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AN HISTORICAL DEMOGRAPHIC INVESTIGATION INTO MORTALITY IN THREE HISTORICAL BIRTH COHORTS BORN BETWEEN 1837 AND 1900 IN MAMRE, WITH SPECIAL REFERENCE TO LIFE EXPECTANCY

Judy Katzenellenbogen

A thesis submitted to the Faculty of Medicine, University of Cape Town in fulfilment of the requirements for the Degree of Master of Science (Medicine) in Community Health

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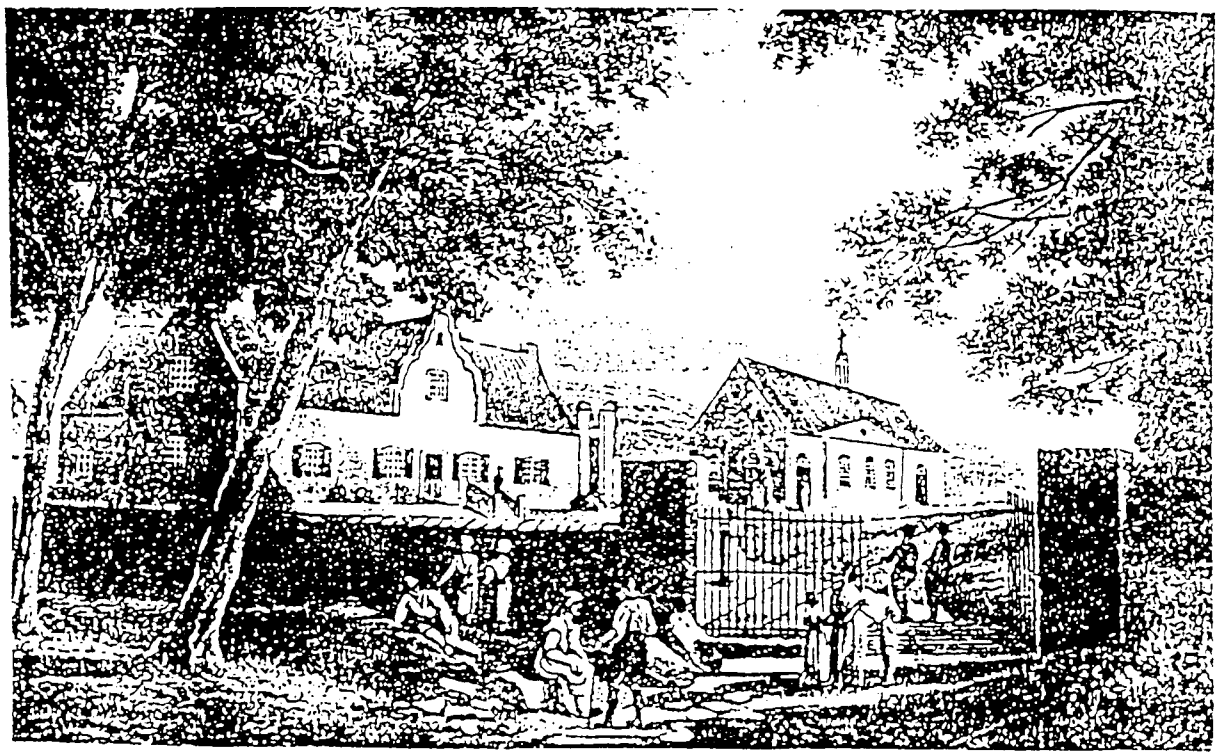

Groene Kloof church and mission house R. Cocking - post 1818

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DECLARATION

I, **Judith Masha Katzenellenbogen**, declare that the work on which this thesis is based is original (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being or is to be submitted for another degree in this or any other university.

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ABSTRACT

This thesis reports on an historical prospective study of three Mamre decadal birth cohorts (1837-1846, 1870-1879 and 1900-1909) constructed retrospectively through existing parish records of the Moravian Mission at Mamre in the Western Cape region of South Africa. Nominative data collection techniques were used to gather information needed to determine the infant mortality rates, quinquennial mortality rates and life expectancies of the three cohorts.

Issues related to the quality of data - non registration and follow-up - were investigated. Birth registration was best for the 1837-46 cohort for males and females, with the 1900-1909 registration being next best. Overall, male registration coverage was substantially better than that for females. Infant death registration was best for males in these 2 cohorts, but were poor for females.

Based on these data, the infant mortality rates for the cohorts born in 1837-1846, 1870-1879 and 1900-1909 - 196, 182 and 128 per 1000 respectively for males and 160, 172 and 97 per 1000 respectively for females - appeared to be underestimates. There is some evidence of a downward trend for the infant mortality rates with time for males, but this was not statistically significant.

Quinquennial mortality rates for the 3 cohorts did not differ statistically, and are similar to the 1935-37 national 'coloured' figures.

The life expectancies also did not differ significantly between cohorts. The life expectancies at birth (range 34-40 years for males and 32-45 years for females) were probably overestimates due to biased IMR's. The life expectancies at age 1 (range 41-44 for males and 37-49 for females) were more representative figures. Life expectancies at age 20 were fairly stable over time (37-45 years) except for females in the 1900-1909 cohort whose life expectancies were substantially higher than earlier figures.

All mortality indices investigated in this study consistantly showed a lighter burden of mortality in historical Mamre compared to 'coloureds' in the Cape Colony at the turn of the century. This is probably associated with the better housing, environmental, social, economic and educational conditions at the Mamre mission relative to the rest of the Colony in the century after the emancipation of slaves.

INTRODUCTION

Motivation for the Mamre Church Records Study

Mamre is a village of about 5 000 inhabitants situated along the Cape West Coast, approximately 48 kilometers from Cape Town, South Africa (Figure 1). As one of the first Moravian Mission Stations in South Africa, it has a rich history which spans the period from Khoikhoi settlement of the area to the present-day secular village.

Mamre has been the subject of much epidemiological research following the establishment of the Mamre Community Health Project in 1986. This collaborative project, jointly established by research, academic and service bodies, in consultation with the community, aims to determine the health status and needs of the people in order to improve the health of the community by introducing appropriate interventive measures. Details of the project have been reported elsewhere.(1,2,3,4,5)

Before surveying the village, all available sources of health-related information were investigated in order to contribute to the community diagnosis. The most accessible source of historical mortality data proved to be the church burial records. Following the discovery of these records, other church records were examined for useful information. Dating back to the 1800s, these records were rich in detail and made it possible to investigate demographic and health issues relating to Mamre's past.

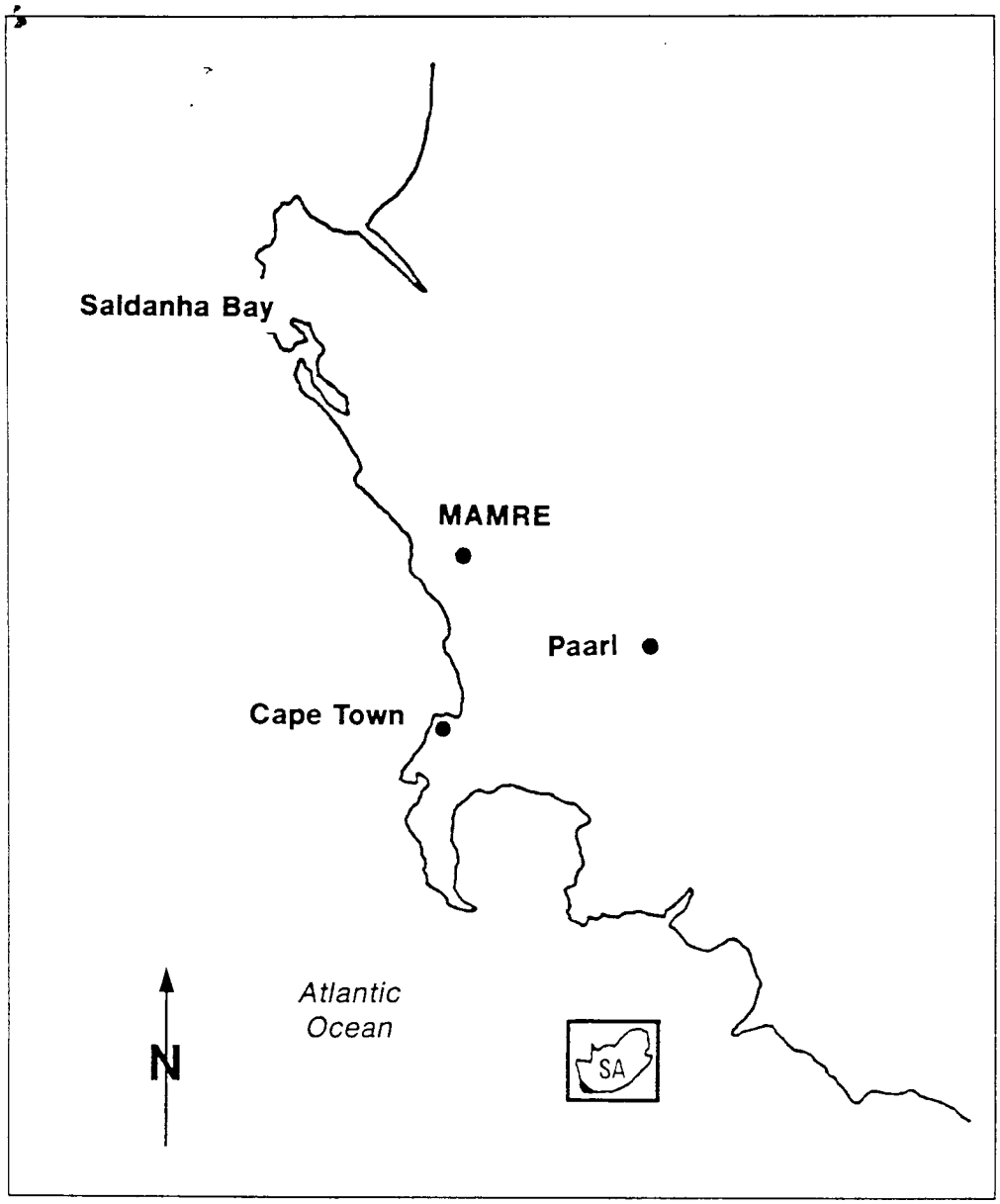


Figure 1 Map of South Western Cape

Quantitative studies of historical communities have been conducted in many European [6,7,8,9,10,11] and other settings.[12,13,14] Studies of the 18th century 'white'* population of South Africa provide a demographic overview of mainly the Afrikaner population[15,16]. The earliest census in the Cape Colony dates back to 1894, providing the first official figures available for demographic study.[17] However, few historical demographic studies have been made of the indigenous people of South Africa. Church records of mission stations present an opportunity to study demographic and epidemiological features of these historical populations. In this way, this study hopes to make a contribution to the body of knowledge concerning the South African population during the 19th and early 20th centuries in general, and specifically to that of the indigenous people of the Western Cape.

However, the investigation of the records has not been done for historical reasons only. In recognising that any future community has strong roots in the past, the Mamre Community Health Project has a unique opportunity for studying long-term trends by using historical-demographic and health information as a baseline.

The sources used in this study also suggest methodological approaches for other types of epidemiological studies where the conventional sources of data are either unreliable or apparently absent. Mortality studies in developing countries are a case in point. Through the use

* Social, economic and political institutions in South Africa are divided along legally defined racial lines. Racial terminology is referred in this thesis in order to make use of available mortality figures for comparative purposes and to explore the evolution of racial divisions in South Africa. Its use should not be seen as legitimising the statutory definitions.

of alternative data sources and epidemiologically unconventional data collection techniques, access to important information may be possible.

The above factors - opportunities to create a historical baseline, general historical insights and methodological investigations - led to the design of this study which uses a combination of these factors to arrive at estimates of life expectancy in Mamre in the last century. It must be stressed that the records have yielded information in excess of what was needed for this study, some of which has already been utilised [18] and some of which has the potential for future investigation.

The specific objectives of this study are as follows:

1. To investigate the quality of the birth and death registration of three Mamre cohorts born between 1837-1846, 1870-1879, and 1900-1909.

2. To determine the infant mortality rates, quinquennial mortality rates and life expectancies of the cohorts mentioned above.

3. To compare these mortality indices with one another as well as with figures found in other populations at different points in time, and to discuss these differences.

Chapters 1 to 3 review relevant literature. In addition, chapter 1 introduces historical demography as a field of study and focuses on nominative data collection methods. Chapter 2 discusses mortality information as health indicators in epidemiology, and describes different

approaches to determining life expectancy. Chapter 3 provides the historical framework of the study, describing the history of Mamre in the context of the broader socio-political environment. Chapter 4 outlines the methodology used in the study, while chapter 5 presents the results. In Chapter 6 the results are discussed in an attempt to integrate the results both epidemiologically and historically.

CHAPTER 1

HISTORICAL DEMOGRAPHY : DATA COLLECTION METHODS AND DATA QUALITY, WITH SPECIAL REFERENCE TO PARISH DATA

SUMMARY

This chapter introduces historical demography as a field of study, within the broader context of demography and population studies. Methods of estimating numerator and denominator data for quantitative historical demographic studies are discussed. Nominative data collection methods are compared with aggregative methods. A list of common sources of historical demographic data is provided.

The quality of historical data needs special investigation. Possible sources of error are discussed, and particular attention is paid to methods of investigating the quality of birth information in parish data.

1.1 HISTORICAL DEMOGRAPHY IN CONTEXT

1.1.1 Demography

Demography is the statistical study of populations, and as such embraces all aspects of population change that are capable of numeric measurement.[19] This involves primarily the measurement of size, growth and reduction in the numbers of people, the proportions living, being born and dying within an

area or region, and the related functions of fertility, mortality and marriage.[20] The three basic components of demographic processes are thus fertility, mortality and migration.

1.1.2 Population studies

A distinction between formal statistical demography and the broad field of population studies is useful for conceptual purposes. In contrast to statistical demography, population studies investigate the social, economic, political and biological causes and consequences of population trends as revealed by demographic analyses, and is inevitably an interdisciplinary field. In the study of problems related to their own fields, sociologists, economists, epidemiologists, biological anthropologists, statisticians, historians, and actuarial and political scientists make use of data assembled and analysed by demographers.[21,22,23]

1.1.3 Historical demography

Historical demography is the study of the dynamics of past populations.[19] Demographic information for most regional and national populations is incomplete, if existent at all, before the mid-19th century.[19,22,24] In order to study past populations, techniques have been developed to elicit demographic information from various sources of historical data. The most common examples of historical demographic studies are drawn from European communities during the pre-industrial and industrial revolution periods[6,7,8,9,10,11,25], although similar studies have been done in other

countries.[12,13,14] Such information provides scholars with insights into past population dynamics as well as with lessons and methodologies applicable to population studies today.

1.1.4 Defining historical populations

A population may be defined spatially (for example, inhabitants of a village, region or country), temporally, or by virtue of membership of a specific social, familial, professional or other group. The latter type of population - a closed population - often has demographically comprehensive records both in terms of scope and completeness. In this case migration, a major complicating factor in geographically defined populations, is minimised. However, analyses are not necessarily representative of any other group, and interpretation is dependent on understanding the criteria for selection into the group. Totals may thus not be useful for representative aggregative analyses.

Classically, historical demographic studies, apart from being defined by the time period, are geographically based.[6,13] However, examples of closed historical population studies include selected European ruling/ducal families[8], knights of certain orders[9], and ethnic, racial or religious groups.[12,14] Historical demographic studies in South Africa have focused on the 'white' population.[15,16]

1.2. QUANTITATIVE DATA IN HISTORICAL DEMOGRAPHY

Temporal and spatial variations in the rates of natural increase in populations are central to the field of historical demography. Methods of estimating the sizes of past populations have been developed to provide denominators for a number of demographic rates. Numerator data for nuptuality, fertility and mortality are obtained by other methods.

1.2.1 Population size

Population size can be determined by the conversion of subgroup totals (for example, totals of men of military age or church membership) into population data by estimation techniques. The division of baptisms, marriages or burials by an assumed rate per 1 000 population provides one such estimate of population size.[22]

The 'counting backwards' technique estimates the size of a population at a particular time by subtracting the excess births over deaths during a period for which the size of the population at the beginning is known.[22] However, this method does not give reliable estimates. The accuracy of the assumptions are not always testable. For example, the method assumes equal numbers of in and out population migration. Deficiencies in the data are not always taken into account, and correction ratios cannot assume a constant rate of omission.[22]

Aggregative back-projection[6,22,26] provides population estimates at 5-yearly intervals by starting at a time point when the size and age structure of the population are known. This method is considered an improvement on previous estimates despite some doubt regarding its accuracy.[22]

1.2.2 Nuptiality, fertility and mortality

Most historical demographic studies are concerned with the measurement and description of the rates of nuptiality, fertility and mortality which determine demographic patterns. In the literature the two aspects of methodology most often discussed concerning numerator data are the method of data collection and measurement on the one hand, and the statistical analysis of the data on the other. The main determinant of the measurement methods is the type of data available. The researcher can choose between two broad types of data: aggregative and nominative.[22,24]

Aggregative data are collected totals (for example, frequencies of events) over a period of time and provide crude rates which do not yield age, sex or marital specific rates. However, aggregative measures, while crude, can provide useful insights into temporal fluctuations in the number of demographic events.

True crude rates can only be calculated if population totals are known or can be estimated. Where population size is unknown, aggregative measures often rely on providing a ratio of two related events

(for example, births to number of marriages or male-female ratio of deaths).

Nominative data are collected by using the names of individuals as the linking device, that is, the unit of analysis is the individual.[13,19,24] Through assembling various pieces of demographic information, individuals are followed throughout their lifetimes and are thus identified at many points in their lives, in a similar way to the cohort approach used by epidemiologists. Such information provides the opportunity for more detailed analyses, for example infant and child mortality, average age at marriage and completed family size.[19,22]

The most common nominative historical demographic technique used is that of family reconstitution (the terms 'nominative' and 'family reconstitution' are often used interchangeably) where family units are reconstructed from recorded baptisms, burials and marriages.[19,24,27] Gautier and Henry, two historical demographers who developed the technique, published their classic study of the French parish of Crulai in the 1950s. They formulated the conventions of data linkage as well as a range of questions that might be addressed by the methodology. A manual was published to ensure a uniform approach by researchers[28], and a section on testing the quality of information was included. A group of historical demographers at Cambridge University have pioneered such work in Britain[6,12,13], and similar studies have been done in other countries.[13,25]

While family reconstitution provides detailed information, it is limited in that only a small

proportion (10%) of each parish can usually be reconstructed according to Gautier and Henry's criteria.[22] For example, they excluded all people for whom complete reconstruction was not possible, usually due to migration to other parishes during young adulthood. This limits the technique in its ability to describe mortality in middle-aged and older persons.[9,19,22] The technique does, however, achieve the most reliable results in a population which has been stable for a long period of time. Less stable populations yield family reconstitution results which do not represent the migratory sector.

The population size and age distribution cannot be directly obtained using the technique described above, making the calculation of crude rates impossible. The methods of estimating population size mentioned earlier have, however, assisted to some extent with this problem.

Table 1 contrasts aggregative methods with family reconstitution.[19,22,27]

TABLE 1

A COMPARISON OF AGGREGATIVE AND FAMILY RECONSTITUTION DATA

Issue	Aggregative	Family Reconstitution
Labour/ logistics	If available, easy to collect data. Applicable to larger populations.	Time consuming, laborious. Often small samples due to rigorous standards for data quality. Some waste of information.
Detail needed	Need little, if any, individual identification and detail.	Much detail needed for linkage. Impractical if not enough detail.
Migration	Can accommodate.	Makes it difficult to get sufficiently large and representative sample. Temporary migration is a serious problem.
Demographic detail	Crude rates only. Often indices not useful.	Detailed information available. Rates take age, sex and marital composition into account.
Omissions	Very vulnerable to under-registration	Rigorous standards force acceptance on only 10% of families.
Representativeness interpretation.	Under-registration casts doubt on	Bias towards particular types of communities. Choice of families determined by records rather than social and economic characteristics. Bias towards particular type of resident (10-30% of families reconstituted) due to under-registration and migration.

1.3. SOURCES OF HISTORICAL DEMOGRAPHIC DATA

Hollingsworth[19] compiled a list of common sources of historical demographic data. Sources are listed below in order of reliability. All types of demographic information cannot necessarily be obtained from all sources. For example, mortality information could be gleaned from sources 1, 2, 3, 4, 5, 6, 8, 9, 11 and 19 only.

1. censuses, especially if names and ages are provided
2. vital registration data
3. Bills of Mortality
4. ecclesiastical records, such as parish registers and communicants' lists
5. fiscal documents
6. military records
7. inventories of property (for example, Domesday Book)
8. genealogies
9. wills
10. marriage settlements
11. eye-witness estimates
12. prices, over the long term
13. number and extent of towns
14. archaeological remains
15. methods of agricultural economy
16. ecclesiastical and administrative geography
17. new buildings
18. colonisation of new land
19. cemetery data, both from skeletons and tombstone inscriptions

1.4 QUALITY OF DATA IN HISTORICAL-DEMOGRAPHIC STUDIES

The retrospective nature of data collection in historical demography demands that verification of the data form an integral part of the researcher's work.[12,19,22,24,28,29]

Historical data are often incomplete, and scholars may only know indices for a certain section of the population without being able to generalise these results to the whole population. Thus the results may be biased in that certain sections of the population are not represented.

The honesty of the source needs to be questioned. Few historical sources were compiled for demographic purposes and were often incomplete and prone to distortion.[19,22] The motivation behind the recording and keeping of the data thus needs to be understood. For example, the information yielded may determine whether or not the recorder would get promoted, benefit materially or be disgraced. Such vested interests in the information could have influenced the occurence of over-, selective or under-recording.[19]

Errors could have been deliberate (such as inflation or deflation of numbers), or accidental (like incorrect or delayed transcription of information). Indications or admission of ignorance on the part of the recorder provides the researcher with some idea of the the level of data validity. The worst scenario involves the individual who fabricated information either because he did not know the truth (random error) or because he wanted to hide the truth (systematic error or bias).[19]

Thus, while statistical analyses of historical data are needed, the skill of evaluating the reliability and validity of the evidence is central to their interpretation.[19,22,24,29] Selected procedures to evaluate and overcome some of these deficiencies in the data will be discussed later on in this chapter.

1.5 PARISH REGISTRATION DATA AND ITS QUALITY

The registration by clergy of religious events such as baptisms, confirmations, marriages and burials has provided historical demographers with data which extends far into the past. Nominative and aggregative techniques assist in establishing the demographic histories of the regions/countries where church records are available.

The nature and quality of parish data varies by region and time. The nature of the details collected may differ or may be standardised by pre-printed pages. Non-registration of events, errors and omissions are the main factors affecting the quality of parish registers as a source of data.[28]

Omissions arise when an item of information is not given, and if too frequent, render the results useless. Errors are more insidious and may relate to dates of events or characteristics, leading to misclassification.[19] Cross-checking different registrations for the same individual can, however, reduce errors.

Non-registration is the major factor affecting the quality of parish registers.[22,29,30] Systematic non-registration takes place when it is the social or religious norm to exclude certain categories of

individuals from registration.[29] In the case of baptismal registration, the absence of children of unmarried mothers could, for example, be a systematic exclusion.

Selective non-registration occurs when a parent or priest has judged it unnecessary to register a birth or death.[29] This commonly occurs in the case of infant deaths before baptism has taken place. No strict policy is adhered to, and thus such non-registration may not be noticed. In such a case, the infant mortality rate will be under-estimated.

Random non-registration is due to circumstantial factors (including negligence and forgetfulness) and shows no clear selection bias.[29] The rates calculated would be fairly representative of all births.

