companies, it proved impossible to find any records to indicate which premises in Erith were sewered, by tracking the route of the new sewerage system. However, Dr Deane Sweeting describes the route of a branch sewer and states that of the nine roads it passes through, eight were totally sewered and one partly sewered. This prompted me to work out an infant mortality rate by street in Erith across the whole six year period. There were 43 streets which experienced at least one infant death during the period. The 43 streets were divided into 3 bands depending upon their total IMR. The results are shown below :-

Table 11 : The number of Erith streets within each IMR range over the period 1893 - 1898

IMR	Number of Streets
Less than 100	18
100 less than 200	16
200+	9

Source : Vaccination registers, parish and cemetery burial registers

Of the eight streets that Dr Deane Sweeting notes as being sewered, every one falls within the 'less than 100 IMR' bracket. The remaining street known to be part-sewered falls in the middle '100 less than 200' bracket. This result is only a small study on the basis of limited information available. However, it appears to be a very significant result and suggests that more work should be done at micro level to compare IMR by street and by actual sewerage/sanitation at street/house level.

Belvedere was described by Dr Deane Sweeting as having a better class residential population, starting to give way to an artisan population, although not to the same extent as Erith. The area had a constant water supply but, like Erith, a main low-level sewer ran through Belvedere, and Dr Deane Sweeting indicated that there were many houses still not connected to it. He commented that "the so-called 'Picardy Ditch' proceeding from

the high land above Belvedere to the marshes bordering on the Thames, is culverted for part of its course; but the open part near Belvedere Railway Station is very foul, and receives hereabouts much slop drainage and filth of various kinds" (p.37). The average infant mortality rate for Belvedere over the period of the six years being considered is 117.3 deaths per 1000 births, ie, slightly lower than Erith and Crayford. Erith and Belvedere share the same pattern of an increasing infant mortality rate over the years 1893 to 1898. This pattern is also seen for the whole district, probably due to a large proportion of the population being based in these two areas. Belvedere was built on much higher ground than Erith and was still a better class area than Erith during the period (although following the same pattern of development) and the one factor which they both seem to share is that the majority of the houses were not connected to the main sewage system.

Bexley Heath was a relatively new town and as such one would expect it to have better public services than the older villages in the area. This, however, is not the case. The village had an intermittent water supply and there was no mains sewage to the area even by 1900. The average infant mortality rate for this parish over the six year period was 105.8 deaths per 1000 infant births. However this would have been much higher had the area not had a particularly low figure for 1894 (being the lowest of any parish in the district for this year). The fact that the overall infant mortality rate was lower for Bexley Heath than for Crayford which shared the same intermittent water supply and poor sewage disposal system might be explained by the fact that Bexley Heath stood on the highest ground of the whole district. This would have facilitated drainage via ditches. Furthermore there was no river the residents might have used for water supplies. In contrast, Crayford stood on some of the lowest ground in the district. Therefore the open ditches used for sewage would probably not have drained so well and the village lay directly on a heavily polluted river.

Bexley village had by far the lowest infant mortality rate of the whole district with an average over the six years in question of 93.1 deaths per 1000 infant births. As mentioned above there is a large amount of variation between the results for Bexley and its neighbouring parishes. The infant mortality rate in Bexley also varied widely from year to year. It should be borne in mind, however, that Bexley was much smaller than the other parishes under consideration having only around 68 births per annum. Therefore the statistics may not be so reliable as for the other more populous districts. Bexley had a constant water supply and of the 718 houses in the parish in 1900, 644 (90%) were connected to the main sewer with the remaining 74 draining into cesspools (which overflowed into tributaries of the River Cray). Bexley therefore had the best sewage disposal system of the entire district.

From the above analysis of each of the five parishes it is evident that the lowest infant mortality rate appears where there was constant water supply and good sewage disposal arrangements and the worst where there was an intermittant water supply and poor sewage disposal, with the remaining parishes falling in between but tending towards the higher mortality rate. The only exception to this rule is Bexley Heath where, in view of the lack of a constant water supply and no sewage one would expect it to rank alongside Crayford. I believe that the overall rate for Bexley Heath may have been improved by its high geographical location and lack of a polluted river, as this meant sewage did not accumulate and stagnate in the district. It is interesting to note that although the overall mortality rate for Bexley Heath was much lower than that of Crayford, it shows a similar pattern over the years of 1893 to 1898 of a reduced mortality rate in 1894 and 1896 with peaks in 1893,1895, 1897 and 1898. The other two parishes which share the same water supply and sewage disposal features, Erith and Belvedere, also share the same pattern in their infant mortality statistics. The only area in the district which had both good sewage

disposal facilities and a constant water supply, Bexley, had a pattern of infant mortality rate that was very different to and substantially lower than any other village in the same district. All these facts indicate that there is a strong correlation between sewage disposal and clean water supplies on the one hand and infant mortality rates on the other. It is possible that the weather conditions may have caused inadequacies in the sewage/sanitation systems to have a greater effect on the infant mortality rate, and further research is needed to clarify if there is any link between weather conditions and annual variations in IMR.

The above results seem to bear out the thoughts of McKeown (1976) who stressed the importance of sanitary arrangements which is borne out by the poor IMR within Crayford and Woods Watterson & Woodward (1989) who highlighted the urban effect and the lack of a steady improvement in IMR in poor urban environments. Erith, which is the most densely populated of the parishes shows a worse IMR than Crayford despite having gone some way towards implementing sanitary improvements (41% of homes having mains sewerage). From the above evidence there appears to be a direct causal link between the extent of mains sewerage and water supply to a district and the IMR.

SOCIO-ECONOMIC STATUS OF FAMILY

The following table shows a categorisation of the families having infants born during the six years under consideration by parish and by socio-economic classification as described above (see also the bar chart in Appendix 5).

Table 12 : The distribution of the population of villages by economic class

Table to Show Percentage of Population of Villages							
Split by Economic Class							
		I	II	III	IV	V	totals
Belvedere	Births	10	21	654	89	411	1185
	%	0.8	1.8	55.2	7.5	34.7	100
Bexley	Births	25	14	192	106	71	408
	%	6.1	3.4	47.1	26.0	17.4	100
Bexley Heath	Births	52	31	609	196	275	1163
	%	4.5	2.7	52.4	16.9	23.6	100
Crayford	Births	3	6	367	108	344	828
	%	0.4	0.7	44.3	13.0	41.5	100
Erith	Births	15	11	1065	261	563	1915
	%	0.8	0.6	55.6	13.6	29.4	100

Source : Vaccination registers, parish and cemetery burial registers

It can be seen from the above that a high proportion of all families involved fell into class III which comprised shopkeepers, skilled craftsmen and the like. For most parishes the second largest classification was V which mainly comprised labourers and unskilled employees, the only exception being Bexley where the economy was largely agricultural and whose second largest category was IV which should also have included agricultural labourers, these having been given a higher classification by Armstrong. Many of these class IV occupations in Bexley were specifically stated as being gardeners or market gardeners and therefore can be accurately classified as class IV. However, it is possible that many of the labourers currently classified as class V would have actually been farm labourers which should be classified as Class IV. The following table shows the percentage of infant deaths by family status in each of the six years studied and in the period as a whole.

Table 13 : IMR by social class by parish by year

									TOTALS	
		1893	1894	1895	1896	1897	1898	DEATH	BIRTHS	IMR
BELVEDERE	I	0	0	0	0	0	0	0	10	**0.0**
	II	0	0	0	0	0	500	1	21	**47.6**
	III	71.4	116.3	122.6	130.4	104	173.9	81	654	**123.9**
	IV	62.5	66.7	0	133.3	157.9	0	7	89	**78.7**
	V	66.7	84.7	58.8	92.3	197.2	193.2	50	411	**121.7**
BEXLEY	I	0	0	200	0	0	0	1	25	**40.0**
	II	0	1000	0	0	200	1000	4	14	**285.7**
	III	43.5	75	25	28.6	166.7	0	10	192	**52.1**
	IV	117.6	58.8	176.5	55.6	318.2	200	17	106	**160.4**
	V	90.9	181.8	0	83.3	166.7	0	6	71	**84.5**
BEXLEY HEATH	I	111.1	0	0	0	166.7	111.1	3	52	**57.7**
	II	0	0	0	0	0	0	0	31	**0.0**
	III	84.3	74.1	77.8	61.4	141.6	138.6	59	609	**96.9**
	IV	117.6	64.5	33.3	47.6	103.4	233.3	19	196	**96.9**
	V	191.5	76.9	230.8	120	108.7	185.2	42	275	**152.7**
CRAYFORD	I	0	0	0	0	0	0	0	3	**0.0**
	II	0	0	0	0	0	0	0	6	**0.0**
	III	228.1	72.7	98.4	69.4	163.9	131.1	46	367	**125.3**
	IV	66.7	35.7	125	250	71.4	260.9	14	108	**129.6**
	V	145.5	125	157.9	103.4	100	172.4	46	344	**133.7**
ERITH	I	0	0	0	0	0	200	1	15	**66.7**
	II	500	0	0	500	333	0	3	11	**272.7**
	III	90.3	143.9	98.3	127.1	147.5	128.2	131	1065	**123.0**
	IV	69.8	120	219.5	93	130.4	105.3	32	261	**122.6**
	V	111	126.4	141.3	129.9	188.9	181.1	84	563	**149.2**

Source : Vaccination Registers, parish and cemetery burial registers

The IMR in socio economic groups I and II should not be considered as significant since low numbers of infant births in these groups have meant that any deaths will produce an untypically high IMR. I have therefore confined my observations about the differences between social classes to the remaining groups where numbers are larger.

Crayford has the least variation between socio economic classes, probably because there was little variation in sewerage/sanitation between the houses that families of different social status occupied. **Bexley Heath** and **Erith** show the same pattern, having the highest IMR in class V families and little, if any, difference in IMR between classes III and IV. **Belvedere** has a peak in groups III and V with a lower IMR in class IV. Men in classes III and V would probably have worked in the factories of the area, the former being the

skilled workers and tradespeople and the latter being unskilled labourers. Given that many families in the 1890s would live close to their place of employment, it is possible that the same environmental conditions could affect both these classes. Class IV families comprise gardeners, house servants and watermen. These Class IV families have lived in a different part of the locality, probably on the outskirts of the parish, and not be subject to the same environmental factors as other classes, resulting in a different IMR. Further research on the geographical spread of families of different status in this area could clarify whether this is significant.

In **Bexley** there is a low IMR among Class III families and the highest IMR amongst Class IV families. When one examines the occupations of the families who form part of Class IV in this village, it becomes clear that the vast majority of these were farm workers and gardeners and therefore likely not to live in the village centre itself. Its may be assumed that a proportion of these would live on the outskirts of the village on farms or estates that are more likely to be in the percentage of houses not having access to Bexley's village water supply and sewage disposal, which might explain why families in Class IV have a higher IMR.

Woods (2000) anticipated a lower IMR for class V than class IV families. On average over the six year period this only holds true for Bexley, the most rural parish. Woods also anticipated that urban environments would be worse than rural within the unskilled worker group. Whilst Bexley does have the lowest class V IMR, the most urbanised environment, Erith, only has the second highest IMR with Bexley Heath being a little higher than Erith. It would seem from this result that either socio-economic status is just one of a number of factors or alternatively that Erith is insufficiently urbanised to show this effect.

As the pattern of IMR between the various social groups varies by parish, it would indicate

that social class was not so much a factor determining the likelihood of infant mortality so much as where the family lived. This is only a small scale study and cannot be taken as proof. It would seem from the above results, however, that it is more likely that sewerage and water supply are more significant factors than socio-economic status although it is possible that the higher the social class the more likely the family is to have access to good sewerage and water which may indicate why, in the majority of parishes the IMR for classes I to IV are generally better than class V.

ILLEGITIMACY

The following table compares the IMR for legitimate births over the years 1893 to 1898 with the IMR for illegitimate births.

Table 14 : The IMR of legitimate and illegitimate births by parish

			1893	1894	1895	1896	1897	1898	Totals
BELVEDERE	Legitimate	Deaths	11	15	16	22	29	42	135
		Births	164	163	187	199	214	248	1175
		IMR	67.1	92.0	85.6	110.6	135.5	169.4	114.9
	Illegitimate	Deaths	0	1	1	1	1	0	4
		Births	0	2	2	4	1	1	10
		IMR	0	500	500	250	1000	0	400
BEXLEY	Legitimate	Deaths	4	7	5	3	14	4	37
		Births	61	74	71	70	64	65	405
		IMR	65.6	94.6	70.4	42.9	218.8	61.5	91.4
	Illegitimate	Deaths	0	1	0	0	0	0	1
		Births	1	1	0	0	0	1	3
		IMR	0.0	1000.0	0.0	0.0	0.0	0.0	333.3
BEXLEY HEATH	Legitimate	Deaths	21	13	17	15	23	28	117
		Births	181	189	164	214	194	190	1132
		IMR	116.0	68.8	103.7	70.1	118.6	147.4	103.4
	Illegitimate	Deaths	0	0	0	0	2	4	6
		Births	1	5	7	4	6	8	31
		IMR	0.0	0.0	0.0	0.0	333.3	500.0	193.5
CRAYFORD	Legitimate	Deaths	21	12	17	13	16	23	102
		Births	125	136	132	141	133	145	812
		IMR	168.0	88.2	128.8	92.2	120.3	158.6	125.6
	Illegitimate	Deaths	1	0	0	1	1	1	4
		Births	4	3	2	2	3	2	16
		IMR	250.0	0.0	0.0	500.0	333.3	500.0	250.0
ERITH	Legitimate	Deaths	26	36	39	38	50	55	244
		Births	288	276	306	300	320	397	1887
		IMR	90.3	130.4	127.5	126.7	156.3	138.5	129.3
	Illegitimate	Deaths	2	1	2	0	1	3	9
		Births	4	3	5	6	3	7	28
		IMR	500.0	333.3	400.0	0.0	333.3	428.6	321.4

Source : Vaccination registers, parish and cemetery burial registers

It should be noted that in Bexley Heath and Crayford the illegitimate IMR is just below twice the legitimate IMR, whereas in the other parishes it is higher, often considerably so. This would seem to support Woods, Watterson and Woodward who noted the infant mortality rate for infants born illegitimately in London in 1902 was over twice the average for the area (Woods, Watterson & Woodward, 1988, p353). It cannot be determined why this difference occurred without further research, but possible hypotheses would be the neglect of a child in view of social stigma or poor economic circumstances (and consequently poor food/housing) as a result of being a single parent family. However, whilst these results appear to bear out the national picture, there were not a large number of illegitimate births in each of these parishes and therefore one more or less over the period can strongly influence the result therefore cautionn should be exercised in interpretation.

Illegitimacy is undoubtedly a factor which greatly influences IMR however the ratio between illegitimate to legitimate IMR varies considerably between parishes. It is possible that in a parish such as Crayford or Bexley Heath which has little sewerage or water supply arrangements the ratio between legitimate and illegitimate IMR is less due to the overriding influence of the environment ie, all births are particularly prone to the environment first and foremost. However we have seen in other analyses that Bexley Heath does not appear to suffer the same IMR as Crayford in general terms. This may indicate that the variation between parishes is a function of the attitudes towards illegitimacy rather than being influenced by the environment with Bexley Heath (a new village) and Crayford (a poor area) being less affected by the stigma of illegitimacy than the more established, wealthier villages.