It is important to note that the quality of registration in a parish can change over time with the same priest performing differently at different times and/or different priests adhering to different practices.[19,29]

1.6 METHODS OF INVESTIGATING DEFICIENCIES IN PARISH DATA

In general, deficiencies in parish data need to be investigated primarily in order to establish whether results can be regarded as valid. Further investigation might enable researchers to provide improved estimates on the basis of corrective adjustments to the results.

The focus here will be on methods of investigating the quality of birth information collected from baptismal records. The major threat to the validity of this source

is sampling bias in that all population births may not have reached the church records, and recorded births will therefore not be representative of the total. Selective non-registration, being insidious, is the main concern. Different methods of investigating the data have been proposed:

1.6.1 Ratio of male to female births

The sex ratio at birth is generally considered to be physiologically fairly constant both spatially and temporally. The expected ratio at birth of most European populations lies between 105-106 males per 100 females. If the sex ratio deviates markedly from this figure, there is reason to suspect differential completeness by gender in the registration of births.[25]

1.6.2 Inversion of chronological order of dates

Henry[29] describes a method requiring meticulous extraction from records of the number of days between register entries and the number of events which were recorded out of chronological order. The method is time-consuming and unsuitable for registers which belong to small parishes (infrequent events) and which do not have the signatures of witnesses to the event accompanying the registration.

The rationale for this method is that if there is a short average interval between births and baptisms in a community, a low frequency of chronological inversion of dates reflects low selective non-registration. However, in communities where this

delay is longer than a few days, the problem of investigating the frequency with which children were not baptised, cannot be solved by this method.

1.6.3 Estimation of birth-baptismal shortfall

Wrigley recommends a method based on the Bourgeouis-Pichat method for estimating levels of endogenous (related to genetic and birth process causes) and exogenous (related to environmental and external causes) infant mortality.[12] It is assumed that biased non-registration is at its highest in the first month of life.

Data on age of death are needed in order to plot cumulative infant death rates against $\ln^3(n+1)$, where n equals the number of complete days since birth. Successive cumulative monthly totals form close to a straight line. Projection of this line onto the vertical axis provides an estimation of the endogenous and exogenous deaths recorded. If it is assumed that most infants who die before baptism were in their first month of life, their absence will be reflected in an apparently low endogenous mortality rate.

In order to establish the extent of under-reporting of births, the method requires that the level of endogenous deaths in the community being studied is known. In addition, the mean baptismal age in the community should ideally be one month at the most, although it can be used when the birth-baptismal interval is longer.

1.6.4 Percentage whose fate is unknown after infancy

The percentage of registered individuals whose fate is unknown after infancy (births for which no other information besides the birth and possibly the baptism is given) reflects the degree to which people were followed up. Infant deaths could be over- or under-reported when this percentage rises. Fluctuations in this percentage over time will reflect a change in the quality of the data.

1.6.5 Percentage infant deaths

Fluctuations in the percentage of infant deaths could reflect changes in data quality rather than changes in infant survival.

1.6.6 Crossmatching with alternative church sources

When alternative sources of church information are available, the sources can be investigated to see which are the best in terms of coverage of individuals. This does not give an idea of the extent of total coverage in the population. The best church sources might change over time, highlighting differing registration practices among priests.

1.6.7 Cross-matching with official registers of births and deaths

If official birth and death registers are available, the cross-matching of two sources can provide some indication of the coverage of church registration compared to the official system.[31] Some

individuals, however, will still not have been registered in either system, and the extent of non-registration remains unknown.

1.6.8 Ratio of expected and observed births

Expected births can be calculated on the basis of an estimated birth rate for a given community and a known population size. The closer the ratio of expected to observed births are to 1, the better the coverage of births by the register.

In summary, while many of the above investigations can be used to evaluate the quality of historical data, the calculation of exact correctional factors is rarely possible. When, despite adjustment and estimation techniques, accurate information is not available, historical demographic estimates may play a supportive role only in the understanding of the relationship between processes of demographic, economic and social change.[22,24]

In this thesis, historical demographic data collection methods have been used. The data available in the Mamre Church Records lend themselves to nominative techniques. Deficiencies in the data have been investigated by calculating the sex ratio at birth, the percentage of births whose fate is unknown after infancy, the percentage of infant deaths, the ratio of expected to observed births, the median birth-baptism delay, and crossmatching of alternative church records.

CHAPTER 2

LIFE EXPECTANCY AS A HEALTH INDICATOR IN EPIDEMIOLOGY

SUMMARY

This chapter discusses the difficulty in defining health, a complex multifactorial concept. While no single measure of population health has been developed, a set of standard health indicators enables epidemiologists to compare key health outcomes between areas and over time. Attempts have been made to develop indicators which also reflect the positive, holistic aspects of health. The uses and categories of health indicators, as well as common data sources, are outlined.

While the World Health Organisation's recommended list of indicators for monitoring the Health for All programmes is given, only mortality indicators are dealt with in detail. Life expectancy, a specific type of mortality statistic, is discussed in depth.

Different sources of data used for life expectancy determination are described. Direct and indirect demographic and epidemiological approaches to life expectancy calculation are discussed and contrasted. The chapter ends with a description of the cohort analysis approach.

2.1 MEASUREMENT OF POPULATION HEALTH CHARACTERISTICS

2.1.1 Defining health

Most attempts at defining health have met with criticism due to the complex, multifactorial nature of the concept. The common themes that emerge in the literature are (1) health as the absence of symptoms, illness or disability, (2) health as a positively valued psychological experience, (3) health as balance or equilibrium within oneself and with the environment, (4) health as a capacity or potential to pursue personal goals and to cope with environmental and social demands, and (5) health as the process of goal-directed action or as the process of effective coping.[32]

Definitions of health are influenced by the currently dominant paradigms. Modern medicine has its foundations in biomedicine which follows the mechanistic, reductionist approach. This is manifest in the study of the human organism and its component parts, with consequent neglect of the human environment, and the division of mind and body.

Multidisciplinary work has promoted the development of an alternate paradigm of health which integrates biomedical, psychosocial and sociomedical perspectives. This socioecological paradigm recognizes the complex, multifactorial nature of health.[32]

Noack[32] places health in the context of systems theory and identifies two key dimensions: health balance (dynamic equilibrium) and health potential (capacity to maintain or re-establish equilibrium).

2.1.2 Measuring health

For the purposes of determining the health status of populations, an important aspect of any definition of the concept is its measurability. Given the holistic nature of health, no single measure would do justice to the concept. However, the measurement of single components helps to operationalise the definition provided recognition is given to the limitations of focusing on such single components of health.

When researching health status issues, the approach taken depends on the component(s) of health being investigated, on the sources of data available for the study, and on the research question being asked.

2.2 MEASURES OF HEALTH STATUS ON POPULATION LEVEL

The researcher interested in single or multiple components of health status on the population level can chose to investigate a variety of aggregated health statistics. There are, however, health measurements - selected from a larger pool of health statistics - which have the power to summarise or represent several statistics or to serve as useful proxy measures for relevant information.[32,33] These health indicators reflect health situations, and are variables which 'help to measure changes', especially when these changes cannot be measured directly. They mostly represent one class of data only, and thus usually reflect

only partial components of health, for example infant mortality rates.[32,33,34] Health status indicators in populations differ from health status indices which are composite measurements combining several individual indicators.[32,33,34] An example of a composite measure outside the health field is the Socio-Economic Index which has as its components income, occupation and education.

Although the value of a single indicator is obviously limited, the use of a standard set of indicators enables public health professionals to compare key health outcomes between areas and over time. Such routine monitoring of the population health status requires standard, easily collectable and interpretable measures.

Health indices may initially appear to provide a more adequate assessment of the health of populations. However, not all indices are particularly valuable. They can never truly summarise health in its totality, and at best can address some of its components. By using a single composite measure, the specific influence of the contributory measures are often lost, and may be more open to abuse than traditional simpler measures.

Historically, mortality statistics formed the basis upon which population health was assessed until the end of the 19th century when morbidity indicators (incidence and prevalence rates) were introduced.[34,35] These two 'classical' measurements of the state of health of a population focus on negative health (death, disease) rather than the more positive aspects of health.[34,36] The recording of the events was always the responsibility of the medical profession, and took on a dichotomous form, often ignoring the complexities of the events and factors related to them.[34]

Indicators have been developed to address some of these deficiencies. The concept of morbidity has been extended to incorporate the personal and social consequences of the disease. To break away completely from the negative aspects of health, the measurement of holistic health has been attempted. Implicit in this is the measurement not only of consequences of ill-health, but also of positive health (for example, potential, capacity), thus reflecting a continuum of health in the population.[34] This usually necessitates the use of data collected from individuals, not only aggregated data.

2.2.1 Uses of health indicators

Health indicators assist in the identification and quantification of health problems. Since health status is dependent on socio-economic factors, health indicators may provide insight beyond the health status of populations: they often reflect socio-economic development, exposures to specific risks, health service access and utilisation, and other factors that impinge on health in the population.[33]

In identifying the magnitude of health problems, such indicators assist in the establishment of priorities and in decision-making concerning the allocation of resources. This often provides the necessary stimulus to new, improved strategies. They may also be used to evaluate national and local health activities by being used as markers of progress.[32,33,34] Some authors differentiate between indicators used for descriptive purposes (generic health indicators) and those used for evaluation (health evaluation indicators).[32]

2.2.2 Characteristics of indicators that determine their value[32,33,34]

As with any measurement in epidemiology, there are criteria against which the usefulness of an indicator are judged. These include (1) validity, which refers to the degree to which a measurement truly measures what it sets out to measure, (2) reliability, which refers to the degree of agreement of results when the measurement is repeated (stability of measure), and (3) precision, which refers to the exactness of a measurement. The level of precision needed will depend on the use to which the indicator will be put. While precision of indicators may be poor at times, their measurement over time can reflect trends in both extent and type of change. They can thus serve to compare different areas or groups at the same or different points in time.

Other important criteria of the usefulness of indicators are their provision of adequate information relative to their cost (economic criteria) and their acceptability to the providers and users of the information.

Rarely do indicators comply with all the above criteria. The decision to use a health indicator, and the amount of concern about its quality, depend to a large extent on the organisational, technical and financial feasibility of data collection and analysis.

2.2.3 Categories of health indicators

The WHO compiled a list which - while by no means complete - provides an outline of the basic types of indicators that can be used to monitor health in the context of their 'Health for All by the year 2 000' programme.[33] The different types include health policy indicators, social and economic indicators related to health, indicators of the provision of health care, and health status indicators. The particular indicators recommended are the simpler and cheaper ones which would be accessible to health departments in developing countries. Of particular interest here are the health status indicators which include:

- nutritional status and psychosocial development of children
- infant mortality rate
- child mortality rate (ages 1-4 years inclusive)
- life expectancy at birth or at other specific ages
- maternal mortality rate
- disease specific mortality
- morbidity
- disability
- social and mental well-being.

2.2.4 Sources of data for health indicators

A variety of sources are commonly used to provide data for health indicators. The indicator used depends on the quality of the data source, the nature of the health indicator itself, the costs involved, and the availability of alternate sources.[33,37]

The following is a list of common sources of data:[33]

- vital events registers
- censuses
- routine health service records
- epidemiological surveillance
- sample surveys
- disease registers
- alternative data sources (including non-health sector).

2.3. MORTALITY STATISTICS

The simplest mortality rate, the crude death rate, does not distinguish between the two factors that contribute to it - the probability of dying for individuals, and the age distribution of the population - and thus when used alone is not a useful health indicator.[35,37]

Age-specific rates address the problem of comparing the mortality pattern of populations with different age-structures, and also reflect the marked effect that age has on mortality. The classic J-shaped mortality curve shows this variation in death rates from all causes at different ages.[35] Selected age-specific rates are commonly used as health indicators. For example, the infant mortality rate, comprising the ratio of the number of deaths in a year among children under one year of age to the number of live births occurring in the same period, is considered of great significance in public health. A high infant mortality rate usually reflects poor socio-economic conditions and inadequate health care.[37]

Age-specific rates are, however, often difficult to assimilate and do not provide a summary figure for comparative purposes. While direct and indirect statistical methods can be used to adjust death rates to take account of different age distributions[38], the summary figures obtained do not have the ability to highlight differences in death rates at different ages. The numeric values of adjusted rates depend on the population(s) on which the adjusted rates are based. Thus, unless a world reference population is used universally (which may not necessarily be the appropriate population), these summary measures fluctuate when different reference populations are used.

Life expectancy is a useful summary measure which is calculated on the basis of age-specific death rates. It provides a composite measure of the average number of years an individual of a particular age in the population is expected to live[33,37], and thus uses mortality rates to express the reverse of mortality (that is, life). Life expectancy is minimally affected by the population age-sex distribution or by its birth and migration patterns.[39] It is an extremely stable measure, whose weights are neither arbitrarily determined nor a function of the population structure.

Life expectancy at birth is the most frequently used measure, but represents only a portion of the total mortality information in the population. Variations in the life expectancies between males and females and at different ages occur between populations and/or over time. The estimation of additional life expectancies at higher ages, in addition to that at birth, is recommended to supplement the survival picture of a community.[39]

While life expectancy is considered a general indicator of the level of survival in a community, no indication is given concerning the causes and duration of ill-health in the population. Life expectancy free of disability is a fairly newly developed indicator which determines the average number of years that people live in the community free of disability. However, this indicator uses data from disability and morbidity studies, and not mortality figures.[32,34,39]

An index which utilises both age and cause distribution of deaths is the potential years of life lost (PYLL). It illuminates the relative impact of the various causes and ages of death by assuming that the death of a person who has died during the period was premature if she/he died before the age of 65 years. The number of years lost is the difference between the age of death and 65 years. Some authors have suggested raising the reference age to 80 years or using the difference between age at death and life expectancy. PYLL weighs deaths occurring among the young proportionately more than those in later life. This weighting relates to the value attached to life at different ages, and involves a value judgement. It may be more appropriate if mortality data are to be used in planning preventive rather than curative and rehabilitative strategies. [5,40]

2.4. SOURCES OF INFORMATION FOR THE ESTIMATION OF LIFE EXPECTANCY

As mentioned earlier, the estimation of life expectancy is based on the age-specific death rates in a population. These age-specific death rates, in turn, can be calculated or estimated from raw data available from vital statistics

registers, censuses and sample surveys, and occasionally from unconventional sources.

Vital statistics registers form part of the legal registration system of a country and provide an ongoing record of vital events like live births, deaths, marriages and divorces.[33,37] Comprehensive coverage of the population and reporting of events by the population are needed to provide reliable statistics. This is not the case in over two-thirds of the world's population where the main problems are under-counts in the numerator (due to under-registration of deaths per se as well as variable under-registration in different regions and groups) and under-enumeration in the denominator (due to population under-counts).[33] In South Africa, the vital statistics of Africans, especially in rural areas, is a case in point.[41,42]

Censuses are population counts at specified times (often periodic) in which demographic, social and economic data are collected for each person in a specified area and provide denominator data for demographic, social and health indicators. Complete population censuses, being expensive and demanding of organisational infrastructure, take place infrequently, even in developed countries. Sample censuses and estimations provide denominator data between censuses.[33]

Sample surveys provide information about a defined community on the basis of the information collected from a representative sample of that community.[33,35,37] Sample surveys are considered when the required information is unavailable, incomplete, inaccessible or inadequate.[33,35,37]

Unconventional sources of data which were not intended for statistical purposes and not necessarily routinely collected, may provide data for the determination of life expectancy. Church records[12,16] are one example of such an unconventional source and will be discussed in detail in Chapter 4.

2.5 METHODS OF DETERMINING LIFE EXPECTANCY

One of the most frequently used methods of mortality analysis in a wide range of fields is the life table model. The modern life table, first publicised by John Graunt in 1662, remains the basis upon which later approaches developed. The life table consists of a number of columns, each of which displays a specific aspect of the mortality risks of a given population at each age x, with x measured in whole units of years.

Key columns in the life table include l_x (number living at the beginning of a specific age interval), d_x (number dying at a specific age interval), q_x (probability of an individual dying in a specific age interval x) and p_x (probability of surviving the age interval, calculated as $1 - q_x$, the complement of the probability of dying). Each single age/time interval has its probability of survival, which is unconditional upon having survived the other intervals. The life expectancy at a specific age is the product of p_x values for each age group above (and including) the starting age.

In reviewing different analytic techniques for studies of mortality in general, and life expectancy in particular, three broad approaches emerge, namely the (direct) demographic, indirect demographic and epidemiological techniques. The different approaches to life tables, and

hence the calculation of life expectancy, have been designed to cope with data of varying availability and reliability. While the three approaches are dealt with seperately in this text, an analytic framework has been proposed by Mosley and Chen (1984), which integrates research methods employed by socio-demographic scientists on the one hand and epidemiologists on the other.[43]

2.5.1 Demographic techniques

Demographic (actuarial) life tables, computed on the basis of national or regional mortality data, are obtained by applying the currently observed (although graduated) age-specific mortality probabilities to an arbitrary number of starting lives, the radix, to generate the number of survivors at older ages.[44,45]

This model is based on mortality at a point in time and not during the lifetime of the cohort. The life expectancy calculation on this basis is a measure of the overall level of mortality in the table rather than the life expectancy of individuals at a point in time. Notwithstanding this limitation, the demographic life table is a useful way of summarising current mortality risks.[44,45]

2.5.2 Indirect demographic techniques

Techniques of demographic analysis have been developed to estimate birth and death rates of populations in many parts of the world where registration of births and deaths is incomplete or non-existent.[19,46] The same methods can be used

for historical populations[22] and populations in developing countries.[45]

In general, these substitute or indirect methods depend on comparisons of one population with another. They are characterised by the use of model life tables (constructed to represent a wide range of mortality patterns which occur at different levels of socio-economic development) or the use of consistency checks.[45] If the data for a group are inadequate, a search is made for another group with similar characteristics, and for whom more information can be obtained. The substitution need not be made from an actual population. In some circumstances a suitable theoretical model may be employed, that of a stable population being an example of such a model.[19,45]

2.5.3 Epidemiologic techniques

Epidemiologic studies commonly investigate health outcomes in study subjects. However, outcome measures often need to be provided, not only in terms of values for the outcomes themselves, but also in terms of the time that elapsed until responses occurred.[46] The time elapsed from the beginning point is called survival time, and the end-point measured can be death, disease or disability. Subjects whose outcome is unknown (censored observation) can still contribute to the analysis for the period during which their information is known. Analytic techniques based on the use of survival data have been developed to cope with measuring outcomes in the context of survival time.

Survival analysis is used in a variety of epidemiologic study designs, including randomised clinical trials and cohort studies. Life expectancy can be calculated using the cohort life table method or person-year method.[47]

Cohort Life Table Analysis is a method of studying mortality in a population or sample, where data collected longitudinally for long periods or for varying lengths of time (that is, accrual time and length of follow-up are variable), are summarised in a systematic way.[47]

The observations which are not followed to death or other outcome, called censored observations, occur when subjects withdraw from the study or when individuals are still under observation at the end of the study. The method allows such individuals to contribute to the analysis until the last time point at which the survival status is known. In the case of censored observations, adjustments are made to the number under observation for the calculation of the probability of dying in a specific time interval.

The standard error and confidence limits can be calculated for the cumulative survival rate and for the mean survival time. In order to compare survival functions of different groups, parametric tests can be used if the survival function has a known underlying distribution. If a distribution cannot be assumed, non-parametric tests like the logrank and generalised Gehan tests can be used.[46]

The person-year method of analysis is appropriate for a study in which individuals in a group come under

observation at different ages or times, and remain under observation for varying periods of time. It makes use of a person-time denominator, which comprises the sum of all individual times of all persons contributing to the study.[47]

The sampling error of the person-year rates can be calculated subject to the assumption of uniform distribution of deaths within intervals of analysis, or under the binomial assumption. With knowledge of the standard error, the confidence limits of rates can be calculated and the differences in rates tested for.

In general, cohort life table analysis is used when cases observed have a common point for initiating observation (such as date of surgery, birth) and where the dominant factor controlling risk is likely to be the time since that original date. For observations lacking this common initial date and where a major factor of risk tends to be age at observation, person-year methods are preferred.[47]

In this thesis the person-year method is used to ensure the accommodation of both left and right censored data for the analysis of age-specific mortality rates.

CHAPTER 3

THE HISTORICAL CONTEXT OF THE STUDY

SUMMARY

Mamre's history spans the period of Khoikhoi habitation of the area to the present-day village. This chapter touches on the social, political and economic context in which Mamre and its community developed.

The pre-colonial, pastorally-based social and economic structure of Khoikhoi society hindered their consolidation into stable political units. The Khoi, thus particularly vulnerable to the assault of the colonial system on all components of their independence, lost their cultural cohesion and autonomy.

The chronic shortage of labour in the Cape Colony intensified after the abolition of the slave trade in 1806. Legislation at first entrenched cheap, forced Khoi labour, but later was repealed at the expense of Africans who then became the target of similar laws. A distinguishable class of individuals of intermediate social status was forged from ex-slaves, Khoikhoi and people of mixed descent: the so-called 'coloured' people. The development of this ethnic stratum is discussed.

The role of missionaries in the extension of European values, culture and ideological influences in South Africa is described. The history of Mamre is given, covering pre-colonial times to the present day.

3.1 COLONISATION OF THE KHOIKHOI

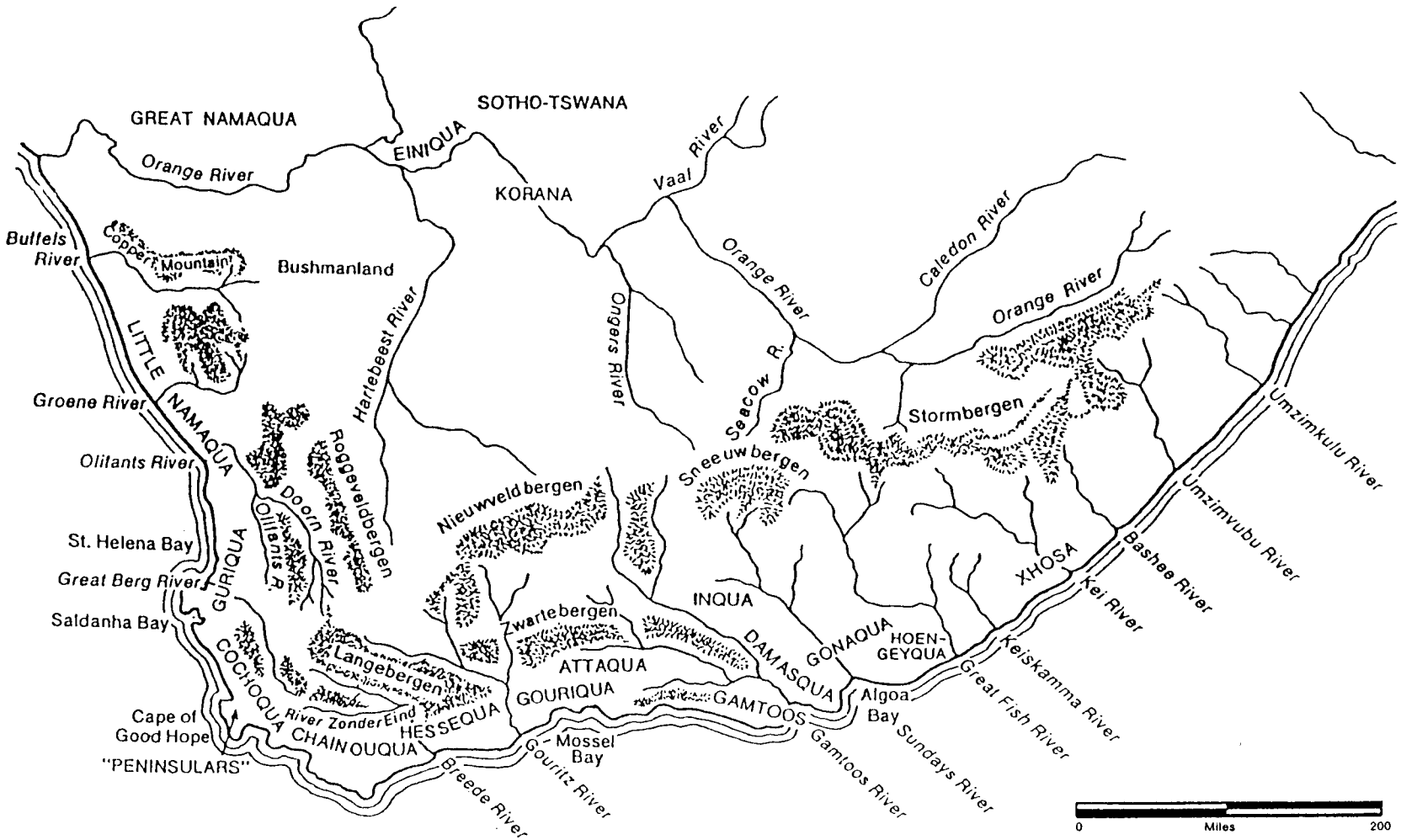
The Khoikhoi were descendants of hunters who acquired stock near northern Botswana in approximately 100 BC and who migrated due to the needs of their pastoral economy.[48] When some Khoi tribes arrived in the South-Western Cape, hunter-gatherer San of aboriginal descent inhabited the region.[48]

The Khoikhoi were distributed in patrilinear tribes of up to 2 500 members.[49] Livestock was of economic, political, social and aesthetic importance. The pastoral nature of Khoi society - with its dispersal of tribes at different times of the year, continuous movement and mobile wealth - was at the root of its relative instability, leading to the decentralisation of political control and other institutions. These factors hindered the consolidation of the people into large and stable political units[48,49,50], in contrast to the stability of the Nguni peoples who were also pastorally based.