LOCALITY

We have seen above that several authors have described the urban effect ie, that the infant mortality rate is on the whole higher in urban areas. However, all such previous research has either been based on London data, figures provided by the Registrar General for large towns or on an assumption regarding the population of an entire county or registration district eg, that residents of the whole district lived in similar conditions. We have seen above that the five parishes each had a different environment which can be summarised as follows :-

Bexley : smallest parish, rural economy

Crayford : larger village, industrialised

Bexley Heath : slightly larger than Crayford, little industry, mainly residential population working in neighbouring areas

Belvedere : similar size to Bexley Heath & residential

Erith : town, increasingly industrialized and expanding rapidly

If the urban effect were to exist, we would expect to see it in Erith as the only very densely populated area in the district. Crayford, though industrialized, was only a fraction of the size of Erith and therefore should have a much lower overall infant mortality rate. Bexley Heath and Belvedere should all have lower infant mortality rates being even more sparsely populated, whilst Bexley as a small, rural village should have had the lowest rate of all.

The following table shows the average infant mortality rate over the six years under consideration (1893 to 1898) in each of these five parishes :-

Table 15: IMR by parish for the period 1893 - 1898

Parish	Infant Mortality rate (deaths before age 1 per 1000 births)
Belvedere	117.3
Bexley	93.1
Crayford	128.0
Bexley Heath	105.8
Erith	131.1

Source : Vaccination registers, parish and cemetery burial registers

From these data, Erith has the highest IMR which, being a densely populated urban area, seems to bear out the existence of the urban effect. Crayford, a larger industrialised village, had the second highest IMR. Belvedere follows next being partly a middle class residential area for London commuters and partly working class residential area for those working in nearby factories.

If the urban effect was a significant factor, one would expect to see the infant mortality rate for Erith being higher than for the other parishes in the same district and this is the case, although the rate is not significantly higher than that for Crayford. Although Erith has a greater population density than the other parishes, the urban effect is probably not as significant a factor due to Erith not having the same density as the towns and cities which have been the subject of other studies. It is my belief that the IMR for Erith was higher because of the stretched water supply and sewerage infrastructure and these may also be the significant factors within the urban effect. The results also bear out the hypothesis of Woods (2000) who links the urban effect to the sanitary environment and notes the rural/urban differences. The above results show that the urbanised area with the inadequate sanitary environment (Erith) has the worst IMR followed by the rural village with industry and no sanitation (Crayford) with the rural village with good sanitation having the best IMR. This would seem to show a direct causal link between industry and sanitation and IMR.

SEX

The following table shows the split in IMR by sex in each of the five parishes during the six year period :-

Table 16 : IMR by sex and parish 1893 - 1898

		1893	1894	1895	1896	1897	1898	Averac
BELVEDERE	FEMALE	42.5	109.9	92.8	118.8	132.7	154.6	**93.1**
	MALE	100	81.1	87	107.8	145.3	179.9	**124.6**
BEXLEY	FEMALE	64.5	102.6	65.2	27	225.8	0	**83.7**
	MALE	64.5	111.1	80	60.6	212.1	108.1	**107.7**
BEXLEY HEATH	FEMALE	96.8	67.3	93.8	39.2	117.7	170	**97.2**
	MALE	134.8	66.7	106.7	94.8	132.7	153.1	**114.8**
CRAYFORD	FEMALE	138.5	109.4	87	85.7	140.8	177.2	**124.4**
	MALE	203.1	66.7	169.2	109.6	107.7	147.1	**131.4**
ERITH	FEMALE	62	120.6	110.3	92.2	98.8	128.2	**104.1**
	MALE	123	144.9	138.6	151.5	217.4	157.9	**155.7**

Source : Vaccination registers, parish and cemetery burial registers

The average IMR for each parish is higher for males than for females ranging from 5.6% higher in Crayford to 50% higher in Erith. This may be due to the difference in birth weight as suggested by Woods, Watterson and Woodward (1989). It is also interesting to note that the most industrialised part of the district, Erith, has by far the highest male infant mortality rate whereas the most rural, Bexley, has the lowest. This also seems to bear out the findings of Woods (1982) that high male IMR is linked to areas of industrialisation. This latter result is particularly interesting since Woods' report was at a larger, regional level and was based on assumptions as to the profile of the entire region whereas it appears here to have been upheld by results at a micro level. This result would seem to disprove the statement of Woods (1982) that male mortality is not a factor in the south.

The following table shows the parish data for all years split by sex and by social status of the family (the detailed data is shown in Appendix 7).

Table 17 : Table to show the split of IMR by sex by parish by social class

			I	II	III	IV	V
Bexley	Male	B	12	6	81	56	40
		D	0	1	5	11	3
		IMR	0.0	166.7	61.7	196.4	75.0
	Female	B	13	8	111	50	31
		D	0	2	4	6	3
		IMR	0.0	250.0	36.0	120.0	96.8
Bex Heath	Male	B	22	16	294	101	134
		D	2	0	26	14	23
		IMR	90.9	0	88.4	138.6	171.6
	Female	B	31	15	314	95	141
		D	1	0	33	5	19
		IMR	32.3	0	105.1	52.6	134.8
Belvedere	Male	B	2	13	306	45	228
		D	0	1	40	4	30
		IMR	0	76.9	130.7	88.9	131.6
	Female	B	8	8	348	44	183
		D	0	0	41	3	21
		IMR	0	0	117.8	68.2	114.8
Crayford	Male	B	1	5	184	59	161
		D	0	0	27	6	21
		IMR	0	0	146.7	101.7	130.4
	Female	B	2	1	183	49	183
		D	0	0	19	8	25
		IMR	0	0	103.8	163.3	136.6
Erith	Male	B	7	8	551	143	293
		D	1	3	77	20	55
		IMR	142.9	375.0	139.7	139.9	187.7
	Female	B	8	3	514	118	270
		D	0	0	54	12	29
		IMR	0	0	105.1	101.7	107.4

Source : vaccination registers amended by parish and cemetary records

It should be borne in mind that numbers of births and deaths in classes I and II are small and must be treated with caution since one death can skew the IMR.

In the neighbouring parishes of Belvedere and Erith the male IMR is higher than the female rate in every social class. For Belvedere the percentage by which the male IMR exceeds the female varies from 10% in class III to 30% in class IV. This variance is much more pronounced in Erith where it varies from 33% in class III to 75% in class V. It is not surprising that Belvedere and Erith show the same pattern since the parishes are adjacent.

The more extreme results in Erith can probably be attributed to the crowded nature of the parish and increasing population size which stretched the infrastructure. These parishes indicate that male infants are more likely to die in their first year of life regardless of the social standing or environmental conditions. However, it appears that these external conditions also have an affect and make the variance between male and female IMR more extreme. This is best indicated in Erith where the lower the social class the greater the amount by which the male exceeds the female IMR.

Whilst Belvedere and Erith give a clear picture, this is not the case for the other three parishes and therefore we must be cautious about how much credence we give to these results. Bexley Heath shows a markedly higher male IMR in classes I, IV and V but has a higher female IMR in class III. The class III occupations in this parish were mainly retail or skilled labour - it is hard to understand why female infants in these households should be particularly at risk compared to other occupation types.

Bexley and Crayford both have mixed results with big variations between the sexes. Bexley has a higher male IMR in classes III and IV whereas in Crayford it is higher in class III. It is hard to draw any inferences from these parishes.

Looking at the variations between parishes by social class the results can be summarised as follows :-

Class I - male IMR is higher in the two parishes which have infant deaths

Class II - male IMR is higher in two of the three parishes which have infant deaths

Class III - male IMR is higher in four of the five parishes

Class IV - male IMR is higher in four of the five parishes

Class V - male IMR is higher in three of the five parishes

The above data indicate that the male/female variation is more pronounced in classes I to

IV but less so in class V. However this is hard to reconcile with the data for Erith where the variance between the male and female IMR in class V is wider than all the other classes.

Across the twenty IMR figures greater than 0 (ie classes within each parish which involved at least one infant death), 15 were higher for males and 5 were higher for females. This data indicates that males are more susceptible than females and that this effect may be exacerbated by external factors however these results are not conclusive and this topic would benefit from other studies in other areas.

CONCLUSION

When the IMR for the whole of the Bexley Sub-District is analysed in more detail, what is immediately apparent is that there is much variation in IMR between parishes and for different years within each parish. This suggests that IMR is influenced by more than one factor, since if one factor alone was involved, one would expect to see a pattern within one location or within a year across all parishes, which does not occur. Crayford and Bexley Heath show a similar pattern of rises and falls over the six year period examined although Crayford continually has a higher IMR than Bexley Heath. This same pattern can be seen in the IMR figures for England and Wales over the same period. However, Erith, Belvedere and Bexley show almost the opposite pattern of rises and falls. When the IMR is considered for the whole of Bexley Sub-District, as seen in Table 10, it would appear the IMR climbed by a small margin each year from 1893 to 1896 to fall slightly in 1897 and increase sharply in 1898. However, in the five parishes discussed here, the trend was very different which shows the value in analysing IMR at a micro level. The total IMR for the five parishes (see table 10 page 40) shows an IMR which matches the pattern for the whole of England and Wales ie, IMR falls 1893-4, rises 1894-5, falls 1895-6, rises 1896-7

and rises again 1897-8. This pattern of rises and falls is also apparent within the Bexley Heath and Crayford parishes although the extent of the rises and falls varies. Bexley and Erith also both share the same pattern but this is quite different to the other districts and the IMR rate is substantially higher in most years for Erith than Bexley. Belvedere has a pattern of rises and falls which it does not share with any other parish or with the total figures for the sub-registration district or the rest of the country.

As the individual parishes have small numbers of births and infant deaths, we must, however, always exercise caution about how much emphasis we place on such results which could be the result of a random variation. Only by extending research over a much longer period of time would we see whether the pattern continues to hold true.

Bexley shows a very erratic pattern, possibly due to the small annual number of births and deaths (68 births per annum on average) whereas Erith shows less variance which can possibly be due to the large number of births and deaths per annum (320 births per annum on average). These figures indicate that we need to exercise caution when drawing conclusions from data on this scale since the small numbers can produce spurious results.

There was little variation of IMR between the different socio-economic classes (excluding classes I and II), although in all regions other than Bexley, the IMR was the highest in the lowest (and presumably the poorest) class families. This anomaly for Bexley can probably be explained by examining the IMR peak for class IV households. Agricultural labourers would have fallen into class IV instead of class V, which would include all other labourers, but they probably would not have enjoyed a higher wage or better standard of living than their class V counterparts. Therefore as Bexley was predominately a farming community and the other parishes either light industrial or residential areas, one should expect to find the peak IMR to be class V for all parishes except Bexley. An analysis by class cannot

yield any definitive conclusion since it is not the class itself that is important but what it means in terms of culture, housing, feeding, work, etc.

One factor that is consistently significant throughout all parishes is that of illegitimacy. Woods, Watterson and Woodward (1989) found that the illegitimate IMR was over twice the normal IMR for legitimate births and this holds true for most parishes within Bexley Sub-District other than for Bexley Heath and Crayford where it is just less than twice the legitimate IMR. It is hard to draw a conclusion from this since a high IMR may be due to any or all of a number of factors eg, mother working late into pregnancy, poor childcare whilst the mother works, poor living standards and food, neglect of the child by the mother who does not want the stigma of having an illegitimate child, etc. An interesting point to note from Table 12 is the large number of illegitimate births in Bexley Heath compared to Belvedere which had a similar overall number of births, particularly when one considers that Bexley Heath had by far the lowest illegitimate IMR. Bexley Heath was a relatively new town in the 1890s and it may well be that although water and sewerage conditions were not as good as some areas, perhaps housing was otherwise reasonable and the culture of a new, maybe young, community was more accepting of the stigma of illegitimacy.

A further constant factor across all parishes was that of IMR by gender with all parishes having a higher male IMR than female. This bears out research by Woods, Watterson and Woodward (1989) who attributed this to differences in birth weight. Also Woods (1982) found that high male IMR is linked to areas of industrialisation, which holds true for the Bexley Sub-District where the highest male IMR was found in Erith, the most industrialised parish.

Sewage and water supply seem to be very significant factors and where a locality shares similar characteristics of such supplies with another, similar patterns of changes in IMR

can be seen year on year. As within Bexley Sub-District, neighbouring parishes can have vastly different environmental factors. Bexley and Crayford lie just a mile or so apart both within the Cray Valley at a similar height above sea level but the similarities end there. As shown above, Bexley was provided with a constant water supply and 90% of the houses were connected to mains sewerage whereas in Crayford there was no mains sewerage and the water supply was only switched on for 2-3 hours per day. The IMR for Bexley was significantly lower than that for Crayford. This indicates the significance of water supply and sewerage when considering IMR. However, even looking at IMR at parish level can disguise fluctuations street by street and house by house. By examining IMR by street in Erith I have shown that there is significant variance within a district and where details exist at street level as to which properties were sewered it has been shown that those with mains sewerage had the lowest IMR. It is difficult to obtain information about the services to individual premises and this exercise has therefore only been possible for a small number of streets. It is my belief that this is one of the most significant factors affecting IMR and more research needs to be done on this topic.

The only conclusion that can be drawn from this work is that there is no single factor determining the IMR. Services to houses, legitimacy and gender are all influencing factors and it is possible that geography may combine with weather conditions to either exaggerate the effects of other factors or to act in their own right.

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Vaccination Registers for Bexley Urban District, years 1893 to 1898 inclusive
Reference Numbers G/DA/NPv2/5,6,7,8,9,10&11

Local Studies Centre, Hall Place, Bexley

Parish Burial Registers for :-

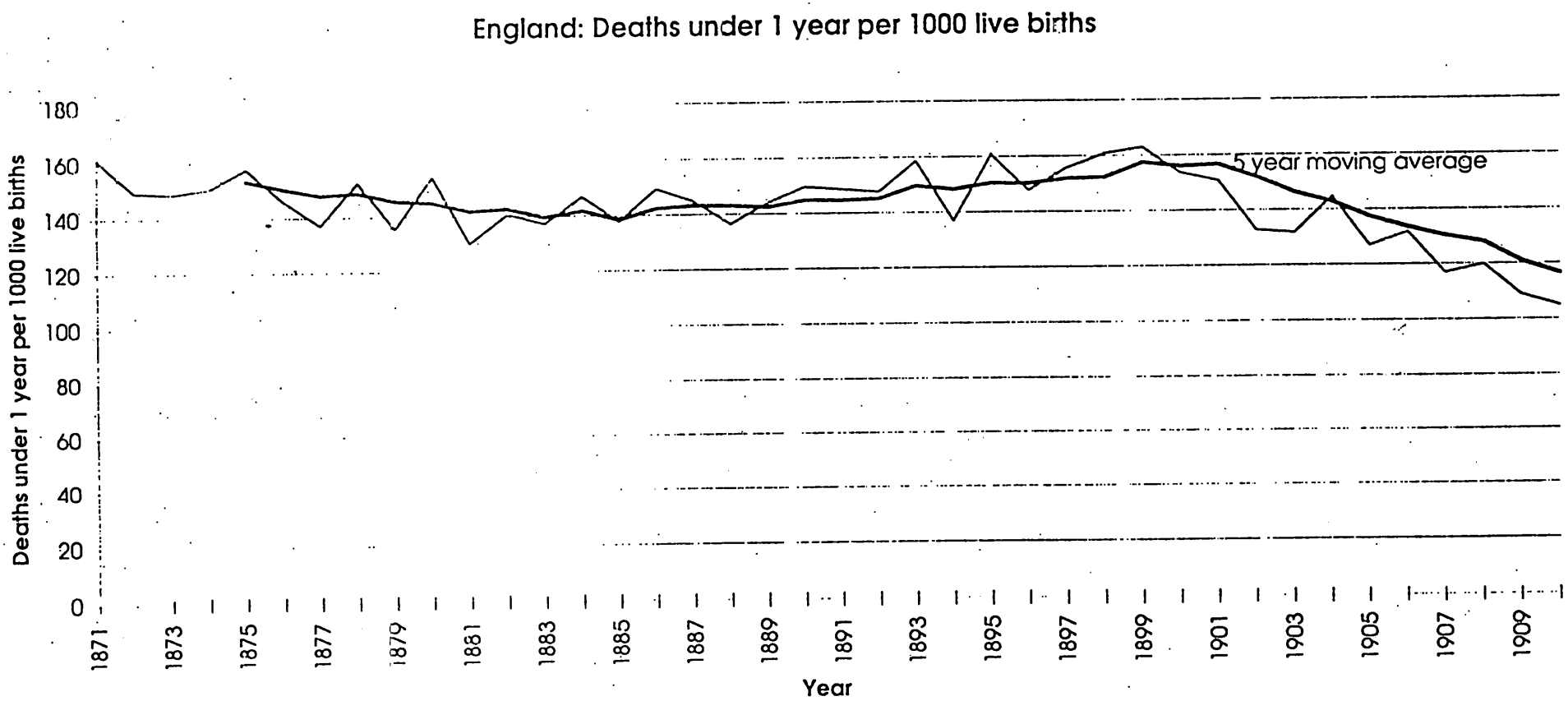
	Reference Number
- Bexley, St Mary's	PA23/1/28
- Bexley Heath, Christ Church	PA23c/1/4/3,4&5
- Crayford, St Paulinus	PA105/1/33&34
- Erith Cemetery *	Not referenced
- Erith, St John the Baptist *	PA137/1/4