When the Dutch East India Company established the beginnings of a permanent colony at the Cape in 1652, the total Khoi population in southern Africa was approximately 100 000[49] with nine Khoi groupings in the Western Cape. Peninsular tribes were small, while the larger more powerful Cochaquas inhabited the region north of Table Bay to Saldanha Bay (Figure 2).

The initial trading relationship between the Western Cape Khoi and the colonists determined the Dutch policy of recognising the Khoi as free people who were not to be enslaved or conquered.[48] With the development of agricultural settlement in 1657, however, the Peninsular

Figure 2. Approximate location of Khoikhoi before contact with Whites



Elpick R. *Khoikhoi and the founding of South Africa.*
Ravan Press, Johannesburg (1985).

Khoi lost access to pastures and waterholes. This resulted in the first Khoi-Dutch War (1659) through which the Peninsular Khoi, though not totally defeated, were compelled to recognise the sovereignty of the Company over free-burger land.

With the defeat of the Cochaquas in the second Khoikhoi-Dutch War (1672-1677), the Company gradually overturned its recognition of Khoikhoi independence, and gained control over collaborationist tribes who had co-operated with the Company against the Cochaquas. From 1672 the Khoi were gradually assimilated into the colony's legal system.

The rapid decline of Khoi wealth and security, coupled with the colonists' need for labour due to colonial expansion, forced many Khoikhoi to enter employment on farms and in Cape Town. At first they maintained their bases in their kraals, but later increasingly took up residence in huts on farms.

Thus, by the second decade of the 18th century, Khoi autonomy in the Cape had almost totally disappeared due to the assault of the colonial system on all components of their independence. Livestock and labour were withdrawn from Khoi society, pastures were taken over, and chiefs and their followers were subjected to Dutch law.[48] The Khoi culture, value system and cohesion was eroded. The decimation of one in ten Khoi during the 1713 small pox epidemic further hastened this process.[48,49,50]

3.2 LABOUR MARKET IN THE WESTERN CAPE, 1652-1910

When the Cape Colony was established in 1652, the need for a stable source of labour was recognised. Slaves were introduced from various parts of Africa and the East while the Khoikhoi still had independent access to land, game and cattle and had no need to work for colonists on a permanent basis.[48,50,51] By the mid-1700s, however, only a few Khoi remained in small, semi-independent clans, and a small number of men attached themselves to white masters as skilled servants in client-patron relationships. The majority were now dependent on wage labour and offered their services to white farmers[48,50,51,52]. As a landless proletariat, they retained their status as freemen, but were drawn progressively closer to slaves in culture, status and economic function, gradually losing their freedom.[50,51]

When the slave trade was abolished (1806), the labour shortage experienced at the Cape prompted British authorities to tighten control over non-slave labour.[50,51] Legislation passed by Caledon in 1809 effectively entrenched cheap, forced Khoi labour.

By 1828, the colonial powers recognised that forced labour *per se* was having limited success. The main labour shortage now occurred on the Eastern Frontier. Through Ordinance 50 (1828), Caledon's Hottentot Code was repealed removing restrictions on the mobility of Khoi and ensuring their right of land ownership. This legislation was passed in response to the continuing labour shortage, Hottentot resistance, and pressure from missionaries concerning the emancipation of the Khoikhoi.[50] Linked to Ordinance 50 was Ordinance 49 (1828) under which Africans were now permitted to enter the Cape Colony as

labourers, but forbidding their movement without passes and making limited provision for child captivity.[51] Thus, through Ordinance 50, there was an attempt to depoliticise the Khoi cause and thereby to form a distinguishable class of individuals of intermediate social status.[50,53,54]

The early period after the emancipation of slaves (1834-1838) was characterised by an exodus of ex-slaves from farms to missions, urban centres and common land, causing concern among farmers regarding their labour supply. In reality, there was increased competition for jobs among ex-slaves, Khoikhoi and other landless people in the Western Cape[50,51,53]. The latter constituted a labouring class which included resident regular farmworkers, a variety of casual labourers, tenants and sharecroppers.

Moves by the government to control squatting and vagrancy and to privatise public land (including missions), caused extreme militancy among a broad spectrum of people who perceived the laws as a threat to their freedom and access to land.[55] The withdrawal of the Vagrancy Ordinance defused the revolt.

Drought, crop disease and a slump in trade in the 1860s caused low wages, unemployment and hardship for the rural Western Cape population, thus further eroding their autonomy. An expansion in the Cape economy in the 1870s as a result of the discovery of diamonds and an improvement in the wool trade, prompted major public works (for example, the building of the docks and the railways). This diversification of the labour market drew rural workers to the urban centres where better wages and work conditions contrasted sharply with those on the farms. With this increased work opportunity for labourers, farmers lost

control over their labour supply and had to pay competitive wages in order to attract labourers, who often worked in teams and circulated between farms.(55,56)

Despite recession and drought in the 1880s, unemployment was not on the same scale as in the 1860s, although it remained a problem and urban migration continued to be a feature of the colony. After the Anglo-Boer War there was an influx of poverty stricken people to the cities, with the population of Cape Town increasing from 51 251 in 1891 to 77 668 in 1904.(17)

From the 1890s onwards it was becoming an increasing practice of employers, first in rural areas and later in the cities, to employ Bantu-speaking men from outside the region in the lowest status heavy manual occupations. European immigrants and demobilised South African war veterans also attempted to secure employment for themselves, forming whites-only unions from 1900 onwards. These developments created competition among groupings for jobs and also changed the ethnic proportions in the region. From 1904, chronic unemployment existed in the greater Cape Town area.(53,54)

3.3 ETHNICITY : THE ABSORPTION OF THE KHOI AND THE PROCESS OF FORGING A 'COLOURED' IDENTITY

Criteria for defining people as 'coloured' have changed over time. Until 1894, the term referred to all non-Europeans in the Western Cape. By 1904, the census for the first time classified people as White, Bantu and Coloured. Thus, by the turn of the century, a decisive shift in terminology had taken place.(53,54)

The process of proletarianisation of the Khoikhoi occurred earlier and was different from that of the Bantu-speaking people. As mentioned previously, the repeal of the Caledon codes in 1828 considerably improved the position of non-African non-Europeans, creating a group of people with intermediate social status who gradually assimilated with freed slaves to form a homogeneous labouring class.(49,50,51,53,54)

In the Western Cape, the limited work and social opportunities for these dispossessed people caused concern among colonists, who feared uprisings which would threaten political stability at the Cape. The decision to enfranchise a section of the colonised class when the Cape was granted self-rule in 1853 can be seen as an attempt to co-opt potentially discontented leaders.(48) In the rural areas, the educated elite (teachers and clergy) usually qualified for the franchise, while in the towns this was the case for petty bourgeois tradesmen, artisans and other educated people.

The next half century saw an increasing competition among people in the Western Cape for jobs, as described earlier. The distinction between Africans and other non-European people was accentuated by the formation of the Afrikaner Bond (1883), the effective disenfranchisement of Africans when the property qualifications for Africans were changed (1892 and 1894) thus leading to the dispossession of the African peasantry, and the growing anxiety among non-Africans regarding loss of political and economic rights.(53,54)

Social Darwinist theories, which encouraged a belief in an hierarchical racial order, further encouraged ethnic differentiation between whites, Africans and people of

mixed descent.[53,54,57] The assertion of a distinct 'coloured' identity also provided 'coloured' people with an escape from the health and housing ordinances passed by the Cape Town City Council, effectively relegating African workers to segregated compounds at the turn of the century.

The discriminatory tactics of white unions united the non-European skilled and artisan class in a defensive position concerning their place on the labour market.(53,54) The political aspirations of this group were further frustrated by the outcome of the Anglo-Boer War when, in spite of their support for the Crown, no advancement in rights was forthcoming.(53,54,58)

In an attempt to secure franchise rights and employment prospects, petty bourgeois/artisan groupings formed political organisations in the Western Cape, the African People's Organisation being the most prominent of these (1902).[53,54,58,59] Thus, according to Shula Marks, 'Political organisation transformed shared language, religion, history and predicament into ethnic consciousness'.[59]

Ethnic stratification of dispossessed people was used as a strategy by the colonial government to divide people by the hierarchical ordering of social status and employment in order to deflect opposition. At the turn of the century, the 'coloured' petty-bourgeois and skilled strata attempted to defend their precarious position by the assertion of a distinct identity and the sacrifice of African interests. The racial categorisation of 'coloured' continues today to be clearly related to the objectives of apartheid ruling class ideology.

3.4 THE MISSIONS

Early missionary activity in southern Africa was exclusively Protestant, the Saxony-based Moravian Church (Unitas Fratrum) being the first of these.(49,50,60,61) The initial work among the Khoikhoi occurred between 1737 and 1744 at Baviaanskloof (Genadendal), but was halted by the Dutch due to opposition by the colonial and local (Dutch) church authorities. The mission re-opened in 1792, 48 years after the first missionary, George Schmidt, was expelled. The mission grew, establishing other mission stations in both the Western and Eastern Cape.(50,60,61) Missions from other churches joined the expanding missionary movement during the next decades, notably the London (1799), Rhenish, Paris, Norwegian and American missionairy societies, and the Methodist and Anglican Churches.(49,50,62) Missions were established among Khoikhoi, San, Nguni and Sotho people covering the whole of southern Africa.

By 1815, more than 2 500 Khoikhoi and others were affiliated to missionary settlements in the Western Cape, while thousands of servants and slaves had come into contact with them.(50)

The colonial authorities, in support of farmers who perceived mission stations as a threat to their labour supply, often came into conflict with the missionaries.(49,50,51,61,62) The social protest expressed by the London Missionary Society against the conditions of slaves and the rights of Khoikhoi further fuelled differences between missionaries on the one hand and the farmers and authorities on the other. The Moravians tended to be more paternalistic, focusing less on social and political issues, and devoting their

energies almost entirely to the building up of religious communities.[49,50]

With time, the colonial authorities recognised the value of mission stations as a source of 'migrant' farm labour and as a means of ensuring a stable social order among the landless proletariat. On several occasions the authorities took the initiative in the planning of mission stations. Indeed, Caledon and Cradock moved against the last independent kraals in the Cape, turning several of them into mission stations.[50,60,61] After the emancipation of slaves in 1839, the majority of slaves who moved off Western Cape farms went to mission stations.[55] This created pressure on existing missions, although attempts to extend mission land were unsuccessful. Between 1841 and 1846, new missions were established along the perimeter of the Western Cape farming belt where farmers could have easy access to labour.

Mission dwellers were often subsistence producers who had vegetable and fruit gardens, allotments for the cultivation of grain, and common grazing lands. Many depended on seasonal farm-wages to supplement their incomes, with missions effectively functioning as labour reservoirs for farmers.[55] Mission residents often enjoyed relatively privileged positions vis a vis their rural counterparts (resident farm labourers, among others) in that they had independent access to land and were employed as casual labourers with higher wages and less dependence on farmers.

On all missions the centre of the community was the church and school. The missionaries stressed the moral value of work and struggled to build up communities of peasant farmers and craftsmen.[62] A trading store on the

mission, or nearby, was also a common feature of mission stations.

The Church had a central role in creating new social groupings, in fostering agriculture and writing, in establishing schools and in caring for the sick.[62] Literacy and education were introduced to indigenous people in order to make the Bible accessible. In the Western Cape, Dutch was commonly spoken on the mission and formed the basis upon which the modern Afrikaans language was built. The Moravian journal 'Bode' is the first publication (1859) which shows early evidence of the development of modern Afrikaans from Dutch.[61]

Thus, through the pursuit of religious conversions to Christianity, most European missionaries promoted the extension of European values and cultural influences among the indigenous people of southern Africa.[49,50,58,60,61] Most conversions took place at times when traditional discipline and social cohesion had broken down in communities, thus facilitating the extension of white political, administrative and cultural influence.[49,50]

3.5 THE ESTABLISHMENT OF A MISSION STATION AT GROENEKLOOF AND THE DEVELOPMENT OF MAMRE

Groenekloof, the farm upon which Mamre is situated, was originally land controlled by the Khoikhoi Cochoquas.[48,50] In 1697 it became a government cattle post, and between 1701 and 1791 a small garrison was stationed at what was then known as De Kleine Post.[60,61]

The motivation for the establishment of a mission station at Groenekloof in 1808 came from the need perceived by the

colonial authorities to create an institution for the Khoikhoi soldiers of the Cape Corps and their families, to stem the influence of Islam among the slave community at the Cape, and to move against one of the last independent Khoi clans.[50,60,61] The Earl of Caledon was a strong motivator for the establishment of a Moravian Mission Station although the Moravian missionaries, known as the Brethren, were at first ambivalent about the idea.[60,61] However, they were encouraged by the reported desire of the Khoikhoi to receive instruction in Christianity, by the acceptance of the government of the conditions that there would be no compulsion to admit to the mission dependants of soldiers who did not want to become Christians, and by the probability of a closed community at the mission.

The Brethren were committed to a closed community where a community identity could grow among the culturally and ethnically heterogeneous converts.[61] Outside influences could be minimised, while church control could be facilitated. The first Moravian Mission station at Genadendal served as a model upon which the Brethren wished to build other missions.

In March 1808 the government farm De Kleine Post (Groenekloof) and the adjoining Louwskloof and Cruijwagenskraal were given to the Moravians as a trust for the purpose of establishing a mission station (Figure 3). Captain Hans Clapmuts, a Khoi chief, and 70 of his followers were still living in Louwskloof at the time.[50,52,61] The first religious service was held in the open during that month. The land was divided into plots and the church, as trustee of state land, allocated plots to parishioners who built and maintained their

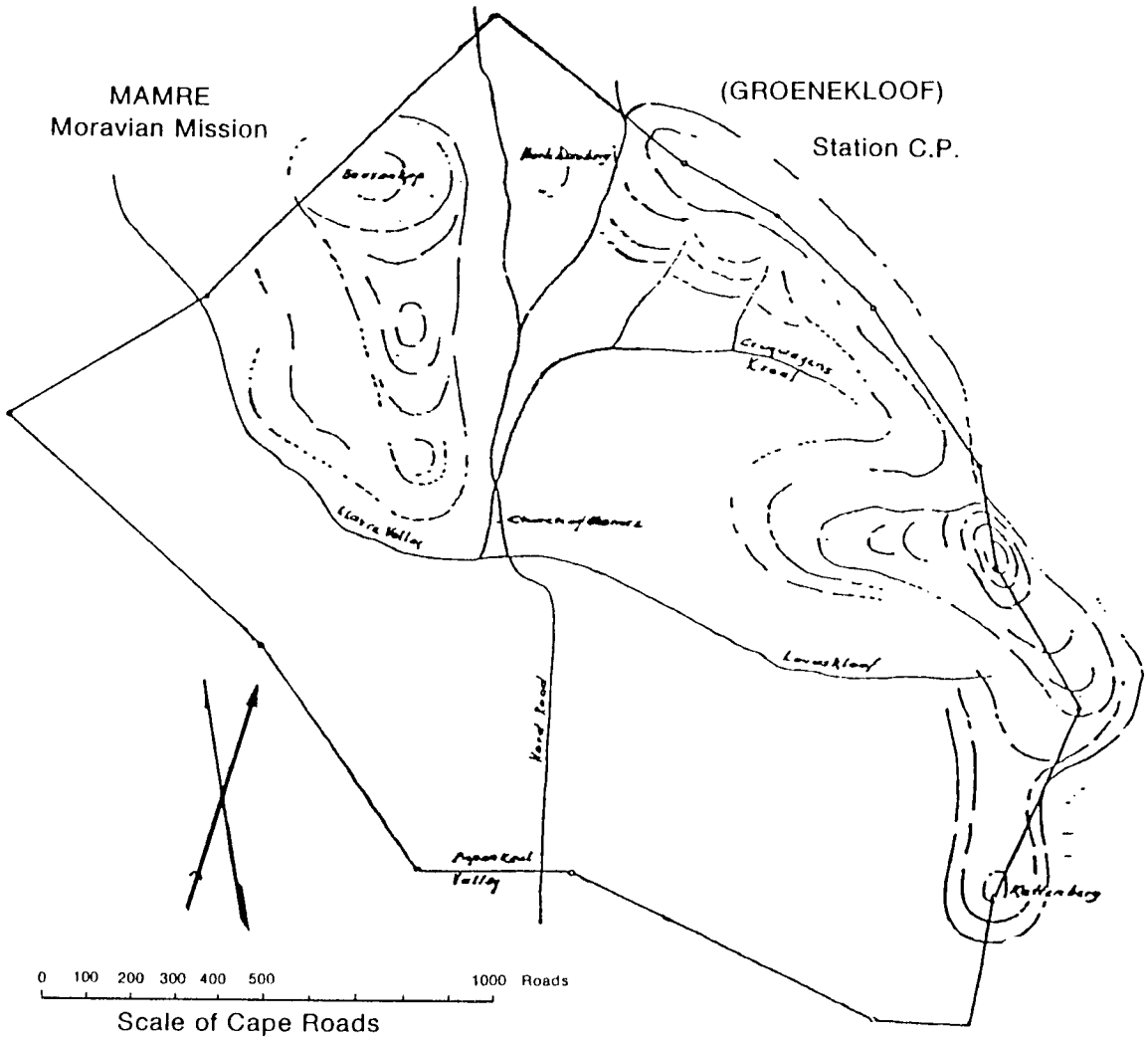


Figure 3. Map of farms constituting Groenekloof (1808)

Source: Moravian Church Archives, Heideveld, Cape Town.

homes. This pattern of plot allocation continued until the 1950s when the Mamre mission returned the land grant to the government.

The mission population was 101 by the end of 1808 and continued to grow. The church building was completed in 1818.[52,60,61] Khoikhoi from the surrounding farms populated the mission, and after 1839 there was an influx of liberated slaves, who integrated well into Groenekloof life, having attended services there in the past. Hans Clapmuts, now aged 110 and blind, having resisted conversion for 30 years, joined the community in 1839, a year before his death.[52,60,61] Table 2 gives the numbers of men, women and children who joined the Groenekloof community between the years 1828 and 1843, showing peak in-migration between 1839 and 1841.

A school was started in Groenekloof in 1833, with local residents being trained as teachers. In time, the people formed a closely knit community. Most people were involved in agricultural work in their gardens. Grain milling started in 1830, using a horse-mill. A water-mill, still standing today, was built in 1844 (Figure 4). Some inhabitants trained in a variety of trades, and worked in the district as tradesmen. The majority hired out their labour to surrounding farmers during the season to supplement their income. Some Groenekloof residents cultivated considerable pieces of land and lived in 'neat, comfortable cottages, well built and thatched'.[55]

About a hundred Mamre citizens qualified to vote in the first Cape Parliament election in 1854. Many participated in petitions against the proposed privatisation of public land, which included the subdivision of grant stations for

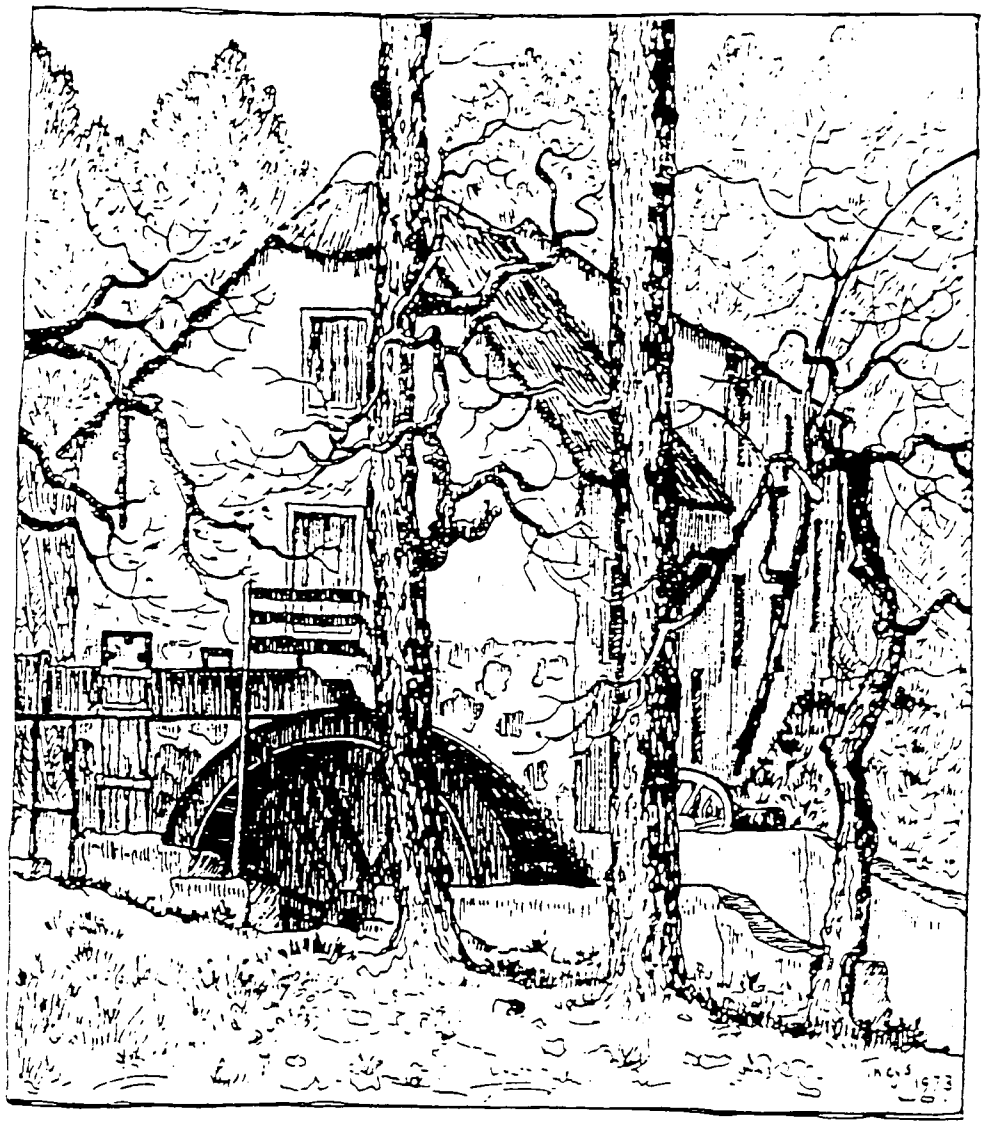
TABLE 2

NUMBERS OF NEWCOMERS TO MAMRE FROM 1828 TO 1843

Year	Adults		Children		Total
	Male	Female	Male	Female	
1828	10	6	15	6	37
1829	5	5	2	8	20
1830	7	8	7	6	28
1831	10	9	2	2	23
1832	19	15	15	13	62
1833	5	6	7	8	27
1834	5	5	6	2	18
1835	8	7	2	3	20
1836	13	9	6	1	29
1837	8	7	10	6	31
1838	15	15	18	17	65
1839	34	22	22	17	100
1840	88	59	38	38	188
1841	38	23	9	15	85
1842	21	19	13	13	66
1843	18	19	20	17	74

Source: Mamre Church Mission, Rough Notebook, 1828-1843.