* these burial registers incorporate Belvedere

Ordnance Survey Maps for all parishes, various dates mostly in early 1890s - not referenced

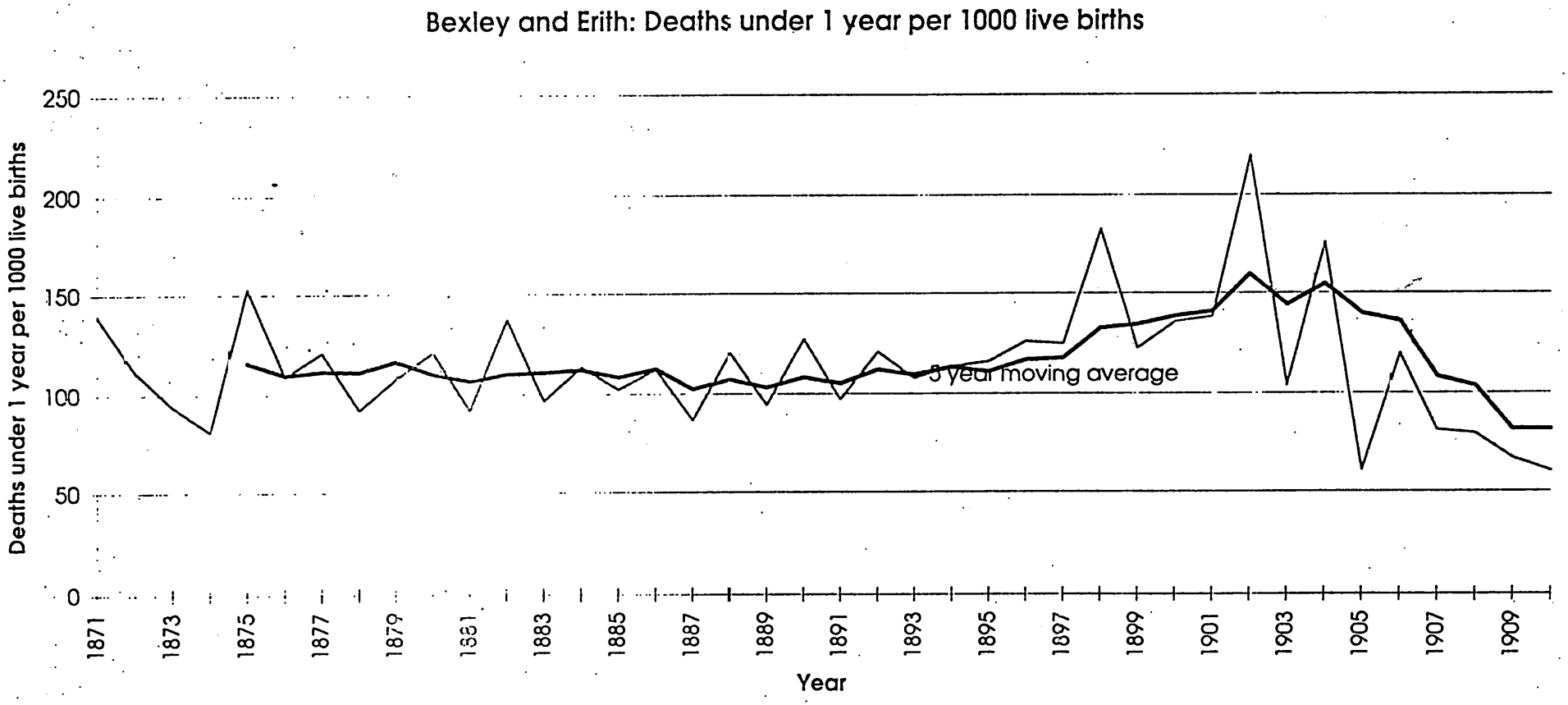
APPENDIX 1
ORDNANCE SURVEY MAP
SURVEYED 1861-1868
REVISED 1903 1" TO 1 MILE