Figure 4



MAMRE WATER-MILL

freehold plots for individuals.[60] So acutely was this proposal perceived as a threat to their autonomy and access to land, that some Mamre dwellers prepared for armed struggle.[55] They preferred to keep the land in joint property, for fear of ultimately being bought out by colonists.

In 1854, Groenekloof was renamed Mamre, a name originally given to a mission station on the Begha River in the Ciskei. This mission was closed on account of the border wars with the Xhosa.[61] 'Mamre' is a Hebrew word meaning a temporary settlement, and Mamre is referred to in Genesis as a place where Abraham built an altar to the Lord.

Initially, migration from Mamre was mainly to the surrounding farms, but after 1870 most people sought work in Cape Town on public works like the building of the railways and the docks.[60,61] A mission was set up in Cape Town to gather together all the Moravians who were living there, mostly among the Malay community. Between 1883 and 1887 the foundations of what later became known as the community at Moravian Hill were laid. This community was situated in District Six and disbanded in 1981 with the forced removal of the people from the area as a result of the Group Areas Act.[58,61]

The Coloured Political Association of Mamre, the first political organisation of 'coloured' people and a predecessor of the African People's Organisation, was formed in Mamre in 1900 in part response to the growing dissatisfaction of Mamre residents with the paternalism of the missionaries and their suspected support of the Boers.[60,64] Mamre residents were sympathetic to the

English, and many served in the Imperial Army as transport riders.[63,64]

Figure 5, which shows the population growth in Mamre between 1808 and 1986, highlights the bimodal population growth pattern. The population diminished from the first peak (1860) as people migrated from Mamre to Cape Town from the mid-1860s. Around the turn of the century, the population of Mamre started increasing once more, and this trend continues to this day.[52,65,66]

Up until the 1930s all Mamre inhabitants belonged to the Moravian Church, but since then other churches have established themselves in the village.[67] At present 90 per cent of the population is affiliated to the Moravian Church.[2]. The village is administered by a Village Management Board which was initially under the control of the church but became autonomous in the 1941. A ratepayers' association was formed in 1989.

Over the last 2-3 decades and until 1987, Mamre had little building maintenance and infrastructural development. The well-kept gardens described in historical accounts are now neglected and many houses fell into disrepair. The restoration of the mill in 1973, and the recognition of the mission area as an historical monument, did not form part of any general community upgrading programme, and therefore did not directly benefit the people of Mamre.

Piped water only became available in 1978 following an outbreak of typhoid, the source of which was the local spring (Dr L.H. Tibbit, Medical Officer of Health, Western Cape Regional Services Council [1988] - personal communication).

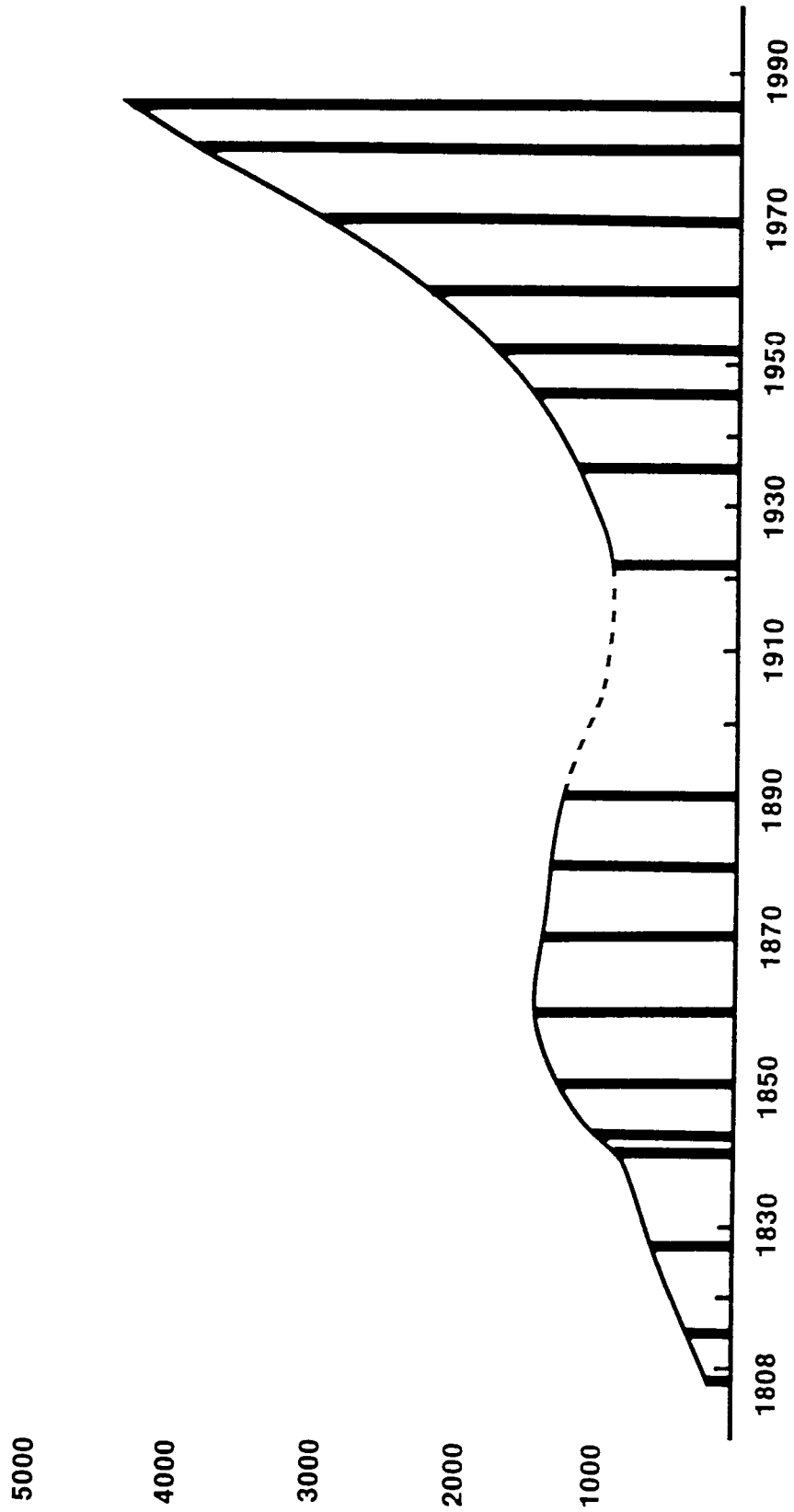


Figure 5. Population of MAMRE 1808-1986

In the 1970s Atlantis, a dormitory town to Cape Town, was developed 5 kilometers from Mamre to accommodate some of the thousands of people removed from the 'white' areas of Cape Town under the Group Areas Act. Thus, from the mid-1970s, Mamre was less isolated and gained easier access to whatever services, facilities and employment were available in Atlantis.

Until 1986, despite exposure to modern environmental services in nearby developed areas, the majority of Mamre residents did not have access to basic modern bulk services. In 1987, the Village Management Board implemented plans to upgrade Mamre with funds raised from the much-debated sale of one of the farms belonging to the community. By the end of 1989, the rebuilding of the roads, electrification of the village and the renovation of dilapidated houses was almost complete.

Present-day Mamre can be considered a dormitory town to Atlantis-Cape Town with its demographic, educational, employment and health profile reflecting that of the nearby urban centres.[2,4] However, the village has maintained its unique character, with the church remaining an important social influence.

CHAPTER 4

THE RESEARCH METHOD

SUMMARY

This chapter first describes the investigations that were undertaken prior to the preparation of the formal protocol and the implementation of the study. Discussions with key informants are reported and an overview of available and newly discovered sources of information is given. The results of the pilot studies are described.

The second part of the chapter deals with the methodology that was followed in the quantitative part of this investigation into the life expectancy of three historical Mamre cohorts. Key features of the methodology are the historical prospective study design and nominative data collection techniques. Age at death is the outcome measure of interest. Analyses include descriptive statistics, survival analysis and actuarial life expectancy determination.

4.1 PRELIMINARY QUALITATIVE INVESTIGATION

4.1.1 Discussions with key informants

The initial enquiries into the feasibility of the study mainly dealt with issues of access to church and official information sources. The information provided by key informants is discussed below.

(a) Head of the Moravian Theological Centre: Bishop Temmers

The Church Archives of the Moravian Church are housed at the Moravian Theological Centre in Heideveld, Cape Town. Bishop Temmers agreed that access to the Mamre records be given to those involved with the Mamre Church Records Project with the assistance of the archivist, the late Reverend Joorst, and the librarian, Ms Taillard.

Available documents and registers from Mamre were kept in one cupboard and were easy to access. Potentially useful registers and documents were noted by the researcher. This included a list of all the Mamre people who died in the 1918 Influenza Epidemic and a pile of marriage certificates from the 1840s.

The first Mamre Church register (1808-1828) was not available as it had been returned to the central Moravian Church Archives in Hernnhut, East Germany. Two later church registers were available, covering the years 1828 to about 1918. It was these registers which were used as the initial central source of data for this study. Unfortunately these went missing some time after being utilised for this research.

(b) Ministers at the Mamre Moravian Church: Reverends Cloete and Reicher

The Mamre Church was approached somewhat later to investigate the availibility of additional information. The ministers were agreeable to the use of whatever records were available. The records that

were immediately available - relatively recent burial orders, and baptismal and marriage registers covering the historical period of interest - were extremely useful and later proved to be important primary sources of information. Some records were kindly photocopied and at times loaned out so that data could be transcribed in Cape Town.

(c) Research Assistant involved in tracking family genealogies: Ms van Eck

Ms van Eck of the Medical Research Council was approached to provide information on which sources would be useful in obtaining death information concerning individuals in the Mamre cohorts. She had previously assisted in the tracing of genealogical information in Afrikaans families for the van Rhynsdorp Familial Cancer Project which was co-ordinated by Dr M. Torrington.(68)

The sources that were used to verify data collected from families for the Familial Cancer Project were the Dutch Reformed Church Archives, the Cape Archives and the Office of the Master of the Supreme Court. Of potential value to the Mamre Church Records Project were the Cape Archives which house reported deaths and wills between 1834 and 1920, and the Master's Office which houses death reports and wills from 1920 onwards.

Two issues determine the usefulness of these sources: firstly, the extent to which deaths were officially registered in Mamre and filed in Cape Town in the 19th and early 20th centuries, and secondly, the accessibility of the information to the researcher.

It was decided that the usefulness of these sources be investigated by searching for death information of a few Mamre individuals born in different decades (see pilot study).

(c) Lay historian: Mr Joemat

Reverend Cloete recommended that Mr Joemat, a lay historian from Atlantis with a special interest in Mamre, be contacted for advice and further historical information about Mamre. Mr Joemat's knowledge about Mamre and his enthusiasm about the project were encouraging. He provided references for use in the chapter on the historical context of the study and had access to many interesting historical details.

4.1.2 Detailed investigation of the historical records of Mamre: description, availability and usefulness

(a) Known sources

Following the discussions with key informants, all known potential sources of historical information were investigated. A description of the sources, their usefulness and the information they provided follows below.

Casualis registers are semi-alphabetically listed registers which give information concerning the church-related milestones that each individual achieved from birth to death. These registers were not necessarily filled in as events occurred, but rather served as an holistic account of the

individual's life, with the priest filling in details periodically. As mentioned earlier, the second and third of this type of register were kept at the Moravian Theological Centre Archives. There was much overlap between the books, and they served as a method of cross-checking. Many dates of death were absent from these registers.

The Baptismal Register is a chronologically listed register giving mainly birth and baptismal information. Additional information was often present as well, frequently providing dates of death. This register was more complete with regard to the total number of births in the community, than the Casualis Book. It covered the years 1837-1914. A second baptismal register covered the years from 1918.

Miscellaneous church documents, including accounts, minutes of meetings, newsletters and magazines, are also kept at the Archives in Heideveld. These were not used for this study.

Miscellaneous lists, including taxes, heads of households in particular years, and the victims of the 1918 influenza epidemic, are kept at the Church Archives. These were also not used for this study.

The Cape Blue Books in the South African Library provide some population figures, although these are of unknown accuracy.

A biography of the life of a well-known Mamre matriach[52], Benigna Johannes, provided some early population figures.

Burial/removal orders have also been recovered from the church files for the years between 1946 and 1986. These provide the date, age and cause of death. Many people who were born in Mamre, but who moved away, have been buried in the village. This greatly assisted the tracking down of dates of death of such people.

Original birth registration lists are filed in the Church Archives covering the years 1899 to 1930. Unfortunately only one date was available for these people, and thus those who appeared in this register only could not contribute to the study, other than in the evaluation of the quality of the data used for the determination of life expectancy.

Tombstones in the Mamre graveyard did not prove useful in providing death dates. Most of the old tombstones were in a state of disrepair. A further problem was the disorganised allocation of graveyard plots, with the result that some graves were accidentally dug up in the past.

The dataset from the baseline study of the Mamre Community Health Project provides the full name, address, date of birth and maiden name (if appropriate) of all the people who were living in Mamre at the time of the household information survey in 1986. A good proportion of the individuals from the last cohort, for whom little information was available, were traced as living in Mamre in 1986.

The Master's Office of the Supreme Court was not used as a source of data as the system proved to be laborious in that a number of separate alphabetical indices were kept according to the year of death. Thus, if a year of death was unknown, a search for date of death meant going through all the books by year. This was obviously unproductive and impractical. Death information for a few individuals from Mamre, whose dates of death were known could not be found at the Master's Office. In general, the best use for this source is the verification of known dates of death and the acquisition of additional information concerning the deceased.

(b) Further sources

The study was undertaken on the basis of the availability of information from the above sources. However, even once the data collection phase had begun, the search for further sources of historical data continued. Reverend Cloete agreed to undertake a joint search with the author for more information in some of the old buildings in the mission area. The extra effort proved to be very worthwhile, especially the cleaning out of the 'bakhuis' (an old building in which the church congregation baked bread and buns for special occasions). The search in the lofts of the 'langhuis' (the building which housed the de Kleine Post garrison in the 1700s) was less productive. The following additional sources of information were discovered in this way:

Notebooks, used by the ministers to jot down church-related information in rough as the events occurred, were found in the 'bakhuis'. The earliest one

covered the years 1808-1827, while the second one covered the years 1828-1842. They contain records of most church-related activities (excluding deaths and baptisms, but including births and dates of arrival at Mamre). Appendix 1 shows a page from the notebook diary documenting births. The earlier book is one of the few accounts of events available for the first years of the Mamre mission. The second one contains a record of the date of arrival for everyone joining the mission during the period when slaves were freed. One important entry is that of the arrival of Hans Clapmuts, the leader of the last Khoi grouping in the area (see Appendix 2). The discovery of the second notebook, and the subsequent utilisation of the information in it, showed that the Casualis Books had grossly under-registered children who had died in infancy (see report on pilot studies in section 3 of this chapter). The notebooks seemed to record most births (including some that seem to be stillbirths), but only continued until 1843.

Two hard-covered fullscap books, covering the years between 1937 and 1963, recorded all church-related events including deaths, church suspensions and readmissions. The information seems to have been listed as events occurred. These proved to be useful for the provision of dates of death and last known dates alive.

A fourth Casualis Book covering a slightly later period than the third book provided more information on individuals in the middle and last cohort. The completeness of birth registration in this book was better than the other casualis books.

A final attempt at tracing some individuals was made by interviewing surviving siblings or survivors of the cohort who were still living in Mamre. An 84-year old member of the cohort accompanied the author to the homes of some 10 such cohort members.

4.1.3 Pilot studies

Pilot studies were done to develop different aspects of the protocol. The first pilot study determined the overall feasibility of the protocol, while the second investigated issues which would assist in making decisions in the advanced stages of the design of the study.

(a) Pilot Study I

Specific objectives included: the investigation of alternative sources for data validation and completion; the establishment of the process for data transfer from the church records, including the design of a data capture form; and the establishment of appropriate methods of sampling and sample size.

Methods: A count of baptisms in the baptismal register was used to estimate the number of births per year. Sampling and sample size were decided on the basis of these numbers. Data was collected for ten individuals from each cohort using all potential sources. Cards were developed for data capture.

Results: Initially all Mamre births between 1828 and 1918 were to be included in the study. However, during the pretest the data collection proved to be extremely laborious and the cohort sizes were larger than anticipated (estimated fifty births per year). It was thus decided to focus on three specific decadal cohorts, which were estimated to be large enough to provide reasonably reliable estimates.

In terms of providing dates of death, conventional sources of death data (Master's Office and the State Archives) proved unfruitful for dates of death prior to the 1930s. It seems as if the Mamre deaths were systematically excluded from these before this time. However, burial records and baptismal records helped complete many cards in the sample.

A decision was made to design a card to be filled in for each individual in the study, because logistical problems were anticipated with regard to the transfer of information onto the computer. The design of the cards was done by listing all the church information available and laying out the form in such a way as to facilitate accurate, easy transfer of information. Issues such as filing, source references and cross-references were considered. Two interlinking card systems - one for individuals and one for families - were designed, piloted on the small sample and adjusted for the main study.

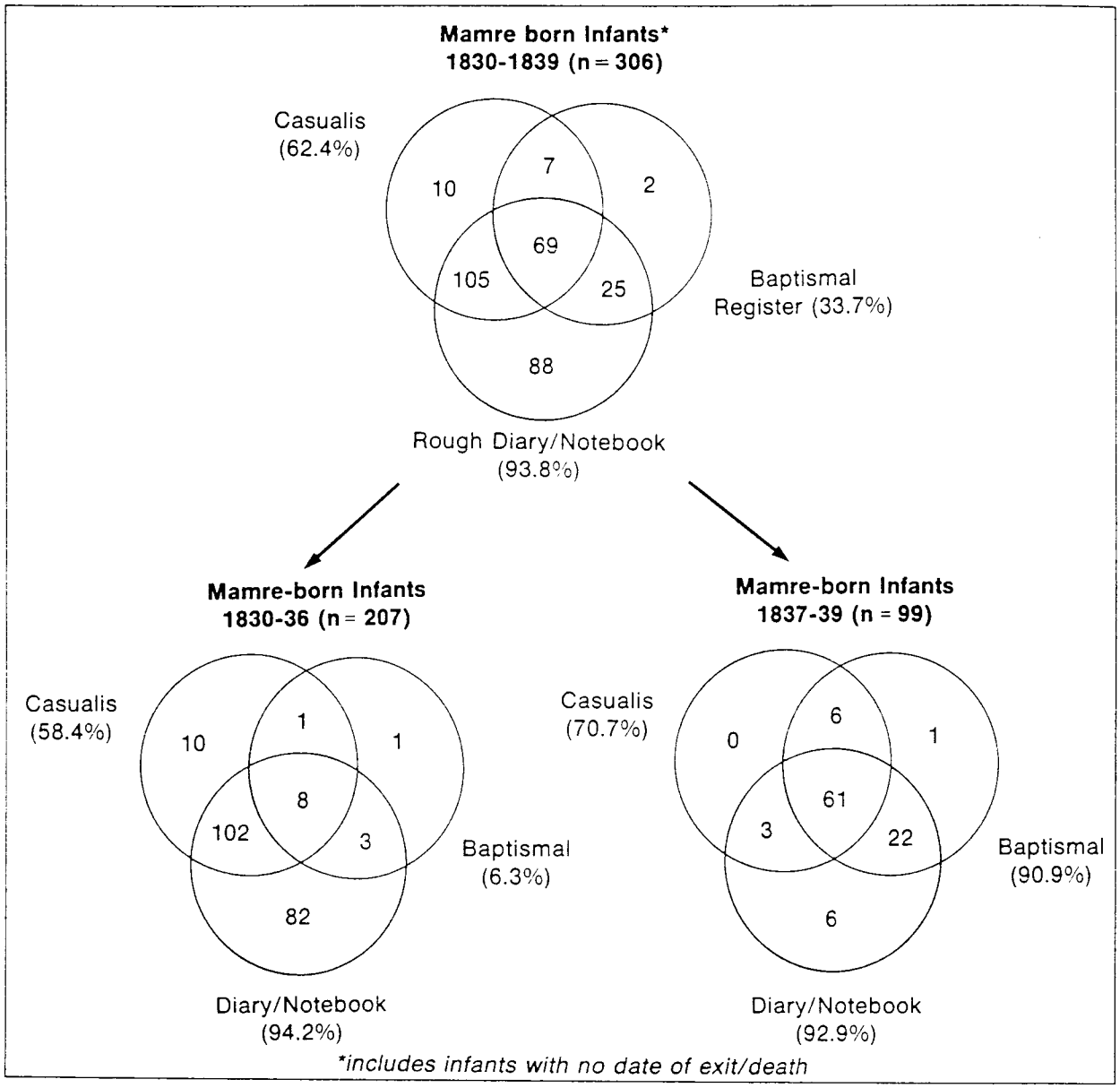
(b) Pilot Study II:

Specific objectives included the investigation of the completeness of different sources, with a view to deciding which time periods to select for the first study cohort, as well as to develop and test methods of data analysis.

Methods: Data was collected and computerised for individuals born between 1830 and 1839. Computer programmes were written for the analysis of the data. The sources of data were investigated. Sources of birth information and infant mortality rates were determined for the 1830-1836 and 1837-39 periods in order to contrast figures before and after 1837, when the Baptismal Register was available.

Results: Figure 6 contrasts the sources of Mamre births before and after 1837. The best single source of birth information over the whole period in question was the notebook/diary. The Casualis was the second best source for the 1830-36 period but missed out a high proportion of births. The Baptismal Register , while not available before 1837, was a good second source for the post-1837 period, missing only a small proportion of the notebook births. As many of the children registered in the diary had no dates other than birth dates (and therefore could not contribute to the mortality analyses), and the Casualis was clearly an incomplete source of births, a decision was made to select the first cohort to coincide with the availability of the Baptismal Register.

Figure 6. Pilot study results: Source for data and all Mamre-born infants, (1830-1939)



Selection of the births between 1837 and 1846 ensured optimal utilisation of sources in the main study. Figure 7 shows that the infant mortality rates for the two periods differed widely (90 per 1 000 as compared to 217 per 1 000) due to the biased registration of births in the Casualis Book, the main source in the 1830-36 period.

4.2 QUANTITATIVE METHODOLOGY

The overall AIM of the study was to investigate life expectancy at birth in three historical Mamre cohorts: 1837 to 1846, 1870 to 1879 and 1900 to 1909.

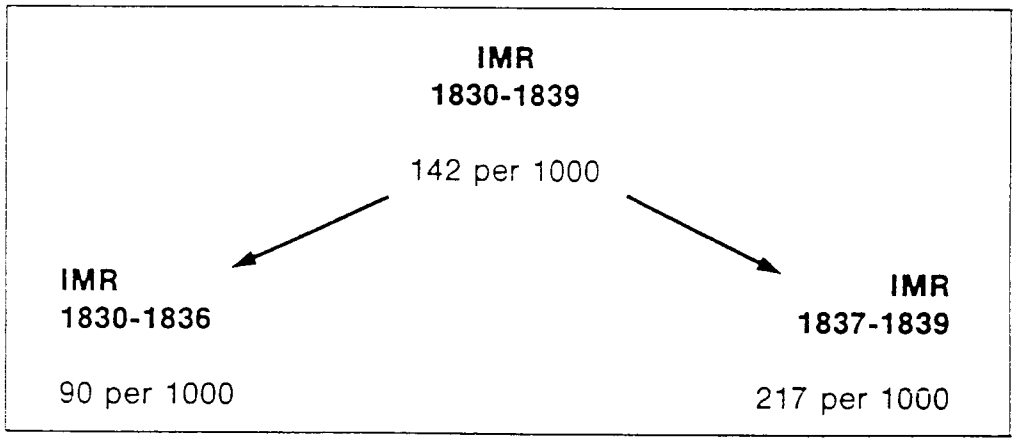
4.2.1 Definition of terms

Mamre inhabitants are those individuals who lived in Mamre for at least six months (or in the case of infants, at least half of their lives). In this study there are four categories of inhabitants :

a) those who were born and died in Mamre
b) those who were born in Mamre but moved away
c) those who were newcomers to Mamre and remained
d) those who were newcomers to Mamre and moved away.

Excluded from the definition are those who were registered in Mamre but lived elsewhere and those for whom only one date is known (for example, birthdate or date of arrival).

Figure 7. Pilot study results: Infant Mortality Rates (IMR) (1830-1839)



4.2.2 Study Design

This study is an historical (or non-concurrent) prospective study of decadal birth cohorts constructed retrospectively through existing parish records of the Moravian Mission at Mamre. In order to calculate life expectancy at birth by the cohort life table or person-year method, all individuals participating in the study had to be followed from birth or first entry date to either death, withdrawal or loss to follow-up. Thus, while data was collected retrospectively, observation time proceeded prospectively.

The church records followed each subject from his/her birth to death, with age at death being the outcome measured. Where cross-sectional lists were found, they were used to verify or complete data.

Exposure *per se* was not measured but is considered to be the cumulative secular effect of living through that time period with its material and political forces. Thus the exposure for each cohort is the historical period in which its members lived.

4.2.3 Sampling

Information covering the whole population of Mamre is available from 1830. However, the labour-intensive nature of data collection made collection of all the data prohibitive. Data was thus collected for those individuals born during three decades: 1837-46, 1870-79, and 1900-09.

These particular decades were chosen because they represent the earliest, latest and middle decades of completed registers. The extent to which the results of these cohorts can be generalised to any other Mamre cohorts or birth cohorts from other areas is discussed in the Chapter 6.

Decadal rather than annual or quinquennial cohorts were chosen in order to ensure that results would be stable and not subject to minor annual variation. The sizes of the cohorts were roughly estimated to be between 400 and 600 each.

Incomplete baptismal registration may be a source of sampling bias. The main reason for non-registration in Mamre was probably the high infant and child mortality rates which led to many children dying before being baptised. This is an example of selective non-registration, defined by Henry as those births which parents or priests judge unnecessary to report or register when the child died very shortly after birth (see page 17).

Other sources of bias mentioned in the literature - systematic non-registration (exclusion of a whole category of people) and non-conformity (sections of the whole community did not belong to the church) do not appear to have been a problem in Mamre. Baptism records exist for illegitimate and ill infants. Random non-registration probably did occur.

4.2.4 MEASUREMENT

Data collection was done by record review using nominative methods common in historical demography, as described earlier (see page 11).

Age at death is the variable of interest in this study. The point of entry is the date of birth for all Mamre-born individuals and the date of arrival for all newcomers to Mamre known to have been born in the chosen years.

Survival analysis allows for withdrawals and losses to follow-up (censored data) of some of the individuals in the cohort. The outcome measure is thus the last known date alive. This might be any of the dates appearing in the register - death, departure from Mamre, confirmation, marriage or any other recorded date. In this way the person contributes to the analysis for as long as information is known about him/her.

(a) **Sources of Data**

(i) Historical Sources :

Table 3 gives a summary of the sources of data used in the main study, as described on pages 62-67.

TABLE 3

SOURCES OF DATA USED FOR INDIVIDUAL INFORMATION

Source	Type of information	Cohort(s) used for	Comment
1. Baptismal Register (1837-1909)	All church-related events including births and deaths	All	Single best source of information for births and deaths
2. Casualis	As above	All	Best for 1870-1879 cohort
3. Rough Notebooks/ Diary	Birth dates, arrival dates	1837-1843	30 births appear that could not be used. Excellent source of births only.
4. Burial/ Removal orders	Age, date of death, cause of death	Mainly 1870-1879 and 1900-1909	
5. Official birth registration lists	Date of birth only	1900-1909	Many births could not be used because only one date
6. Official death registration lists	Date of death, indication if infant	1900-1909	Many infant deaths could not be used because only one date
7. Hard covered Diaries (1937-1963)	Miscellaneous dates, including death dates	1870-1879 1900-1909	
8. 1986 Household survey of Mamre	Tracing of people still alive in Mamre	1900-1909	
9. Interviews with survivors of cohort	Tracing of people beyond baptism	1900-1909	last resort

(ii) Sources of comparison data:

South African Figures: The earliest mortality figures for the Cape Colony covering the years 1894-1912 have been published by Simkins and van Heyningen.[17] South African national 'coloured' figures are available from 1935-1937.[69] The 1894-1912, 1937-1939 and 1984-1986 'coloured' figures have been used for comparative purposes. In addition, figures dealing with 'white' mortality before 1820 are also referred to.[15]

Mortality statistics for Mamre, which were extracted from the Regional Services Council records for 1981-1987[5], were be used for the calculation of present-day Mamre life expectancy at birth. Small numbers disallowed the calculation of precise figures. (Professor R. Dorrington - personal communication)

Other historical populations: Mortality statistics of other historical groups were gleaned from the literature for comparative purposes. These include populations from Western Europe (1840 and 1900)[71], England and Wales[72] and England (1426-1456)[73].

(b) **Quality of data**

(i) Precision :

It is difficult to evaluate the precision of data originally recorded. Errors are insidious and may relate to the date of an event, the age,

marital status, name or other demographic detail. Errors of this type are known to be infrequent in well-kept registers of small parishes (see pages 16-17).

(ii) Reliability :

Evaluation of the degree of precision of the transfer of information by the ministers from one record to another (repeatability by the original recorder) can be done by checking that different sources give the same information. Three sources are ideal (but not always possible), as two corresponding dates can then confirm each other and exclude the differing third.

The time sequence in which the sources were recorded, reflecting also the ranking of accuracy of sources, seems to be as follows :

- rough notebooks - filled in as the occasion arose;
- Baptismal Register - filled in baptisms (not births) as occasions arose; and
- Casualis Book - filled in as a summary after events.

All documents which list particular events in chronological order (for example Baptismal Registers) rather than to record events for a particular individual (for example, Casualis Books) seem to be more precise.

(iii) **Validity:**

The completeness of the registration of births and deaths determines the validity of the data. Biases in the registration were investigated using a variety of methods. These included:

- A comparison of the relative contribution of different sources of birth and death information, as well as the overlap in the different sources.

- The determination of the ratio of male to female births in Mamre for the three cohorts.

- The determination of the age distribution of the birth-baptismal interval for Mamre-born children.

- The calculation of the ratio of observed to expected births in Mamre was based on an expected crude birth rate of 47 per 1 000. As a maximum of 47.9 was estimated by the Bureau of Census and Statistics for the period 1937-1958[69], and a maximum of 46.2 was estimated by Sadie over the 1960-1965 period, the crude birth rate in Mamre is unlikely to have been much in excess of this.[70]

- The determination of the age distribution at censorship.

- The calculation of sex ratio at death for all infant deaths.

- The determination of the percentage of 'emergency baptisms' which, for the purposes of this study, were defined as all baptisms preceding infant deaths by ten or fewer days. These baptisms were usually performed because the infant was expected to die shortly after baptism. Any attempt to baptise dying infants indicates that the community did not systematically exclude such infants from the records and reduces the extent to which infant mortality is underregistered.

(c) **Recording of Data**

Recording of data was done by, firstly, transferring the information onto cards (hard copy), and later entering it into the computer by way of a computer screen, specially designed to fit the needs of the data. Analysis was done once the 'computer copy' was completed. Coding was by-passed in this way.

The hard copy consisted of cards, which had been specially designed to suit the horizontal layout of the Casualis Book in order to ensure ease and accuracy of recording (Appendices 3 and 4). All dates and information provided were recorded even though only limited information was needed for the study. Reasons for collecting extra facts were, firstly, that often other information was needed in order to facilitate finding missing information elsewhere; secondly, that additional analyses could be done to

the data set at a later stage without having to repeat the laborious process of data collection; and, thirdly, that apparently unnecessary dates often provided the last known date alive (date of withdrawal from study).

The following information was recorded on the individual cards:

- Dates and places of birth, baptism, marriage, confirmation, first communion, arrival in Mamre, suspensions from and re-admission to the church, and death

- Sex

- Category/type of Mamre inhabitant, for example newcomer, always lived in Mamre.

- Names of parents and spouses with cross-references to both the parental marriage card and own marriage card(s).

The family card recorded the surname and Christian names of the couple, their date of marriage and the names of all the children of that union. Each person was cross-referenced to his/her own individual card or to the source of further information about him/her. These cards were filed in alphabetical as well as chronological order, and were not computerised.

4.2.5 IMPLEMENTATION

Data collection was done by the researcher with the assistance of research assistants, who transferred all the necessary information from the historical records. While church records formed the initial source of the data, all other sources were tapped to both validate and/or complete the data.

The location of data collection varied according to the source. Thus data collection demanded travel from a central office to the Archives to Mamre, depending on which source needed to be consulted at a particular time.

The sequence in which sources were used was, firstly, the Baptismal Register; secondly, the Casualis Book; thirdly, burial records and notebooks; and lastly, any other available sources.

The 'computer copy' was completed by the researcher after completion of each cohort. The hard copies were kept in special boxes, filed in a systematic way (alphabetically but also by date of birth) and were easy to transfer from location to location.

Time Allocation:

1986

April: initial idea and reading

May-June: church contacted, access arranged

July- September: investigation of data sources
development of protocol
pilot study
design of record sheet

October: intermittent data collection

1987

December:

1988

January-March: punching of data

April: cleaning of data

May: analysis of data

June: initial presentation of results

July: leave of absence

1989

April-December: documentation

4.2.6 Analysis

The analysis was conducted in two stages, namely an investigation into the quality of the data, and the calculation of mortality indicators.

(a) **Quality of the Data**

Descriptive analyses were done by the researcher, using SAS packages[74] on an IBM main frame computer, with the assistance of a consultant biostatistician.

The quality of the data was investigated, using frequency data to calculate sex ratios, ratios of observed to expected births, age distributions of the age at baptism, age distributions of first and last recorded events, types of last recorded events, and the frequency of 'emergency baptisms' among infants who died.

(b) **Mortality Indicators**

The years of exposure contributed by each individual in the different age groups were computed and summed by a specially written computer program. Initial rates of mortality were calculated by dividing the deaths in a specific age category by the initial exposure to risk for that age category. Thus age-specific mortality rates, including infant mortality rates, were obtained.

Age-specific observed rates of mortality were used in the calculation of life expectancy. 95 per cent confidence limits were calculated for the quinquennial mortality rates in order to provide interval estimates for these rates. These were also used to assess whether there were differences in mortality rates between cohorts.

Life expectancies at age 0, 1 and 20 were calculated. These actuarial calculations were done with the assistance of Professor Dorrington of the Business Science Department, University of Cape Town.

4.2.7 ETHICS

Consent for the collection of church registration data was obtained from the Moravian Church Theological Centre which houses the archives. The two Mamre Moravian Ministers were also approached for approval.

Subjects did not remain anonymous seeing that names and dates of birth were essential for the identification of individuals and the linking of relevant information.

While the details of individuals were confidentially kept, the results of the study groups will be reported. In the case of individuals requesting to know their genealogy, special permission is received from the church so as to ensure some degree of

confidentiality with regard to individual information.

The protocol for this study was approved by the Ethics Committee of the University of Cape Town, Medical School.

CHAPTER 5

RESULTS

SUMMARY

This chapter presents the findings of the study. An analysis of results within the different sub-groups is given. Descriptive statistics are given in order to evaluate the quality of the data. Under-registration of infants deaths, particularly female, is evident. Registration of births was best for the first cohort.

Mortality statistics are described for the three Mamre cohorts. No statistically significant differences were found between the infant mortality rates, quinquennial mortality rates and life expectancies in the three cohorts. Infant mortality rates show some evidence of a decreasing trend over time for males, but not females. Quinquennial mortality rates form a classical J-shaped curve with an unusually high mortality rate for women in the 25-30 year age group for all cohorts. Female rates over the age of 40 were substantially less for the last cohort compared with the earlier cohorts, as well as males for the third cohort. Life expectancies at birth and age 1 were lowest in the 1870-79 cohort for males and females. Life expectancy at age 20 showed an increasing trend with time for females, but not for males.

5.1 BROAD OUTLINE OF THE SUBDIVISION OF THE DATA

Figure 8 gives an outline of how the data was subdivided for analysis. The dataset was divided into cohorts according to the years of birth of each individual. Thus three decadal cohorts exist - 1837 to 1846, 1870 to 1879 and 1900 to 1909. Each cohort consisted of a majority who were born in Mamre and a minority who moved to the village after birth (see section (f) below). People who were registered in Mamre but did not live there were excluded.

While the mortality analyses were conducted on the combined Mamre-born and newcomer groups, most of the descriptive analyses were done on the Mamre-born groups in order to evaluate the quality and representativeness of the registration.

5.2 QUALITY OF THE DATA

5.2.1 Birth Information

(a) **Sources of Birth Information for Mamre-born Individuals**

The Venn diagram in Figure 9 shows how many births were recorded in the different sources of data for all three cohorts.

Baptismal Registers and Casualis Books were available for each cohort. Supplementary sources were available for the first and third cohorts, although the data from these were not suitable for inclusion into the dataset. A rough diary and official birth registers

Figure 8. Outline of the Data

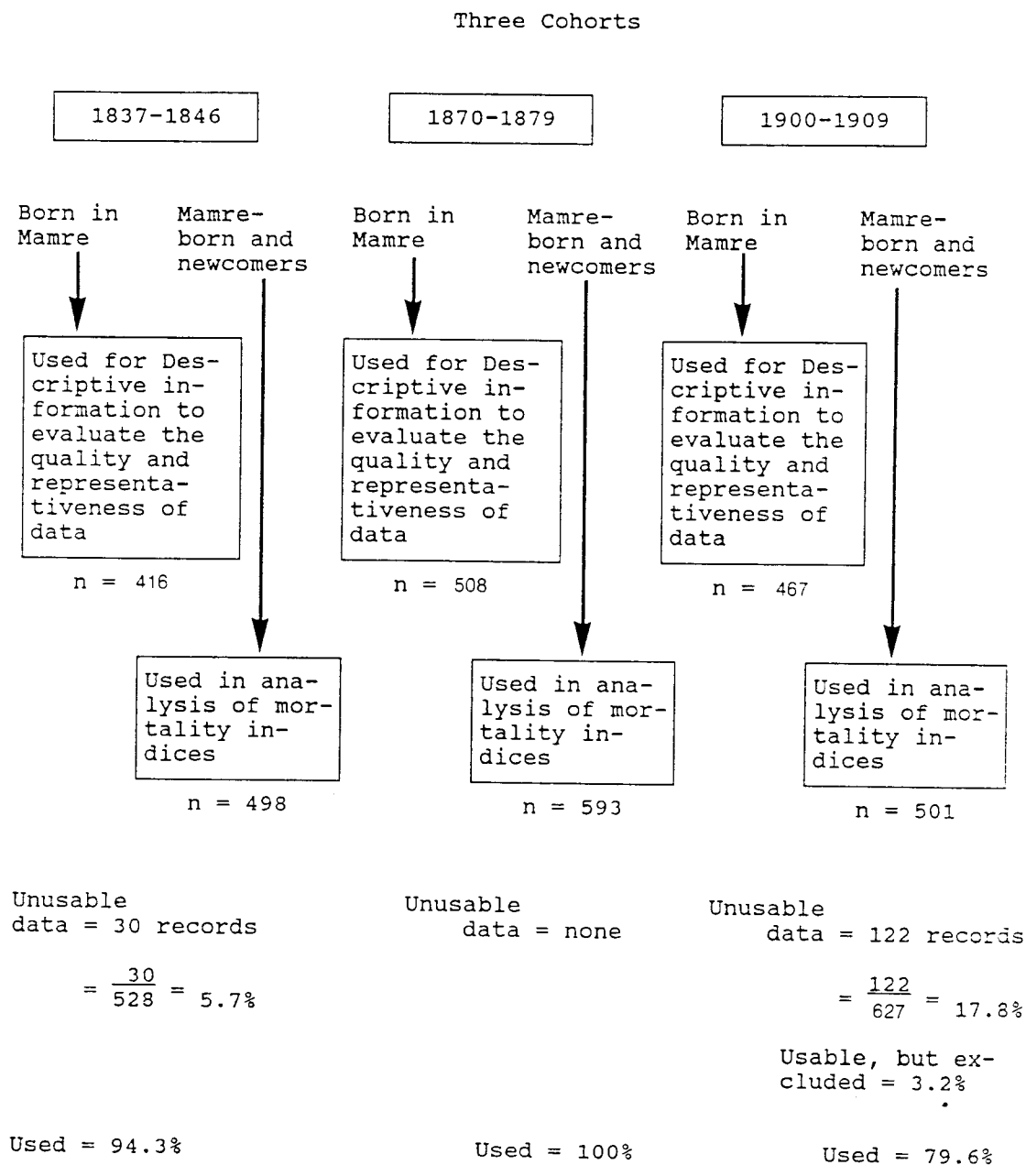
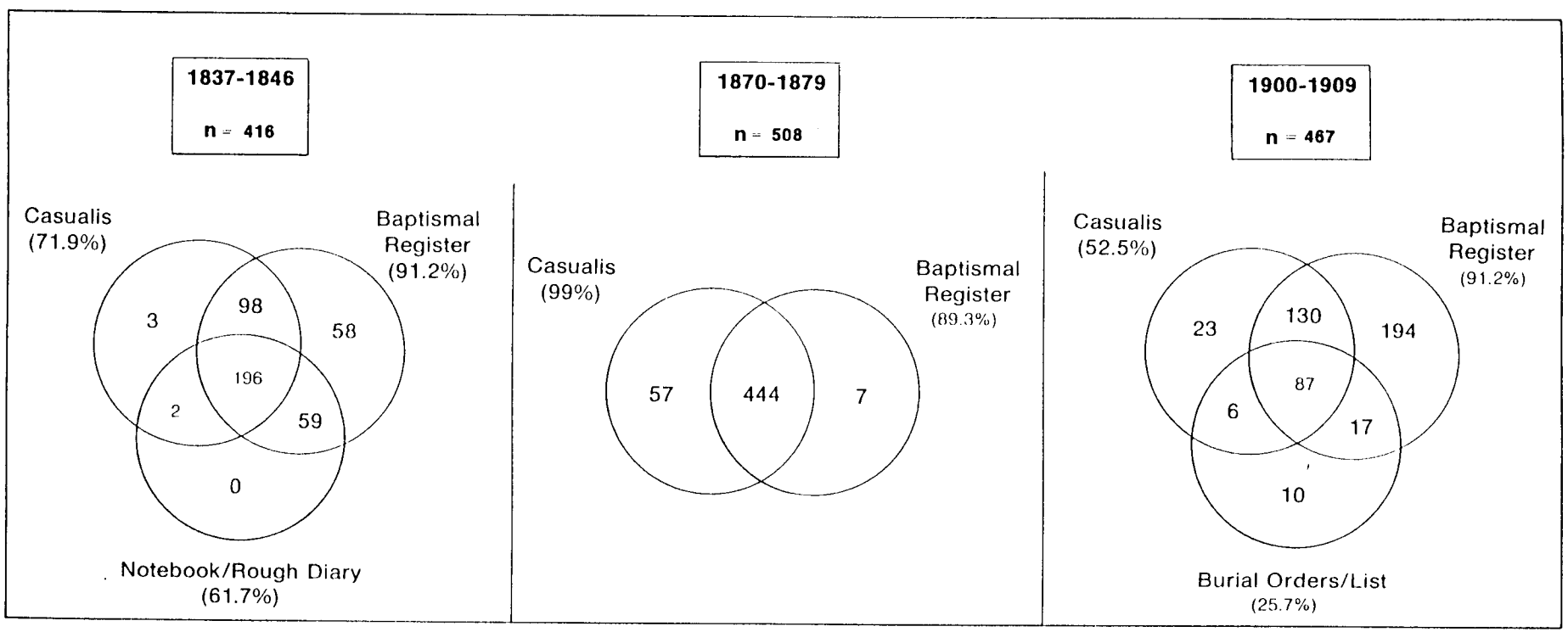


Figure 9. Birth source for Mamre born individuals



supplemented data covering the 1837 to 1843 and 1900 to 1909 periods respectively.

30 births which occurred between 1837 and 1843 were recorded in the diary only, representing 5.7 per cent of the total known births for the 1837-46 period. These data were not used in the analysis as only the date of birth was known for these individuals. For the Mamre births covering the entire cohort, the Baptismal Register is the single best source recording 98.5 per cent of known births. Only 3 births were recorded in the Casualis Book only.

All individuals with births recorded between 1870 and 1879 had more than one date recorded, and thus all could contribute to the study. Of interest in this cohort is the improved quality of the Casualis Book registration as compared with that of the Baptismal Register. It appears that baptisms performed in people's homes as a result of the infants' being close to death, were not registered in the Baptismal Register but in the Casualis Book. This shows a change in registration convention between priests. The absence of a third source for this cohort did not allow evaluation of the sources to the same extent as was possible for the other two cohorts.