APPENDIX 2



SOURCE: QUARTERLY REPORTS OF REGISTRAR GENERAL

APPENDIX 3A

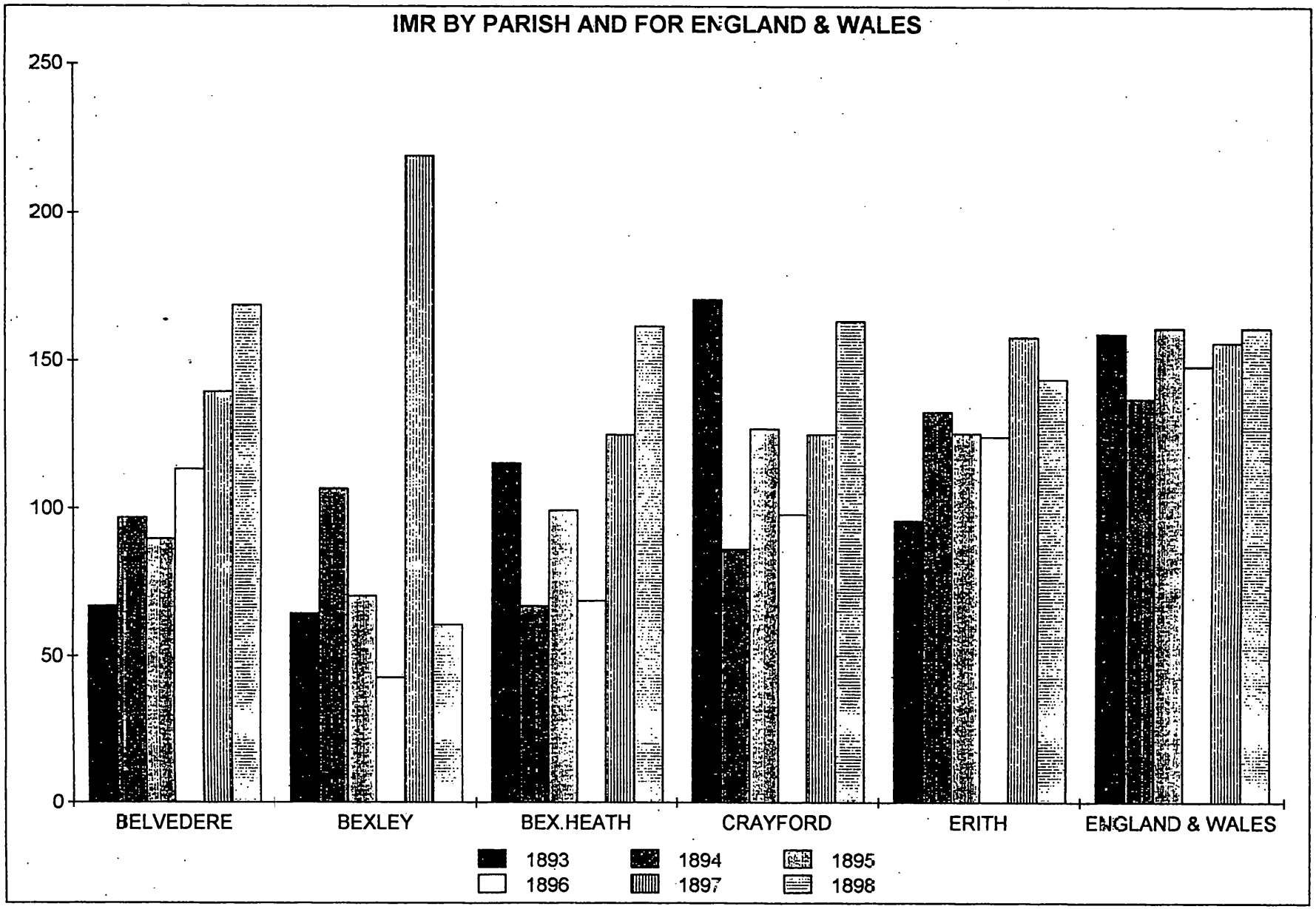


SOURCE : QUARTERLY REPORTS OF REGISTRAR GENERAL

Births and deaths under one year per quarter in Bexley, 1871-1910

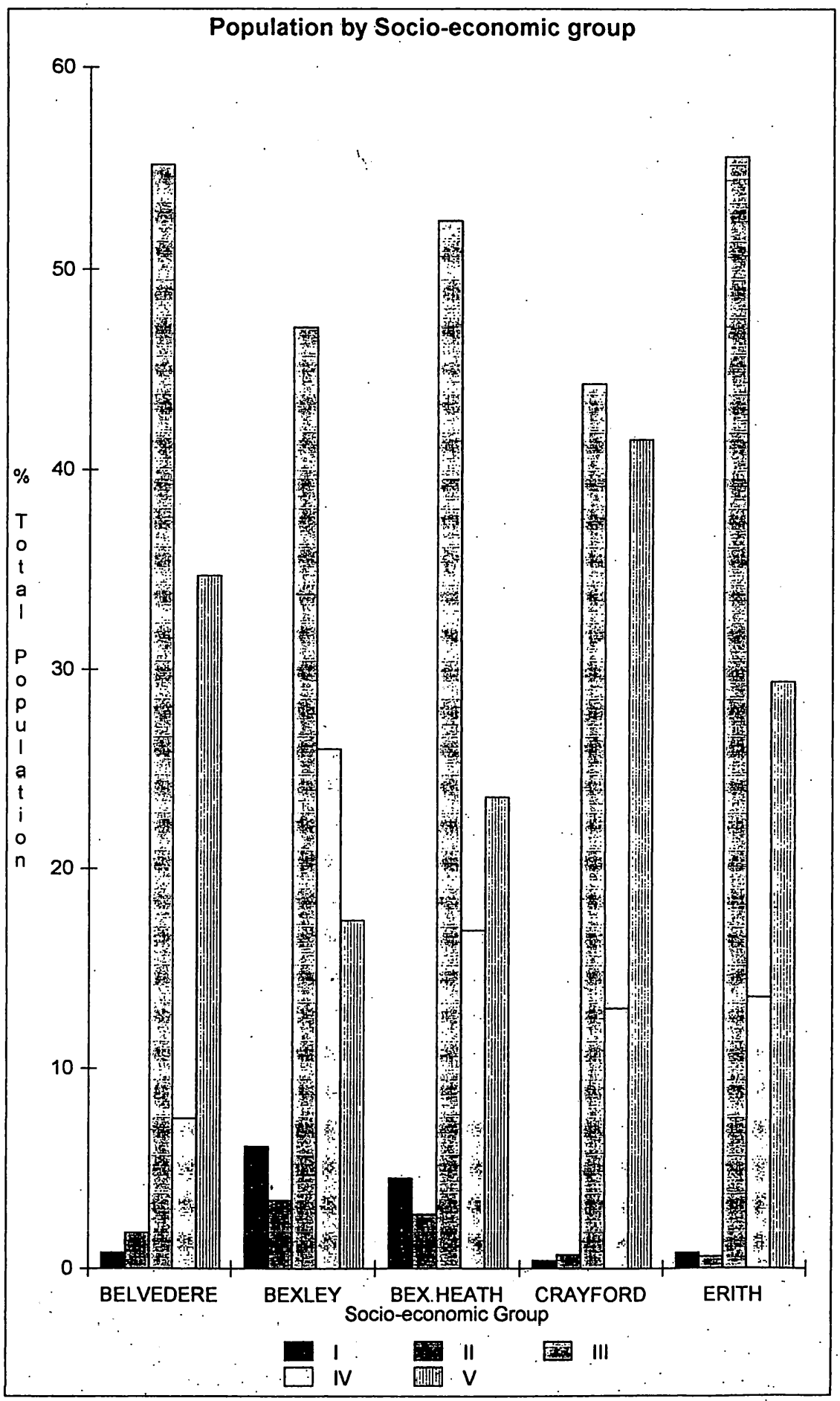
	Q1	Q2	Q3	Q4	Total Births	Q1	Q2	Q3	Q4	Total Deaths		IMR
1871	181	180	140	209	710	22	17	40	20	99		139
1872	197	157	171	173	698	19	17	21	21	78		112
1873	181	155	184	212	732	14	20	25	10	69		94
1874	204	185	180	157	726	11	19	20	9	59		81
1875	139	209	170	208	726	25	22	39	25	111		153
1876	218	169	176	179	742	29	12	24	16	81		109
1877	177	176	166	175	694	16	20	27	21	84		121
1878	189	208	201	193	791	21	11	23	18	73		92
1879	210	173	189	178	750	19	13	18	31	81		108
1880	176	206	202	209	793	22	21	30	23	96		121
1871-90					7362					831		113
1881	188	191	186	195	760	22	15	18	15	70		92
1882	209	194	195	194	792	35	22	20	32	109		138
1883	237	187	201	181	806	19	19	20	20	78		97
1884	227	188	210	184	809	32	14	29	17	92		114
1885	227	197	187	199	810	17	21	26	19	83		102
1886	222	196	213	179	810	21	17	32	21	91		112
1887	199	218	203	208	828	19	11	32	10	72		87
1888	197	216	221	205	839	22	28	19	32	101		120
1889	206	225	228	230	889	17	21	26	20	84		94
1890	234	229	248	231	942	24	16	37	43	120		127
1881-90					8285					900		109
1891	297	248	264	251	1060	39	21	22	21	103		97
1892	250	242	248	227	967	32	19	38	28	117		121
1893	271	224	263	226	984	28	29	35	14	106		108
1894	260	228	252	211	951	31	23	23	31	108		114
1895	218	240	274	250	982	30	15	42	27	114		116
1896	264	252	278	275	1069	25	26	48	36	135		126
1897	294	244	265	300	1103	30	18	64	26	138		125
1898	302	304	293	311	1210	28	49	93	51	221		183
1899	345	367	306	352	1370	24	36	104	4	168		123
1900	376	356	360	357	1449	43	40	63	51	197		136
1891-1900					11145					1407		126
1901	398	388	407	390	1583	53	28	97	41	219		138
1902	391	408	429	140	1368	43	35	39	15	132		96
1903	153	149	166	157	625	12	16	12	22	62		99
1904	166	151	160	153	630	17	16	31	24	88		140
1905	159	158	152	156	625	7	10	7	14	38		61
1906	158	167	160	149	634	18	7	37	14	76		120
1907	160	184	144	151	639	15	12	12	13	52		81
1908	166	185	147	142	640	8	14	12	17	51		80
1909	147	143	153	154	597	7	8	13	12	40		67
1910	138	129	144	119	530	10	4	8	10	32		60
1901-10					7871					790		100
On the 1st October 1902, Bexley was divided into two, Bexley (1) and Erith (2)												