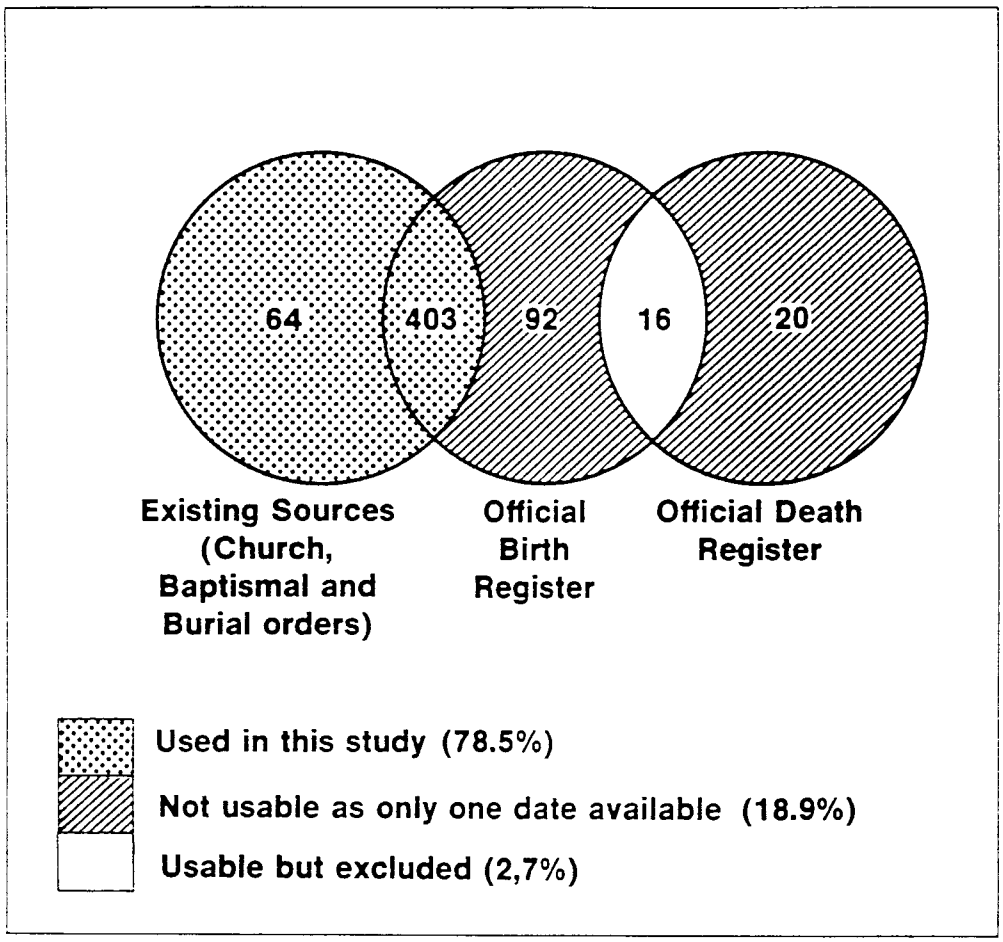
The sources of birth information that were available for the 1900 to 1909 cohort were more complex. The Baptismal Register yielded 91.2 per cent of the birth information used in the mortality analysis. Death lists and burial orders provided birth information for the few newcomers to Mamre. Of interest for this period is the relatively high proportion (18.7%) of

birth information from official registration lists which could not be used as only one date was provided. Attached to the official birth registration list, which contributed 108 extra births, were lists of deaths for the same period. Only 16 deaths could be linked to the birth list, and a further 20 infant deaths provided no birth information. Thus 112 individuals had to be excluded on the basis of insufficient information. The data of the 16 known deaths were excluded on the basis that their inclusion would introduce a bias to the overall infant mortality rate calculation. Thus only 78.5 per cent of church and officially registered births were entered into the study. Figure 10 gives a graphic breakdown of the used and unused information for this cohort.

(b) **Ratio of males to female births in Mamre**

The sex ratios at birth for individuals in the study were 1.25 for earliest and middle cohorts, and 1.18 for the latest cohort (Table 4). With the expected ratio being about 1.05[25], these figures indicate preferential registration of boys, and thus underrepresentation of girls in the dataset. Even when the 30 and 128 individuals belonging to the first and last cohorts, for whom only one date was available, are included in the calculation of sex ratios at birth, these ratios are 1.23 and 1.20 respectively.

Figure 10. Outline of used and unused data sources for 1900-1909 cohort



(c) **Birth-baptism intervals**

96.9 per cent, 94.4 per cent and 96.4 per cent of infants recorded as being born in Mamre in the earliest, middle and latest cohort respectively were

TABLE 4

RATIO OF OBSERVED: EXPECTED BIRTHS FOR THE THREE MAMRE COHORTS*

Year	Population Estimate over Decade	Observed Births		Sex Ratio	Expected Births* (combined)	Ratio Observed: Expected Births
		Males	Females			
1837-46	1000	231	185	1.25(1.23)**	470	88.5%(92.7%)**
1870-79	1250	278	222	1.25***	587	85.7%
1900-09	1100	254	215	1.18(1.20)**	517	90.7%(115%)

* Assuming a crude birth rate of 47 per 1000 population.

** Ratio when unusable births included in calculation.

*** Excluding 3 of unknown sex.

baptised in Mamre itself. Table 5 shows the age distribution of age at baptism (child baptisms) for Mamre-born males and females for the three cohorts.

Overall, the median age at baptismal age increased over time for both sexes, remaining between 1 and 2 months for all groups. Male/female differences are also evident. Males were consistantly more likely to be baptised before the age of 3 weeks and after the age of 3 months than females. Baptism over the age of 3 months was rare for both sexes in the 1837-46 cohort, but increasingly common in the other groups.

(d) **Ratio of expected to observed births**

Given an expected birth rate for the village of 47 per 1 000[70], and a population size of 1 000, 1 250 and 1 100 for the 1837-46, 1870-79 and 1900-09 cohorts, 470, 587 and 517 births could be expected to occur (Table 4). The ratio of observed to expected deaths for each of the cohorts is 0.89, 0.857 and 0.907. When births not included in the analysis were added in the calculation, the ratios are 0.93 and 1.15 for the 1837-46 and 1900-09 cohorts respectively.

5.2.2 Censored Data

(a) **Newcomers to Mamre** (left censored data)

82 (16.5%) of the 1837 to 1846 cohort, 90 (15.2%) of the 1870 to 1879 cohort, and 32 (6.3%)of the 1900 to 1909 cohort were not born in the village. The distributions of the ages of arrival in Mamre for the

TABLE 5

AGE AT BAPTISM FOR MALE AND FEMALE MAMRE BIRTHS*

	1837-1846		1870-1879		1900-1909	
AGE(DAYS)	MALES	FEMALES	MALES	FEMALES	MALES	FEMALES
	n=225	n=183	n=263	n=208	n=238	n=207
0-10	25(11.4)	15(8.2)	12(4.5)	5(2.4)	8(3.4)	6(2.9)
11-20	14(6.1)	3(2.1)	10(3.8)	9(4.3)	13(5.4)	3(1.4)
21-30	65(28.4)	49(26.8)	25(9.4)	26(12.5)	23(9.7)	29(14.9)
31-40	65(28.4)	68(37.2)	46(17.4)	48(23.1)	27(11.3)	31(14.9)
41-50	17(7.5)	25(13.6)	46(17.4)	39(18.8)	24(10.1)	26(12.4)
51-60	7(3.1)	7(3.9)	30(11.3)	26(12.5)	21(8.8)	22(10.6)
60-365	15(6.5)	11(6.0)	63(23.8)	34(16.3)	79(33.2)	60(29.0)
365+	17(7.5)	5(2.7)	31(11.7)	21(10.1)	43(18.1)	30(14.5)
Median	31	34	48	43	62	53

* excludes adult baptisms

three cohorts are given in Tables 6, 7 and 8, and are shown graphically in Figure 11.

A substantial percentage (86.6%) of newcomers in the earliest cohort were under 5 years of age. Newcomers to the middle cohort mainly arrived in Mamre under the age of 25 and showed a fairly even distribution over these younger ages. The latest cohort shows no clear pattern.

(b) **Incomplete follow-up** (right censored data)

In the 1837 to 1846 cohort, 33.1 per cent of observations were not followed up to their date of death. The middle and last cohorts had 28.0 per cent and 37.7 per cent censored information. The figure for the latest cohort includes the 6 per cent of the cohort who were still alive in March 1988.

(c) **The Distribution of Ages when Censored**

Tables 6, 7 and 8 give the relative percentages of censored observations at different ages for the three cohorts. Figure 12 gives a visual presentation of the same material, showing a bimodal pattern for the 1837 to 1846 cohort, a unimodal pattern for the 1870s cohort, and a trimodal pattern (infants, young adults and the aged) for the 1900 to 1909 cohort. In the latter, the high percentage of censored data in the over 65 age group is due to the surviving cohort members.

TABLE 6

AGE AT ARRIVAL BY AGE AT CENSORSHIP: 1837-1846 MAMRE COHORT

		AGE AT CENSORSHIP						
		DEATH *	0-4	5-19	20-34	35-49	50+	TOTAL
AGE AT ARRIVAL	BIRTH	286	54	34	34	5	3	416 83.53%
	0-4	39	1	21	9	1	0	71 14.26%
	5-19	5	0	2	0	1	0	8 1.61%
	20-34	2	0	0	0	0	0	2 0.40%
	35-49	1	0	0	0	0	0	1 0.20%
	TOTAL	333 66.87%	55 11.04%	57 11.45%	43 8.63%	7 1.41%	3 0.60%	498 100.00%

* 'DEATH' describes the outcome measured in this study and as such this column indicates the uncensored information.

TABLE 7

AGE AT ARRIVAL BY AGE AT CENSORSHIP: 1870-1879 MAMRE COHORT

		AGE AT CENSORSHIP						
		DEATH *	0-4	5-19	20-34	35-49	50+	TOTAL
AGE AT ARRIVAL	BIRTH	383	12	44	55	6	3	503 84.82%
	0-4	24	1	9	9	0	0	43 7.25%
	5-19	14	0	14	10	1	0	39 6.58%
	20-34	5	0	0	2	0	0	7 1.18%
	35-49	1	0	0	0	0	0	1 1.17%
	TOTAL	427 72.01%	13 2.19%	67 11.30%	76 12.82%	7 1.18%	3 0.51%	593 100.00%

* 'DEATH' describes the outcome measured in this study and as such this column indicates the uncensored information.

TABLE 8

AGE AT ARRIVAL BY AGE AT CENSORSHIP: 1900-1909 MAMRE COHORT

		AGE AT CENSORSHIP						
		DEATH *	0-4	5-19	20-34	35-49	50+	TOTAL
AGE AT ARRIVAL	BIRTH	288	44	17	76	9	35	469 93.61%
	0-4	12	0	1	4	1	1	19 3.79%
	5-19	2	0	0	0	0	0	2 0.40%
	20-34	5	0	0	0	0	1	6 1.20%
	35-49	2	0	0	0	0	0	2 0.40%
	50+	3	0	0	0	0	0	3 0.60%
	TOTAL	312 62.18%	44 8.78%	18 3.59%	80 15.97%	10 2.00%	37 7.39%	501 100.00%

* 'DEATH' describes the outcome measured in this study and as such this column indicates the uncensored information.

Figure 11. Distribution of ages at first recorded event for newcomers to Mamre

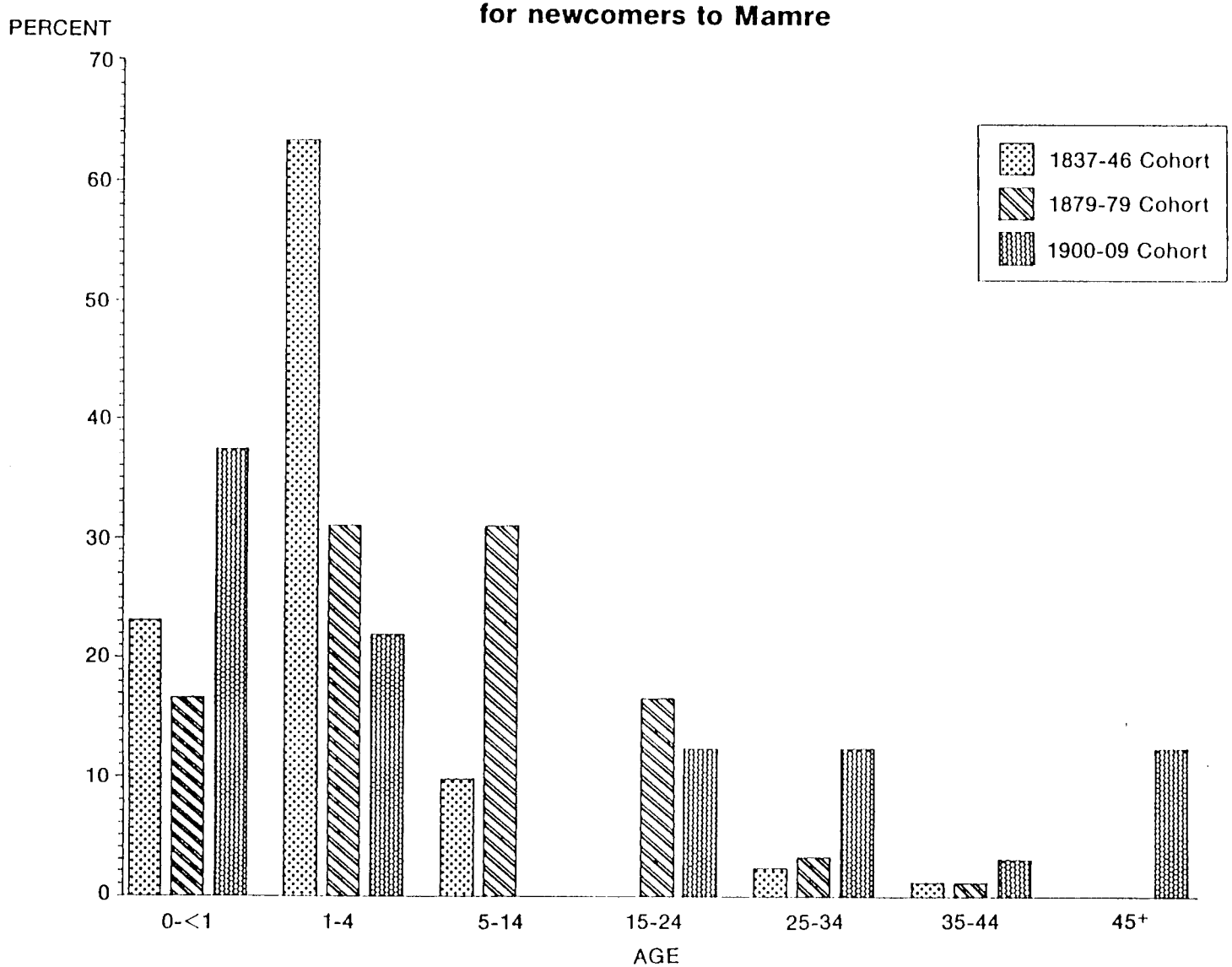


Figure 12. Distribution of ages of last recorded event for individuals lost to followup

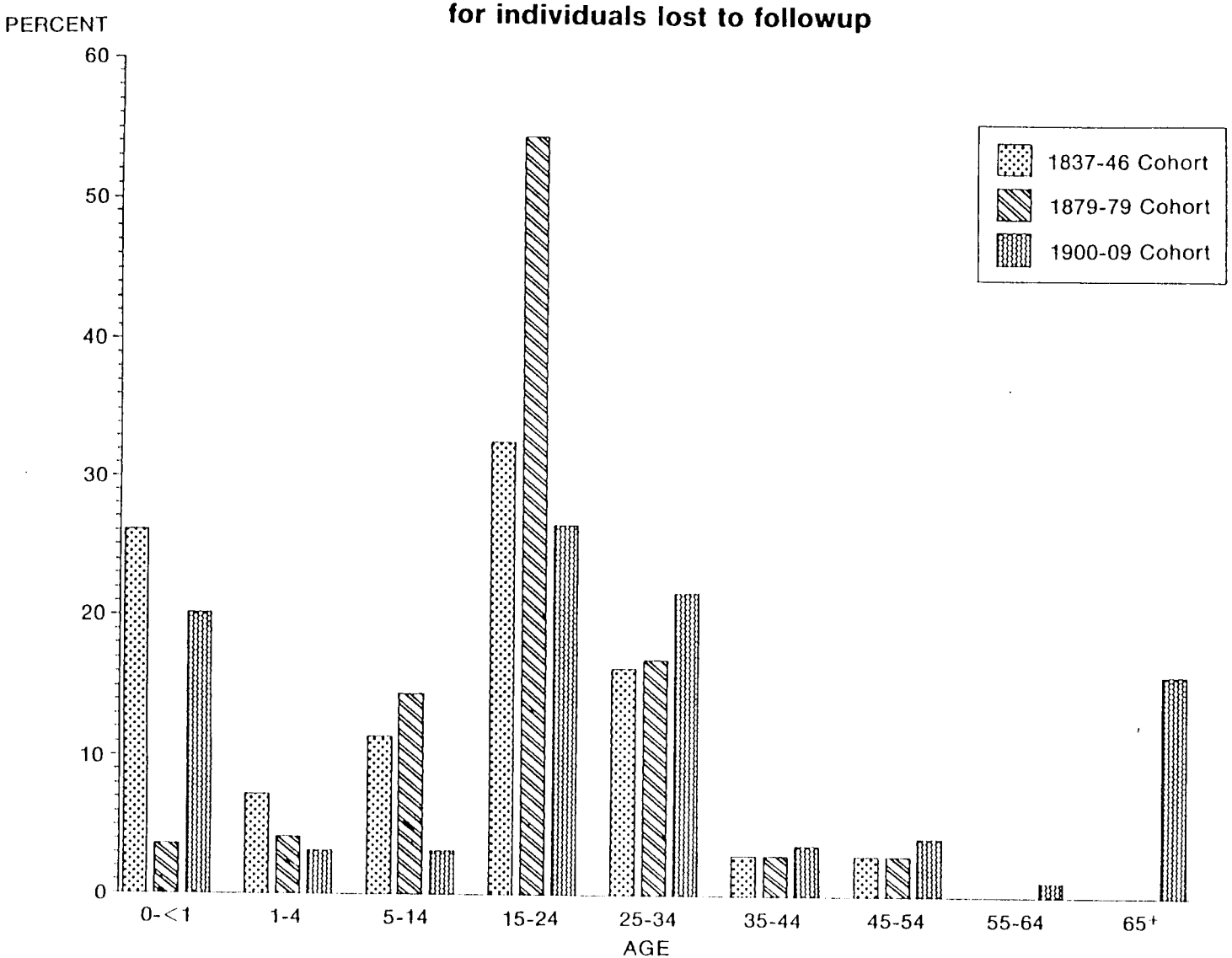


Table 9 gives the frequency of events for which the last recorded date was available.

5.2.3 Mortality information

(a) **Sources of dates of death**

Death information was available for 333 (66.9%), 427 (72.0%) and 312 (72.3%) individuals from the earliest, middle and latest cohorts respectively. Figure 13 illustrates the contributions of three different data sources. In the 1837 to 1846 cohort, the baptismal register provided 91.9 per cent of the death information, confirming the rationale for changing the starting time of the first cohort from 1830 to 1837 so as to make full use of this source. The Casualis and the Baptismal Books have similar contributions in the second cohort. The former was more complete in its registration of infant deaths. Death lists and burial orders, available from 1937, provided death information for older individuals. While the Baptismal Register was the single most useful source of death information for the 1900 to 1909 cohort, it provided only 58.7 per cent only of the information on deaths. In this cohort, very little overlap occurred between sources, compared to the other cohorts.

(b) **Infant deaths**

A closer look at the infant deaths in each cohort (including newcomers) provides some insight into the extent to which infant deaths were reported.

TABLE 9

FREQUENCIES OF TYPES OF LAST RECORDED EVENT FOR THE 1837-1846, 1870-1879 AND 1900-1909 COHORTS

Type of event	1837-1846 (n = 498)	1870-1879 (n = 593)	1900-1909 (n = 501)
Death	333(66.9%)	427(72.0%)	312(62.3%)
Baptism	53(10.64%)	11(1.9%)	48(9.6%)
Opname/Confirmation	19(3.80%)	23(3.9%)	13(2.6%)
Nagmaal	24(4.8%)	12(2.0%)	22(4.4%)
Marriage	6(1.2%)	22(3.7%)	34(6.8%)
Suspension/Readmission	8(1.6%)	14(2.4%)	28(5.6%)
Departure	49(9.8%)	66(11.1%)	2(0.4%)
Other	6(1.2%)	13(2.2%)	42(8.4%)

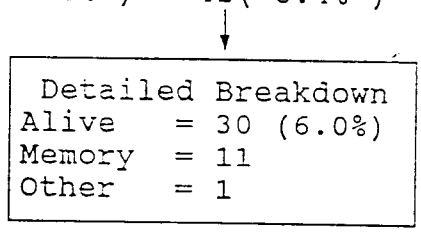
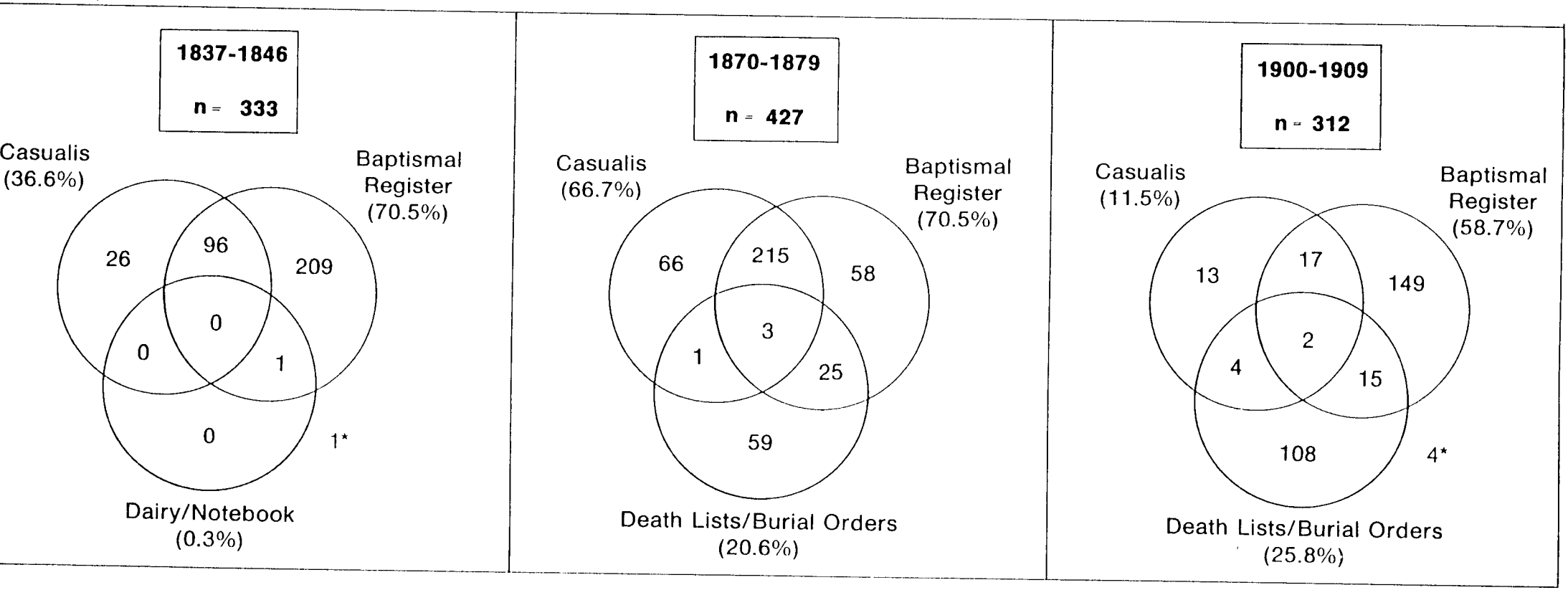


Figure 13.
Sources of death dates for the 1837-46, 1870-79 and 1900-09 Mamre cohorts



*available from other sources

- **Sex Ratios at Death:** The ratio of male infant deaths to female infant deaths for the earliest, middle and latest cohorts were 1.62, 1.34 and 1.55 respectively (Table 10).

- **Unbaptised Infant Deaths** : Deaths of unbaptised infants are rare in this dataset, as the sources usually only record births (and subsequent deaths) if baptism occurred. Most available mortality information concerning unbaptised infants did not provide a date of birth and could thus not be used in the analysis.

  Only one unbaptised infant death in each of the earliest and latest cohorts appears in the dataset (Table 10). However, 13 of the deaths of the middle cohort, comprising 14.3 per cent of infant deaths from that cohort, were of unbaptised infants. The source of these infant deaths was the Casualis Book, which recorded the information despite the infant not having been baptised.

- **'Emergency Baptisms':** In children born between 1837 and 1846, 33 out of 68 infant deaths (48.5%) occurred after emergency baptisms. 20 out of 78 (25.6%) of the 1870s cohort were emergency baptisms compared to 15 out of 51 (29.4%) of the 1900 to 1909 cohort (Table 10). Emergency baptisms were consistently performed more frequently on boys than girls, the sex ratios being 1.54, 2.33 and 2.0 for the 1837-46, 1870-79 and 1900-1909 cohorts.

TABLE 10

CHARACTERISTICS OF MAMRE-BORN INFANT DEATHS

Cohort	1837-1846	1870-1879	1900-1909
Number	68	91	51
Gender Ratio	1.62	1.34	1.55
Unbaptised	1	13	1
'Emergency Baptisms'	33 (48.5%)*	20 (25.6%)*	15 (29.5%)*

* Percentage 'emergency baptisms' of total infant deaths

5.3 MORTALITY DATA

5.3.1 Infant mortality rates (IMR)

Male and female infant mortality rates were calculated for each of the three cohorts. (Tables 11 and 12). Male IMRs were 196, 182 and 128 per 1 000 live births for the 1837-46, 1870-79 and 1900-1909 cohorts respectively. These results suggest a fall in the rates between the earliest and latest cohorts, but the overlap of the confidence limits indicates that differences were not statistically significant.

For females, the IMRs for the three cohorts were 160, 172 and 97 per 1 000 respectively, showing no clear trend in the IMR with time.

5.3.2 Quinquennial mortality rates

Quinquennial mortality rates for males and females are shown graphically in Figures 14 and 15 respectively. (The observed values were graduated graphically to remove the effect of random fluctuations for comparative purposes.) Tabled quinquennial mortality rates for males and females can be found in Appendices 5 and 6. Figures 16 and 17 show the approximate upper and lower 95 per cent confidence limits for each quinquennial estimate for the three cohorts. The shaded area indicates the area of overlap between confidence limits, indicating that differences were not statistically significant. Appendix 7 provides the numeric values of the upper and lower confidence limits.

TABLE 11

MALE INFANT MORTALITY RATES FOR THE 1836-47, 1870-79 AND 1900-09 MAMRE COHORTS
(infant deaths per 1 000 livebirths)

COHORT	INFANT MORTALITY RATE	95% CONFIDENCE LIMITS
1836-47	196	(142;250)
1870-79	182	(136;228)
1900-09	128	(85;171)

TABLE 12

FEMALE INFANT MORTALITY RATES FOR THE 1836-47, 1870-79 AND 1900-09 MAMRE COHORTS
(Infant deaths per 1 000 livebirths)

COHORT	INFANT MORTALITY RATE	95% CONFIDENCE LIMITS
1836-47	160	(104;216)
1870-79	172	(122;222)
1900-09	97	(56;138)

Figure 14

MALES
Quinquennial mortality rates

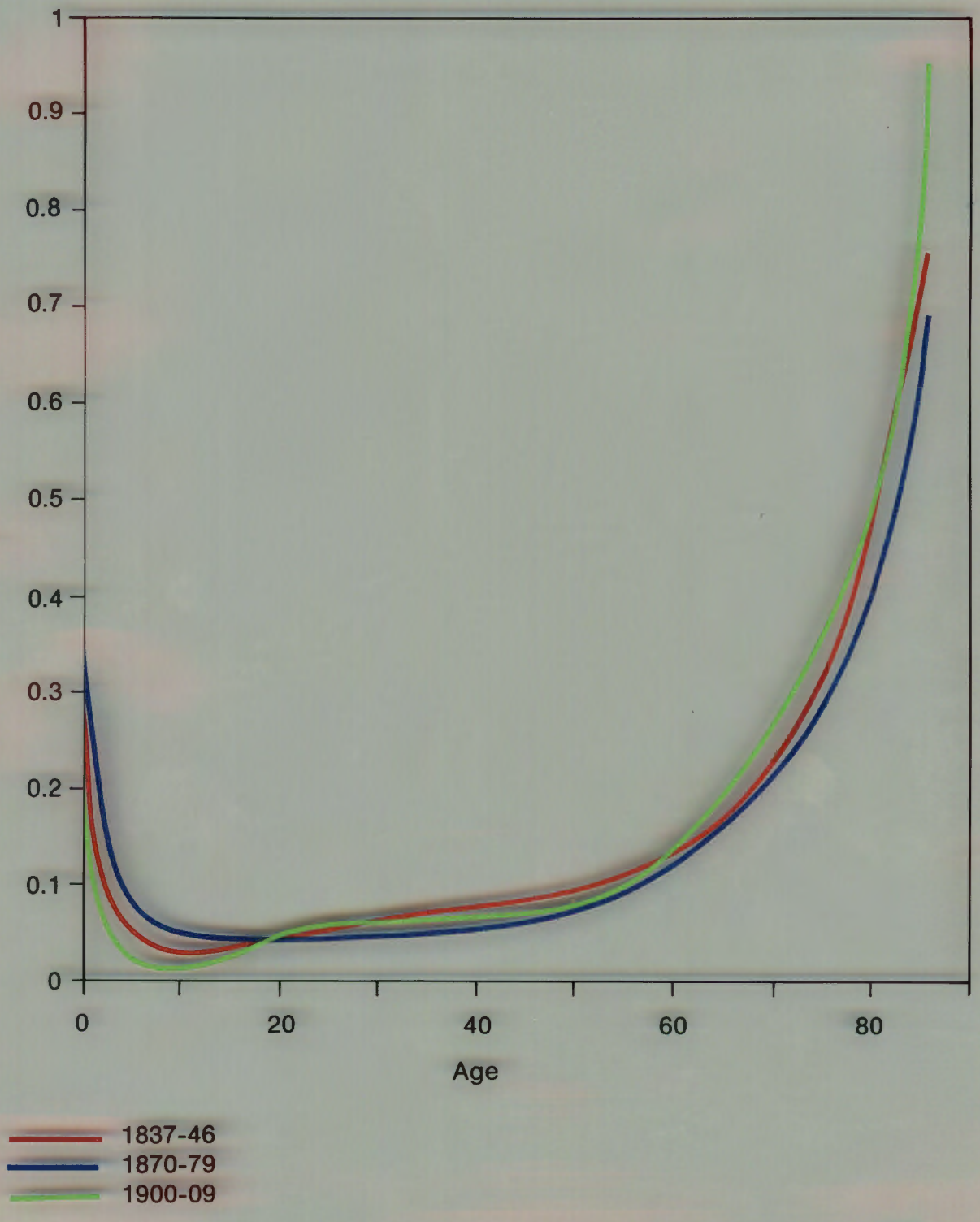


Figure 15

FEMALES
Quinquennial mortality rates

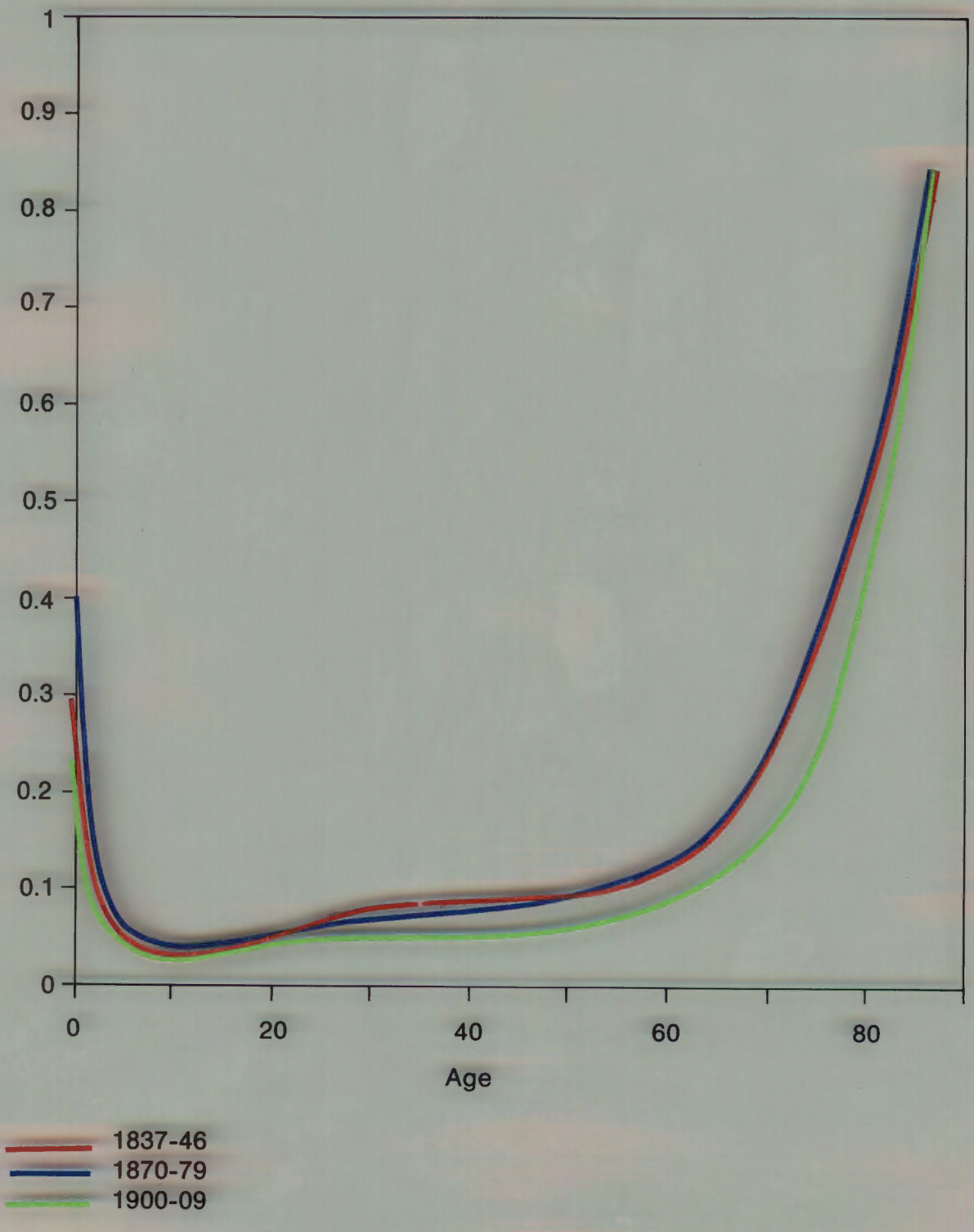


Figure 16. Upper and lower 95% confidence limits for quinquennial mortality rates (males)

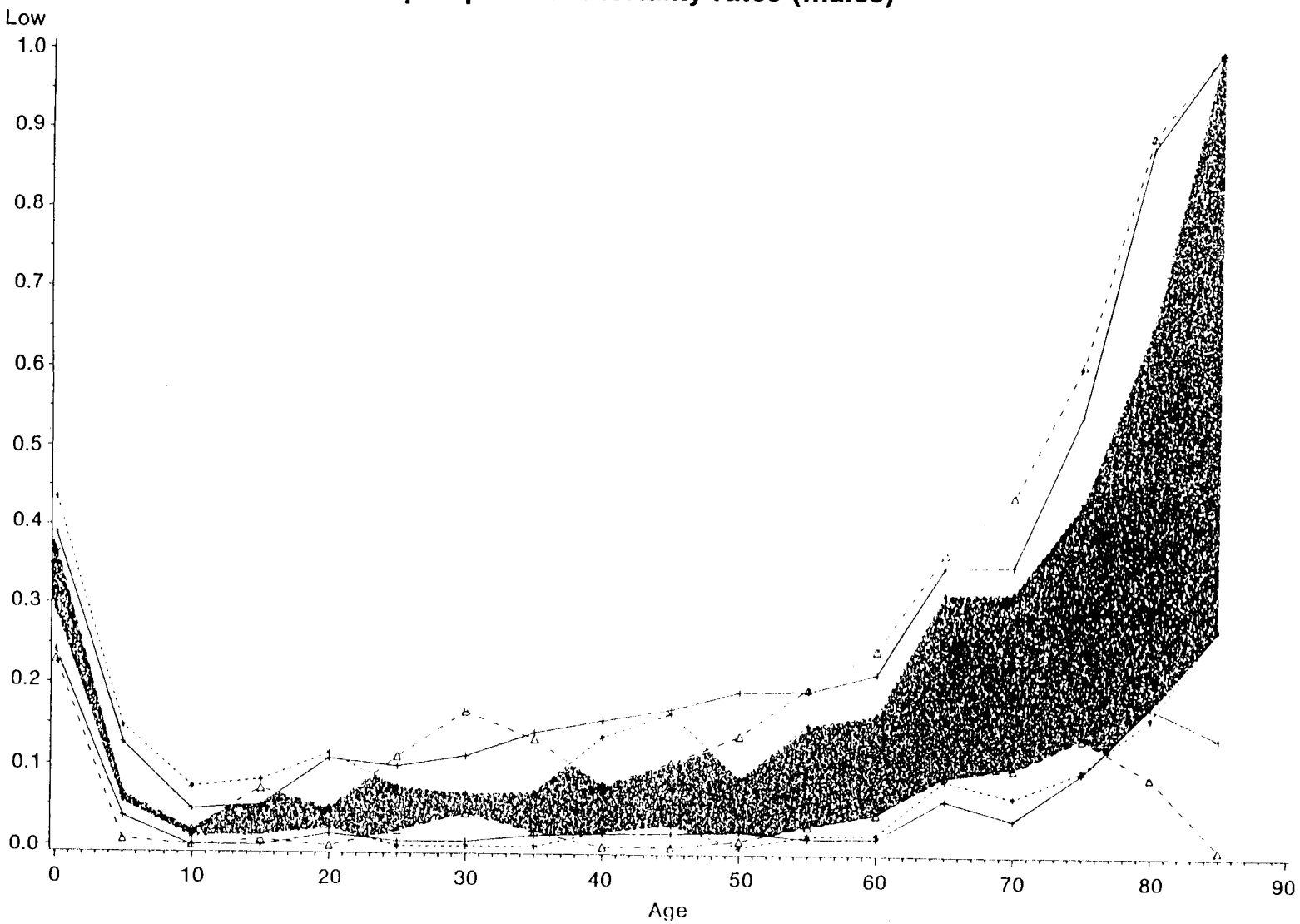
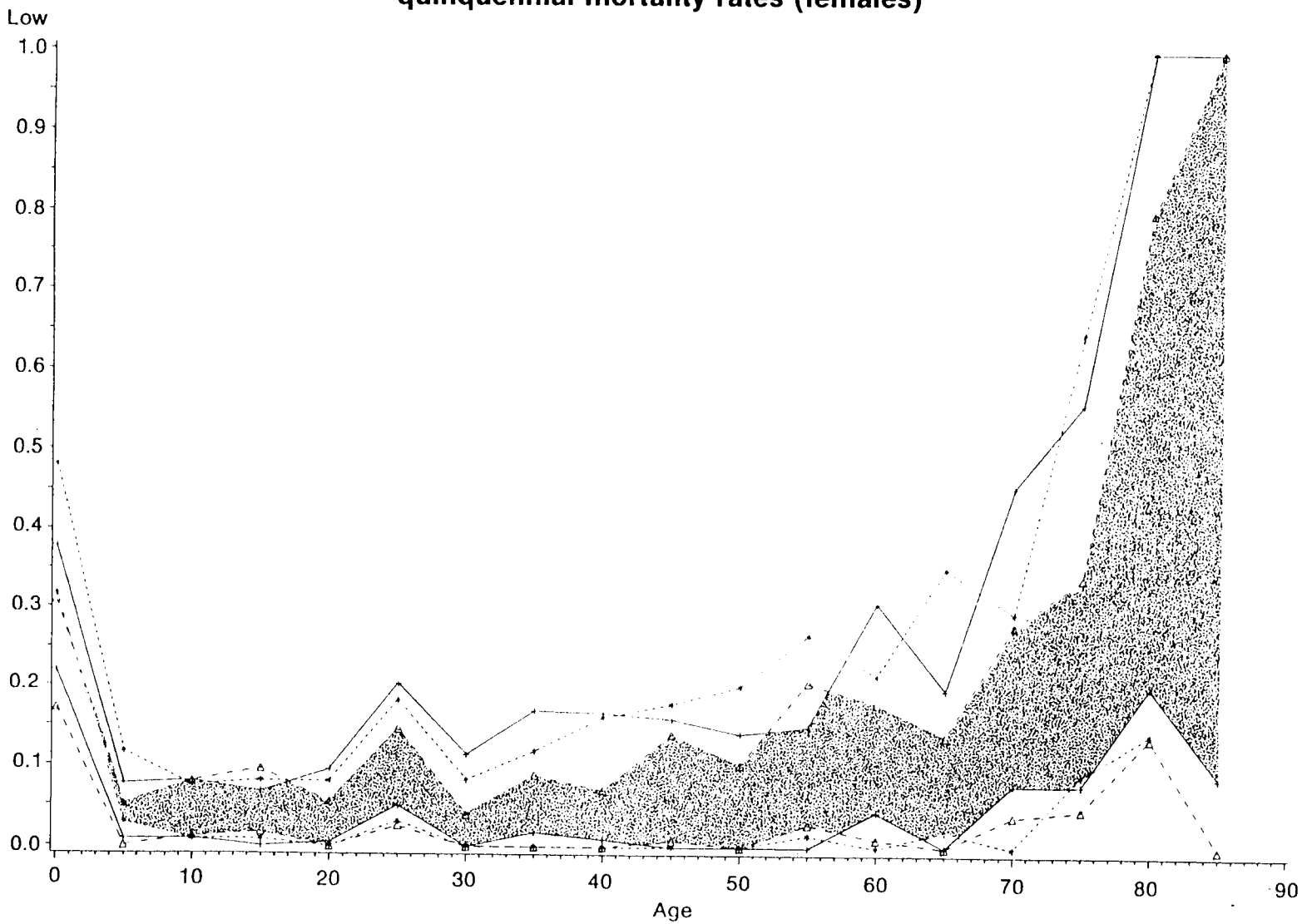


Figure 17. Upper and lower 95% confidence limits for quinquennial mortality rates (females)



The mortality curves have a classic J-shape, with relatively high infant mortality rates and rapidly declining mortality between the ages 1 to 5. From the age of 10, there is a gradual increase in mortality which progresses more rapidly after the age of 40. Consistent deviations from this classic pattern are the high female mortality rates for the 25 to 29 year age groups of all three cohorts, and the low rates for 30 to 34 year females, creating unusual 'bumps' in the three females curves. These can be seen clearly on the quinquennial mortality tables as well as on the graphs of the confidence limits.

The 1900-09 female mortality rates in the 40 and older age group are substantially lower than those of the other cohorts.

5.3.3 Life expectancy

Male and female life expectancies and their confidence limits at birth, age one and age 20 for the three Mamre cohorts, can be seen in Tables 13 and 14. The data from which these were calculated (deaths and person-year exposures for each age group) are tabled in Appendix 7.

- **At Birth :** The male life expectancies at birth for the three cohorts were 36.02, 34.48 and 39.94 for the 1837-46, 1870-79 and 1900-09 cohorts respectively, indicating no secular trend.

TABLE 13

LIFE EXPECTANCY IN MALES: MAMRE 1837-1846, 1870 AND 1900-1909

	1837-1846		1870-1879		1900-1909	
	Point Est	95% Confidence Interval	Point Est	95% Confidence Interval	Point Est	95% Confidence Interval
$\overset{0}{e}_0$	36.02	(30.23;41.80)	34.48	(29.14;39.82)	39.84	(34.60;45.08)
$\overset{0}{e}_1$	43.74	(38.49;48.99)	41.15	(36.18;46.12)	44.65	(39.84;49.54)
$\overset{0}{e}_{20}$	38.95	(34.92;42.98)	43.22	(39.80;46.64)	39.94	(36.36;43.53)

TABLE 14

LIFE EXPECTANCY IN FEMALES: MAMRE 1837-1846, 1870 AND 1900-1909

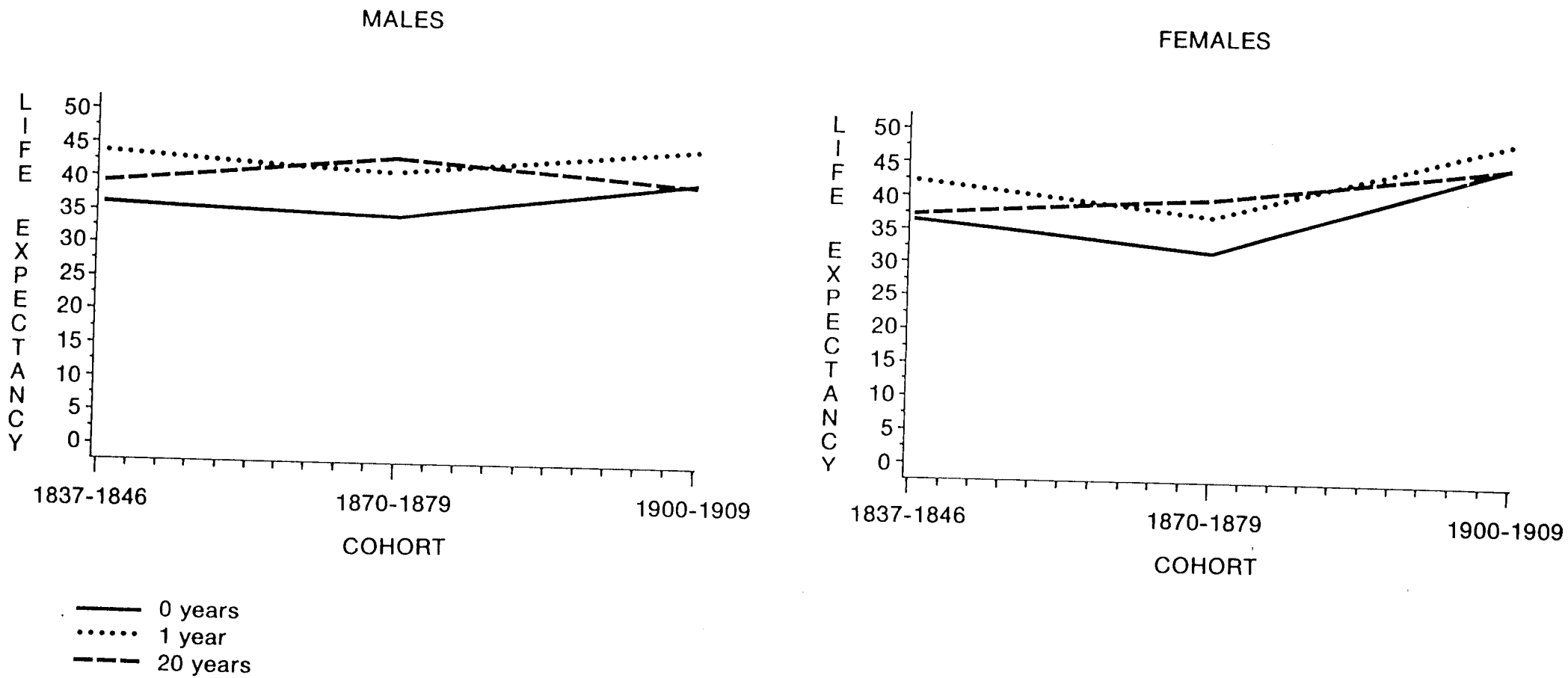
	1837-1846		1870-1879		1900-1909	
	Point Est	95% Confidence Interval	Point Est	95% Confidence Interval	Point Est	95% Confidence Interval
$\overset{0}{e}_0$	36.33	(29.97;42.69)	31.92	(25.50:38.34)	45.12	(39.18;51.06)
$\overset{0}{e}_1$	42.21	(36.33;48.10)	37.49	(31.36;43.61)	48.94	(43.37;54.52)
$\overset{0}{e}_{20}$	37.34	(32.68;41.99)	39.82	(35.01;33.63)	45.25	(41.19;49.31)

Among females, the life expectancies at birth were 36.33, 31.92 and 45.60 for the three cohorts, also showing no secular trend. The figure for the 1870-1879 cohort is low compared to the males of that cohort as well as the females of the other two cohorts. The converse is true for the 1900-1909 females, where the figure is high relative to male and other female figures, although the difference was not statistically significant.