Source: Registrar General's Returns



SOURCES: BIRTHS AND DEATHS FOR PARISHES FROM VACCINATION REGISTERS FOR BEXLEY SUB-DISTRICT AMENDED BY PARISH AND CHURCHYARD BURIAL REGISTERS FIGURES FOR ENGLAND AND WALES FROM QUARTERLY RETURNS OF REGISTRAR GENERAL

APPENDIX 5



SOURCE : BIRTHS AND DEATHS FOR PARISHES FROM VACCINATION REGISTERS FOR BEXLEY SUB-DISTRICT AMENDED BY PARISH AND CHURCHYARD BURIAL REGISTERS

Appendix 6 Armstrong's Social Classifications for York, 1851

Class I

- Accountant
- Archbishop's Secretary
- Architect
- Army Officer
- Attorney
- Dentist
- Independent Minister
- Magistrate (stipendiary)
- Museum Curator
- Naval Officer
- Ordnance Surveyor
- Rector
- Reporter
- Sharebroker
- Shipowner
- Solicitor
- Surgeon/physician
- Surveyor
- Vicar

Class II

- Auctioneer
- Bookkeeper
- Coal Agent
- Commercial Teacher
- Factor (unspecified)
- Farmer (more than 5 acres)
- Inland Revenue Collector
- Land agent
- Language Professor
- Music Teacher
- Professor of music
- Proprietor of ladies seminary
- Police chief constable
- Railway audit clerk
- Railway Inspector
- Relieving officer
- Schoolmaster/ schoolmistress
- Sculptor
- Station master
- Translator (language)
- Vaterinary surgeon

Class III

- Assistant (to linen draper)
- Assistant (ordnance office)
- Baker
- Basket Maker
- Beer retailer
- Blacksmith
- Boiler maker
- Bookbinder
- Bookseller
- Bonnet maker
- Boot closer
- Brass fitter
- Bricklayer
- Brush maker
- Builder
- Butcher
- Cabinet maker
- Cabman
- Calico weaver
- Car (carriage) painter
- Chair maker
- Chemist
- Cattle dealer
- Clerk (unspecified)
- Clockmaker
- Coach builder
- Coach-lace weaver
- Coachman
- Coach trimmer
- Coachsmith
- Coach-wheel maker
- Coal dealer
- Compositor
- Comb-maker
- Confectioner
- Cook
- Cooper
- Coppersmith
- Cordwainer
- Corn, flour dealer
- Currier
- Cutler
- Damask weaver
- Dentist's assistant
- Draper
- Dressmaker
- Eating-house keeper
- Engine driver
- Engineer
- Engine fitter
- Engine-spring maker
- Engraver
- Farrier
- File cutter (maker)
- Fireman
- Fishmonger
- Florist
- French-kid stainer
- Fringe weaver
- Fruiterer
- Gas fitter
- Guilder
- Girth weaver
- Glass blower
- Glass stainer
- Glover
- Greengrocer
- Grocer
- Gun maker (gun smith)
- Gutta-percha merchant (broker)
- Hairdresser
- Hatter
- Hay & straw dealer
- Hosier
- Housepainter
- Innkeeper (publican)
- Ironmonger
- Iron-moulder

Class III (continued)

Iron Turner	Plasterer	Stationer
Joiner	Police constable	Staymaker (corset maker)
Law stationer	Plumber	Stonemason
Leather dresser	Pot dealer	Stone sawer
Linen spinner	Pot maker (potter)	Tailor
Manure dealer	Poulterer	Tea dealer
Marble mason	Printer	Telegraph clerk
Master grinder	Railway clerk	Tobacconist
Master mariner	Railway fitter	Traveller (commercial)
Miller (flour & grain)	Railway guard	Upholsterer
Millwright	Railway pointsman	Victualler
Muffin maker	Railway policeman	Waiter
Musician	Saddler	Warehouseman
Music seller	Saddle-tree maker	Watchmaker
Nail maker	Sailor	Weaver (textile)
Nurse	Sawyer	Wheelwright
Omnibus driver	Seamstress	Whitesmith
Optician	Ship's carpenter	Wine & spirit dealer
Pawnbroker	Shoemaker	Wire worker
Perfumer	Shopman	Wood carver
Picture dealer	Silversmith	Woodsman
Picture-frame maker	Silver turner	Woodturner
Pipe maker (tobacco)	Slater	Writer
Plane maker	Soldier	

(Innkeepers with servants & tradesman, dealers and manufacturers who were employers should be upgraded to class II)

Class IV

Agricultural labourer	Gardener	Office keeper
Brazier	General servant	Ostler
Brewer	Gentleman's servant	Pavior
Brickmaker	Goods deliverer (railway)	Quiltress
Carter/carrier (horse drawn)	Groom	Rail stoker
Cloth dresser	Herdsman	Railway ticket collector
Cork cutter	Horsebreaker	Rope maker
Cowkeeper	Horsekeeper	Steward (club)
Drover	Hotel porter	Stoker
Engine cleaner	Housekeeper	Washerwoman
Flax dresser	Housemaid	Waterman (boatsman)
	Laundress	

Class V

Charwoman	Messenger	Rail porter
Errand boy	News vendor	Road labourer
Hawker	Porter	Scavenger
Labourer	Rag & paper collector	

Source : Drake & Finnegan (1994)pp.48-49

Appendix 7 **Detailed IMR data by sex by parish by social class**

	Year	Sex				Class									
				I	II	III	IV	V			I	II	III	IV	V
Bexley	1993	M	B	3	2	8	9	9	F	B	5	1	15	8	2
			D	0	0	1	0	1		D	0	0	0	2	0
			IMR	0.0	0.0	125.0	0.0	111.1		IMR	0.0	0.0	0.0	250.0	0.0
	1994	M	B	2	1	22	7	4	F	B	3	1	18	10	7
			D	0	0	2	0	1		D	0	1	0	1	1
			IMR	0.0	0.0	90.9	0.0	250.0		IMR	0.0	1000.0	0.0	100.0	142.9
	1995	M	B	1	0	10	9	5	F	B	4	1	30	8	3
			D	0	0	0	2	0		D	0	0	1	1	0
			IMR	0.0	0.0	0.0	222.2	0.0		IMR	0.0	0.0	33.3	125.0	0.0
	1996	M	B	2	0	16	9	6	F	B	1	2	19	9	6
			D	0	0	0	1	1		D	0	0	1	0	0
			IMR	0.0	0.0	0.0	111.1	166.7		IMR	0.0	0.0	52.6	0.0	0.0
	1997	M	B	1	2	12	13	5	F	B	0	3	12	9	7
			D	0	0	2	5	0		D	0	1	2	2	2
			IMR	0.0	0.0	166.7	384.6	0.0		IMR	0.0	333.3	166.7	222.2	285.7
	1998	M	B	3	1	13	9	11	F	B	0	0	17	6	6
			D	0	1	0	3	0		D	0	0	0	0	0
			IMR	0.0	1000.0	0.0	333.3	0.0		IMR	0.0	0.0	0.0	0.0	0.0
	Totals	**M**	**B**	**12**	**6**	**81**	**56**	**40**	**F**	**B**	**13**	**8**	**111**	**50**	**31**
			D	**0**	**1**	**5**	**11**	**3**		**D**	**0**	**2**	**4**	**6**	**3**
			IMR	**0.0**	**166.7**	**61.7**	**196.4**	**75.0**		**IMR**	**0.0**	**250.0**	**36.0**	**120.0**	**96.8**

	Year	Sex		Class											
				I	II	III	IV	V			I	II	III	IV	V
Erith	1993	M	B	1	1	85	24	52	F	B	1	1	70	19	38
			D	0	1	10	3	6		D	0	0	4	0	4
			IMR	0.0	1000.0	117.6	125.0	115.4		IMR	0.0	0.0	57.1	0.0	105.3
	1994	M	B	1	2	64	26	45	F	B	0	0	75	24	42
			D	0	0	9	3	8		D	0	0	11	3	3
			IMR	0.0	0.0	140.6	115.4	177.8		IMR	0.0	0.0	146.7	125.0	71.4
	1995	M	B	1	1	91	23	50	F	B	2	1	82	18	42
			D	0	0	9	5	9		D	0	0	8	4	4
			IMR	0.0	0.0	98.9	217.4	180.0		IMR	0.0	0.0	97.6	222.2	95.2
	1996	M	B	1	2	97	29	36	F	B	2	0	84	14	41
			D	0	1	13	4	7		D	0	0	10	0	3
			IMR	0.0	500.0	134.0	137.9	194.4		IMR	0.0	0.0	119.0	0.0	73.2
	1997	M	B	0	2	95	17	47	F	B	1	1	88	29	43
			D	0	1	17	3	14		D	0	0	10	3	3
			IMR	0.0	500.0	178.9	176.5	297.9		IMR	0.0	0.0	113.6	103.4	69.8
	1998	M	B	3	0	119	24	63	F	B	2	0	115	14	64
			D	1	0	19	2	11		D	0	0	11	2	12
			IMR	333.3	0.0	159.7	83.3	174.6		IMR	0.0	0.0	95.7	142.9	187.5
	Total	**M**	**B**	**7**	**8**	**551**	**143**	**293**	**F**	**B**	**8**	**3**	**514**	**118**	**270**
			D	**1**	**3**	**77**	**20**	**55**		**D**	**0**	**0**	**54**	**12**	**29**
			IMR	**142.9**	**375.0**	**139.7**	**139.9**	**187.7**		**IMR**	**0.0**	**0.0**	**105.1**	**101.7**	**107.4**

	Year	Sex				Class									
				I	II	III	IV	V			I	II	III	IV	V
Crayford	1993	M	B	0	1	32	6	25	F	B	0	1	25	9	30
			D	0	0	9	0	4		D	0	0	4	1	4
			IMR	0.0	0.0	281.3	0.0	160.0		IMR	0.0	0.0	160.0	111.1	133.3
	1994	M	B	0	0	31	16	28	F	B	0	0	24	12	28
			D	0	0	2	1	2		D	0	0	2	0	5
			IMR	0.0	0.0	64.5	62.5	71.4		IMR	0.0	0.0	83.3	0.0	178.6
	1995	M	B	0	0	33	8	24	F	B	0	0	28	8	33
			D	0	0	3	1	7		D	0	0	3	1	2
			IMR	0.0	0.0	90.9	125.0	291.7		IMR	0.0	0.0	107.1	125.0	60.6
	1996	M	B	1	0	33	8	31	F	B	0	0	39	4	27
			D	0	0	3	2	3		D	0	0	2	1	3
			IMR	0.0	0.0	90.9	250.0	96.8		IMR	0.0	0.0	51.3	250.0	111.1
	1997	M	B	0	0	26	10	29	F	B	1	0	35	4	31
			D	0	0	4	0	3		D	0	0	6	1	3
			IMR	0.0	0.0	153.8	0.0	103.4		IMR	0.0	0.0	171.4	250.0	96.8
	1998	M	B	0	4	29	11	24	F	B	1	0	32	12	34
			D	0	0	6	2	2		D	0	0	2	4	8
			IMR	0.0	0.0	206.9	181.8	83.3		IMR	0.0	0.0	62.5	333.3	235.3
	Total	**M**	**B**	**1**	**5**	**184**	**59**	**161**	**F**	**B**	**2**	**1**	**183**	**49**	**183**
			D	**0**	**0**	**27**	**6**	**21**		**D**	**0**	**0**	**19**	**8**	**25**
			IMR	**0.0**	**0.0**	**146.7**	**101.7**	**130.4**		**IMR**	**0.0**	**0.0**	**103.8**	**163.3**	**136.6**

	Year	Sex				Class									
				I	II	III	IV	V			I	II	III	IV	V
Belvedere	1993	M	B	0	0	35	7	28	F	B	1	3	49	9	32
			D	0	0	4	0	3		D	0	0	2	1	1
			IMR	0.0	0.0	114.3	0.0	107.1		IMR	0.0	0.0	40.8	111.1	31.3
	1994	M	B	0	3	34	4	33	F	B	1	1	52	11	26
			D	0	0	4	0	2		D	0	0	6	1	3
			IMR	0.0	0.0	117.6	0.0	60.6		IMR	0.0	0.0	115.4	90.9	115.4
	1995	M	B	1	5	47	6	33	F	B	0	2	59	1	35
			D	0	0	7	0	1		D	0	0	6	0	3
			IMR	0.0	0.0	148.9	0.0	30.3		IMR	0.0	0.0	101.7	0.0	85.7
	1996	M	B	0	3	58	9	32	F	B	3	2	57	6	33
			D	0	0	5	2	4		D	0	0	10	0	2
			IMR	0.0	0.0	86.2	222.2	125.0		IMR	0.0	0.0	175.4	0.0	60.6
	1997	M	B	0	0	58	13	46	F	B	0	0	67	6	25
			D	0	0	6	2	9		D	0	0	7	1	5
			IMR	0.0	0.0	103.4	153.8	195.7		IMR	0.0	0.0	104.5	166.7	200.0
	1998	M	B	1	2	74	6	56	F	B	3	0	64	11	32
			D	0	1	14	0	11		D	0	0	10	0	7
			IMR	0.0	500.0	189.2	0.0	196.4		IMR	0.0	0.0	156.3	0.0	218.8
	Totals	**M**	**B**	**2**	**13**	**306**	**45**	**228**	**F**	**B**	**8**	**8**	**348**	**44**	**183**
			D	**0**	**1**	**40**	**4**	**30**		**D**	**0**	**0**	**41**	**3**	**21**
			IMR	**0.0**	**76.9**	**130.7**	**88.9**	**131.6**		**IMR**	**0.0**	**0.0**	**117.8**	**68.2**	**114.8**

	Year	Sex				Class										
				I	II	III	IV	V				I	II	III	IV	V
Bex. Heath	1993	M	B	3	5	41	16	24		F	B	6	4	42	18	23
			D	1	0	3	3	5			D	0	0	4	1	4
			IMR	333.3	0.0	73.2	187.5	208.3			IMR	0.0	0.0	95.2	55.6	173.9
	1994	M	B	6	2	46	21	15		F	B	4	4	62	10	24
			D	0	0	4	2	0			D	0	0	4	0	3
			IMR	0.0	0.0	87.0	95.2	0.0			IMR	0.0	0.0	64.5	0.0	125.0
	1995	M	B	3	2	35	14	21		F	B	6	1	55	16	18
			D	0	0	2	0	6			D	0	0	5	1	3
			IMR	0.0	0.0	57.1	0.0	285.7			IMR	0.0	0.0	90.9	62.5	166.7
	1996	M	B	5	2	63	22	25		F	B	5	1	50	20	25
			D	0	0	5	2	4			D	0	0	2	0	2
			IMR	0.0	0.0	79.4	90.9	160.0			IMR	0.0	0.0	40.0	0.0	80.0
	1997	M	B	3	2	59	10	22		F	B	3	2	54	19	24
			D	1	0	8	2	2			D	0	0	8	1	3
			IMR	333.3	0.0	135.6	200.0	90.9			IMR	0.0	0.0	148.1	52.6	125.0
	1998	M	B	2	1	50	18	27		F	B	7	3	51	12	27
			D	0	0	4	5	6			D	1	0	10	2	4
			IMR	0.0	0.0	80.0	277.8	222.2			IMR	142.9	0.0	196.1	166.7	148.1
	Total	**M**	**B**	**22**	**14**	**294**	**101**	**134**		**F**	**B**	**31**	**15**	**314**	**95**	**141**
			D	**2**	**0**	**26**	**14**	**23**			**D**	**1**	**0**	**33**	**5**	**19**
			IMR	**90.9**	**0.0**	**88.4**	**138.6**	**171.6**			**IMR**	**32.3**	**0.0**	**105.1**	**52.6**	**134.8**