- **At Age One :** As expected, all life expectancies at age one were higher than expectancies at birth. The male figures were 43.74, 41.15 and 44.80 for the 1837-46, 1870-79 and 1900-09 cohorts. The female figures were 42.21, 37.49 and 49.47 respectively. Neither sex showed a secular trend. The 1870-79 cohort had the lowest figures for both sexes.

- **At Age Twenty :** Table 13 and 14 show the life expectancies at age 20 for males and females for the three Mamre historical cohorts. The 1837-46, 1870-79 and 1900-09 male figures, being 38.95, 43.22 and 40.09, show no trend with time. The middle cohort had the highest life expectancy. This is in contrast to the female figures - 37.34, 39.82 and 45.96 - which increased over time, although the trend was not statistically significant.

Figure 18. Life expectancy at ages 0,1 and 20 of the 1837-46, 1870-79 and 1900-1909 Mamre cohorts (males and females)



CHAPTER 6

DISCUSSION

Summary

The limitations in the quality of the data are typical of historical-demographic studies, and need to be taken into account when interpreting the results. IMRs, while probably overestimates, are substantially lower than that of 'Coloureds' in the Cape Colony at the time. The quinquennial mortality rates from the 3 Mamre cohorts and the SALT (1937-39) 'Coloured' figures contrast sharply with modern figures. The three cohorts had higher life expectancies than 'Coloureds' in the colony (1891-1904).

The lower over-all burden of mortality experienced by Mamre dwellers was probably due to their relatively privileged socio-economic circumstances compared to other 'Coloured' people at the Cape. The causes of death probably did not differ substantially from other groups.

6.1 QUALITY OF THE DATA

Quantitative historical analyses are dependent on both the availability and quality of historical sources of data. In this study, multiple sources were identified and used, with some overlap occurring between sources.

Sources of birth and death data differed in type and quality between cohorts, indicating changes in registration conventions over time.

The sex ratios consistently showed preferential registration of boys above girls for births and infant deaths in all three cohorts. Even when including individuals for whom no information other than birth details were available, the sex ratios at birth did not change substantially.

The increasing median birth-baptismal interval between the earliest and latest cohorts from, 31 to 62 days for males and 34 to 53 days for females, probably led to an increasing proportion of infant deaths being missed due to delayed baptism. Since the least delayed birth registration occurred in the 1837-46 period, can be assumed that this cohort probably had the least biased registration.

The comparatively high percentage of males relative to females baptised in the first 20 days again points to preferential early male registration. Interestingly, for all three cohorts, female and male registration rates were similar (between 3 and 7 weeks), with late (3 months and more) registration being more common for males. The practice of baptising children over the age of 3 months increased between the earliest and latest cohorts.

Assuming a crude birth rate of 47 per 1 000, the three cohorts showed a shortfall of between 10 per cent and 15 per cent of expected births, with the 1837-46 and 1900-09 cohorts apparently having the most complete registration. The third cohort seems to have been particularly well registered, especially if the unused data is taken into

account. The apparent excess of infants registered in the official registers is probably due to the registration in Mamre of infants coming from surrounding farms.

The greatest effort to baptise dying infants was made in the 1837-46 cohort, where almost half of the infant deaths were 'emergency baptised'. In the 1870-79 cohort, the registration of unbaptised infants who died only partly compensates for delayed baptism and the relatively low 'emergency baptism' rate. The greater number of deceased male infants compared to females reflects both the more complete reporting of male births and deaths, as well as the well-documented higher risk of infant deaths among males (some 13 per cent higher according to the South African Life Tables, 1935-71).

An investigation(75) into applying the Bourgeous-Pichat method of separating the endogenous and exogenous components of infant mortality, described in Chapter 1, showed the 1837-46 cohort to have had the most complete birth registration. Taking into account the data which included individuals assumed to have died but for whom no dates of death were available, it appeared that a proportion of the deaths in the first cohort must have been still-births. The inclusion of these individuals improved the extent of registration coverage for the first and third cohorts, although they were excluded from the analysis in this thesis.

The very high proportion of newcomers in the 0 to 4-year age-group belonging to the first cohort reflects the large influx of ex-slaves and their children to Mamre in the 1838-43 period (see Table 2). In addition, the relatively high proportion of last events recorded for this cohort in

the same age group shows that much in and out migration occurred in Mamre at that time.

While the 1837-46 cohort had the highest proportion of individuals not followed to death, this does not indicate lack of conscientiousness in record keeping by the priest. Rather, it again points to a community in flux. The 1870-79 cohort had the highest proportion that were traced to death. Significant issues arising from individuals lost to follow-up in this cohort were the low proportion of last recorded events being baptisms (showing that few people left the community before confirmation), and the high proportion of last recorded events being departures. The latter reflects the trend for young adults to leave Mamre for economic reasons which led to the drop in population size, as shown in Figure 5.

Further investigation[75] suggested bias due to an underestimation of time spent in Mamre of individuals in certain age groups. For individuals who are not followed up to their deaths, the last recorded date should ideally be as close to a date of departure from Mamre as possible. Anyone who remained in Mamre beyond the last recorded date would not have exposure time recorded for the full duration of their stay in Mamre. The effect of this would be an overestimate of the mortality rate. The underestimation of exposure time was found to be fairly substantial in the 0 to 5 year age group, but not so in the 20 to 30 year age group.

Mortality information from church records were most complete for the 1837-46 cohort. Secular records, while making a contribution to the 1870-79 cohort, show moderate overlap with church records, especially for individuals

who died at a later age. The limited overlap of mortality information between sources for the 1900-09 cohort indicates that there was little co-ordination of registration over the lifespan of these individuals, especially after the 1930s when the village officially ceased to be a mission village.

Given the limitations in the quality of the data, it is important to decide whether they seriously compromise the results of this study. When comparing the quality of data used in a number of historical demographic studies, the completeness of the information concerning individuals in family reconstitution studies is excellent.[6] This is due to the fact that strict criteria must be met for subjects to be included in such studies. However, the overall representativeness of the data is not necessarily good (sex ratios often show preferential inclusion of males), and the methodology is not suitable for mortality analyses.

The study most similar in design to this investigation is that determining the life expectancy of the Knights of the Golden Fleece[9]. Even though the problem of non-registration of infant deaths was not a concern in the study (age of entry was 25 years), only 1 041 of the 1 282 knights could be included in the analyses due to missing data. Contrary to the Mamre study as well as to Anglican parish sources[6], data completeness improved with time for the knights.

With the exception of family reconstitution studies, the study of infant deaths in the Lebanese Armenian community used data sources most similar to the Mamre study. Due to the compulsory nature of baptism before burial/death, the

representativeness of death registration was probably excellent. However, the age at death was not recorded in months (for example, an 18 month old child would be recorded as being 1 year old), thus inflating the infant mortality rate. Given these limitations, the authors comment on trends rather than actual values.(12)

From the above comments, it can be seen that almost no historical dataset provides completely accurate and representative data. Each source or approach has strengths and weaknesses, and estimates are reported keeping these limitations in mind.

6.2 MORTALITY DATA

6.2.1 Infant mortality rates

Registration coverage is the key issue upon which the validity of IMRs depends. With the investigations into the quality of the data indicating underregistration of infant deaths in general and females in particular, IMRs calculated in this study must be viewed with caution.

The IMRs for the males in the 1837-46 and 1900-09 cohorts, and for females in the 1900-09 cohort could be expected to give the most reliable results. IMRs for the 1870-79 cohort were the least reliable, with the ratio of the male/female infant mortality rates being lower for this cohort than the other two cohorts.

The fall in the IMRs for males over the period, while not statistically significant, may indicate a real

downward trend. The female figures, however, are biased and should not be interpreted further.

Further investigation[75], making use of additional information not used in this study, yielded higher IMRs. These IMRs appear in Table 15 for comparative purposes, and indicate a downward trend for males and females over the period. Table 15 also presents other South African IMRs, as well as a figure for Western Europe in the 17th and 18th centuries.

These comparative figures provide further evidence of underestimates in the Mamre IMRs. The South African 'coloured' IMR for 1935-37 appears to be of the same order as that of the 1837-46 Mamre cohort, and substantially higher than the IMR of the 1900-09 cohort. This is obviously unlikely, which suggests that the adjusted figures may be more reasonable estimates.

In comparison with Mamre's adjusted and unadjusted infant mortality rates, the pre-1820 figure for South African 'whites' is extremely low (possibly an underestimate). Mamre figures lie between Simkins's IMR's for 'whites' and 'other coloureds' in the Cape Colony over the 1891-1904 period. Mamre infant mortality rates in the 1837-46 period seem to be approximately of the same order as the figure for Western Europe in the 17th and 18th centuries.

These comparative figures suggest that infant mortality in Mamre between 1837 and 1909 was substantially lower than that experienced by

TABLE 15

A COMPARISON OF SELECTED INFANT MORTALITY RATES FOR DIFFERENT GROUPS, REGIONS AND TIMES

		Infant Mortality Rates		
		Males	Females	Combined
Mamre cohorts	1837-1846	196	160	
	1870-1879	182	172	
	1900-1909	128	97	
Mamre Cohorts[75] (adjusted)	1837-1846	211	191	
	1870-1879	182	170	
	1900-1909	176	156	
'Whites', South-Africa[15]	pre-1820			110
'Whites', South Africa[17]	1891-1904			150
'Other Coloureds',Cape Colony[17]	1891-1904			294
'Coloureds',South-Africa[69]	1935-1937	184	163	
'Coloureds',South-Africa[69]	1984-1986	51	45	
Mamre[5]	1981-1987			24
Western Europe[76]	17th and 18th centuries			212

'coloureds' nationally, but substantially higher than that experienced by South African 'whites'.

6.2.2 Quinquennial mortality rates

On the basis of the data analysed in this study, there appears to be little evidence of any secular change in mortality for the three Mamre cohorts. Although some interesting trends do emerge, differences do not reach statistical significance and should be interpreted with caution.

For the purposes of comparing mortality patterns, Tables 16 and 17 provide quinquennial mortality rates from this study as well as from the 1935-37 and 1979-81 South African Life Tables (SALT).

As discussed earlier, the infant mortality rates and early childhood mortality rates found in this study were respectively underestimated and overestimated. This issue must be kept in mind when studying the mortality curves where the intercepts with the Y-axis are lowered by the biases in mortality rates in the 0 to 5 year age group.

The mortality patterns from the three Mamre cohorts show remarkable agreement with each other and with the mortality figures in the 1935-37 SALT.

The highest risks of death relative to modern figures were in the under 10 year age group (in particular the 6 to 10 year group) for males and females. In the teenage and young adult years, the female risk of

TABLE 16

A COMPARISON OF MALE QUINQUENNIAL MORTALITY RATES FOR MAMRE AND 'NATIONAL' COLOUREDS: HISTORICAL AND PRESENT-DAY

Age	Mamre 1837-46	Mamre 1870-79	Mamre 1900-09	SA 'Coloureds' 1935-37	SA 'Coloureds' 1984-86
0	0.316	0.364	0.300	0.277	0.068
5	0.082	0.101	0.036	0.028	0.005
10	0.021	0.041	0.006	0.022	0.003
15	0.023	0.047	0.039	0.033	0.012
20	0.061	0.069	0.022	0.043	0.022
25	0.052	0.037	0.065	0.048	0.027
30	0.059	0.030	0.103	0.055	0.029
35	0.078	0.032	0.076	0.067	0.037
40	0.086	0.077	0.036	0.079	0.050
45	0.094	0.096	0.052	0.093	0.071
50	0.106	0.040	0.073	0.109	0.101
55	0.102	0.083	0.112	0.139	0.140
60	0.114	0.091	0.143	0.185	0.188
65	0.205	0.201	0.229	0.234	0.248
70	0.194	0.191	0.270	0.297	0.319
75	0.320	0.265	0.372	0.388	0.391
80	0.529	0.407	0.493	0.496	0.441
85	0.750	0.688	0.960	0.588	0.582
90	0.769	0.800	1.000		

TABLE 17

A COMPARISON OF FEMALE QUINQUENNIAL MORTALITY RATES FOR MAMRE AND NATIONAL 'COLOUREDS': HISTORICAL AND PRESENT-DAY

Age	Mamre 1837-46	Mamre 1870-79	Mamre 1900-09	SA 'Co-lourdes' 1935-37	SA 'Co-loureds' 1984-86
0	0.298	0.399	0.240	0.260	0.060
5	0.042	0.073	0.026	0.031	0.004
10	0.045	0.042	0.046	0.026	0.003
15	0.034	0.045	0.057	0.041	0.005
20	0.051	0.041	0.026	0.055	0.008
25	0.127	0.107	0.086	0.059	0.011
30	0.057	0.034	0.013	0.060	0.015
35	0.093	0.055	0.041	0.066	0.021
40	0.087	0.081	0.029	0.071	0.032
45	0.079	0.089	0.074	0.077	0.045
50	0.065	0.100	0.048	0.097	0.062
55	0.070	0.141	0.117	0.125	0.086
60	0.175	0.100	0.095	0.165	0.116
65	0.091	0.185	0.064	0.212	0.155
70	0.267	0.136	0.159	0.272	0.223
75	0.318	0.368	0.193	0.348	0.286
80	0.600	0.583	0.468	0.444	0.362
85	0.833	0.000	0.819	0.528	0.541

dying has reduced more substantially in modern times than did that of males.

The reason for the unusual pattern of female mortality rates in the 25 to 35 year age range (that is, high $_5q_{25}$ and low $_5q_{30}$) found in each cohort is unclear. The median age at first marriage for females for the 1837-46, 1870-79 and 1900-09 cohorts were 25.8, 24.1 and 23.4 years respectively. Thus maternal mortality, especially of those women who were having their first child, could provide some plausible explanation for the high $_5q_{25}$. However, this explanation does not address the substantial drop in mortality rates in the 30 to 34 year age group.

Bias in the methodology used for data collection could partially explain this finding in that women who in reality, contributed to the exposure by still living in Mamre, may not have been included in the person-year denominator because the last known date was at an earlier age. The effect of this would be to increase the estimate of the mortality rate in that age group.

Conversely, women whose last known date was much later in life, may have spent time away from Mamre but were incorrectly assumed to have contributed to the exposure time in age groups when they were in fact away. This may explain the low mortality rate in the above 30 year age group, in general. However, the fact that that particular age group was affected to such an extent in all three cohorts is still unexplained. A further explanation for this anomaly in the absence of alternative explanations is that these deviations are a result of random variation.

Thus the deviations are not shown on the graduated curves for the three cohorts.

Lower mortality rates in women in the 30 and older age groups of the third cohort may reflect a real difference in mortality rates in the older ages from the 1950s onwards (when this cohort was 30 and older) when the benefits of improved environmental conditions and medical science (not necessarily medical care) could have been felt. While this finding was not statistically significant, it is similar to the trend of improving mortality exhibited in the national female rates[69].

Male mortality in the 50 to 70 year age group, while showing minor variation (assumed to be random) between the three Mamre cohorts, is substantially higher for 'coloured' males nationally in 1935-37 than for men born in the three historic Mamre cohorts. Thus it seems probable that older Mamre males had a lower mortality over the 1837-1909 period than 'coloured' males nationally in 1935-37.

Male rates for the third cohort in the over 30 year age group were substantially higher than the female rates, reflecting a similar pattern as found in the national figures.

6.2.3 Life expectancy

Not surprisingly, the life expectancies reflect the trends found in the quinquennial mortality rates. The male and female life expectancies at birth, age 1 and age 20 for the three Mamre cohorts showed no time trend (except for the life expectancy at age 20 for

females) and were not found to be significantly different. However, all life expectancies, except for that at age 20 for males, were highest for the 1900-09 cohort.

In this study, the figures for life expectancy at birth are probably less reliable than the other life expectancy figures because of the underestimates of the infant mortality rates. Thus, even though the life expectancies for males and females in the 1870-79 cohort are consistently lower than those for the other cohorts, the underestimate of the IMR, worst for this cohort, explains these lower figures. Differences were more pronounced in the females, where biased non-registration was the greatest.

The increasing trend in the female life expectancy at age 20 over the period reflects the trend of an increasing life expectancy at all ages for women nationally.

When comparing life expectancy for males and females, similar figures were found for the 1837-46 cohort. For the 1870-79 cohort, male figures were consistently higher than females, while this pattern was reversed for the 1900-09 cohort. The 1870-79 pattern was highly unusual as female figures tend to be reported in the literature as being at least equal to, and often higher than, male figures. Thus the 1870-79 pattern is probably due to random fluctuation.

Table 18 provides comparative life expectancy figures from European and South African populations at different points in time.

TABLE 18

A COMPARISON OF SELECTED LIFE EXPECTANCIES FOR DIFFERENT COUNTRIES/REGIONS AND HISTORICAL TIME PERIODS

	^0e		$^0e_1$		$^0e_{20}$	
	M	F	M	F	M	F
Western Europe 1840[71]	39.6	42.5				
Western Europe 1900[71]	48.9	52.1				
England 1426-1456[73]	32.96	-				
England and Wales 1861[72]	40.47	43.09	48.15	49.18	40.20	41.50
'Whites' South Africa pre-1820[15]	42.56	46.06			40.22	39.37
Other 'coloured' Cape Colony 1891-1904 [17]	28.1	30.5				
'Coloureds' South Africa 1935-1937[17]	40.18	40.86	48.14	47.74	38.78	39.13
'Coloureds' South Africa 1984-1986[69]	57.92	65.52	60.02	67.62	43.02	50.32
Mamre 1837-1846	36.02	36.33	43.74	42.21	38.95	37.34
1870-1879	34.48	31.92	41.15	37.49	43.32	39.82
1900-1909	39.94	45.12	44.65	48.94	39.94	45.25
Mamre 1981-1987*	63-64	71-72				

* Dorrington R. Personal Communication

The life expectancy at birth for the 1900-09 cohort was similar to that in Western Europe (1840), England and Wales (1861) and among South African 'coloured' males (1935-37). The earlier cohorts had figures lower than these but substantially above England (1426-56). All Mamre cohorts had much higher life expectancies at birth than 'other coloureds' in the Cape Colony (1891-1904). The pattern of life expectancy at age 1 is similar to that described above. A substantial increase in life expectancy at age one was evident between historical Mamre and 'coloured' 1935-37 figures on the one hand, and present day Mamre and 'coloured' national figures on the other.

Except for females in the last cohort, the life expectancy at age 20 was of the same order for historical Mamre, England and Wales (1861), South African 'coloureds' (1935-37) and South African 'whites' (pre-1820). Modern figures show a substantial increase in life expectancy for adult women which is not evident for men.

In summary, the life expectancies in the three cohorts are remarkably similar although the third cohort consistently has somewhat higher figures. Life expectancies in historical Mamre were probably similar to those in Western Europe a century earlier, and substantially higher than those of 'coloureds' at the turn of the century. Life expectancies for women in the last cohort are higher than the South African 1935-37 figures. The higher expectation of life at birth in Mamre when compared to the general 'coloured' population, continues to the present day.

6.3 HISTORICAL INTERPRETATION

The substantially higher life expectancy found for Mamre residents compared with other 'coloured' people in the period under consideration is hardly surprising. In the first half-century after the emancipation of slaves, Mamre dwellers, like most mission residents, were relatively well-off in comparison to other rural people, as a result of their access to land (albeit limited), housing and education.(55) While a number were financially independent as a result of their own farming practices, the majority were casual day-labourers and had the freedom to change their place of work when opportunities for improved wages presented themselves. They were less vulnerable to dependency on farmers and were able to escape many labour abuses commonly found on the farms.(55)

Reports on housing and living conditions in Mamre in the 19th century reflect an image of a clean, well-kept village.(55) The administration of the village was co-ordinated by the church which was motivated to maintain good living conditions for the community. Mamre residents had a community consciousness and fought to maintain the mission as a collective rather than have the land privatised.(55) The relatively healthy living conditions contrasted sharply with the reports on conditions both in the overcrowded urban areas (especially Cape Town)(76,77,78) and on the farms.(55) Water, sanitation and sewage facilities were probably similar to those in present-day rural South Africa, where infant mortality rates are still high due to a high burden of mortality from diseases like diarrhea and other infectious diseases.(41)

Although no information about causes of death was available for the Mamre population, missions and the urban centres probably had similar disease profiles. Urban mortality profiles can thus provide some insights into those on the missions.

Work done by historians at the University of Cape Town provides some indication of the common health problems in Cape Town during the 19th and early 20th centuries.[77,78,79] Between 1915 and 1925, the major causes of non-European deaths in Cape Town were chest illnesses (bronchitis, pneumonia and pleurisy), diarrhea and enteritis, and tuberculosis.[79] In 1945, tuberculosis was the major killer of non-Europeans. The 1975 disease pattern shows cardiac disease, cancer and non-natural events as the major causes of death in this population.[79] The current mortality profile of Cape Town is similar to that found in present-day Mamre[5], further justifying the assumption that Mamre's disease rates in the 19th century were similar (if lower) than those of Cape Town.

The overcrowded and unsanitary conditions in Cape Town encouraged the spread of infectious diseases in general, and epidemics in particular. The labouring classes who lived under the poorest conditions suffered disproportionately. In addition Cape Town, as a port, was vulnerable to imported infectious diseases and served as the entry point for many epidemics: six of small pox in the 19th century[77], and one each of bubonic plague (1900)[80] and Spanish Influenza (1918).[79] Of these, the 1918 'flu epidemic was the most devastating.

The influenza epidemic reached Mamre within days of hitting Cape Town, and affected mainly the 20 to 40 year

old age group.[18] All three cohorts dealt with in this study were only lightly affected by the epidemic, and thus no evidence of 'Black October' can be seen on the three mortality curves.

Maternal mortality rates were very high in Mamre over the period being studied, as shown by the extremely high female mortality rates in the 25 to 30 year age group for all three cohorts. While little is known about the birth practices at the time, it can be assumed that almost all births took place at home and were supervised by traditional midwives. From the 1930s, qualified midwives supervised most homebirths, while clinic and hospital deliveries became almost universal from the 1970s (Nurses Pick, van der Harte and Martin, trained midwives working in Mamre between 1937 and 1986, personal communications). This pattern of improved neonatal services and a resultant drop in maternal mortality (and infant mortality), could partly explain the 10 year increase in life expectancy at age 20 for females nationally between 1937 and 1986.

The burden of maternal mortality probably accounted for a large proportion of female Mamre deaths. Married females tended to work on nearby farms during the season so as to maintain the home and their own fields.[55] Domestic work in the homes of city dwellers was done mainly by young girls and single women. Males tended to be more mobile in terms of their location of work, which often took them far afield.

Alcoholism, with its medical and social consequences, is commonly linked directly and indirectly to poor health among the labouring classes. The farmers' practice of supplying cheap wine to farm labourers as part payment for work done ('dop' system) and as a means of social control,

encouraged alcohol dependence among farm workers, who gradually became more addicted as the years passed. Although alcohol was discouraged at Mamre, alcohol abuse did occur on the mission and was reinforced by the above-mentioned labour practice.[55] Furthermore, Mamre residents who worked in Cape Town were exposed to and often influenced by the drinking patterns associated with the urban lifestyle.[58,60].

Wars could have had a limited impact on the mortality pattern and life expectancy of Mamre residents. According to Simkins [17], the Anglo-Boer War (1899-1902) had limited demographic consequences for 'whites' in the Cape Colony. The greatest impact was probably on African and 'coloured' scouts and transport riders. While a number of Mamre residents were employed as transport riders, mortality among this group was probably low as little evidence appears in the mortality rates of the 1870-79 cohort.

While the long-term demographic effects of the First and Second World Wars were substantial in Europe[81], these had a minimal effect on the population of South Africa in general, and on the population of Mamre in particular. Some Mamre residents were involved in the Second World War, but war casualties were too few to substantially affect the age specific mortality rates.

None of the causes of death discussed above explains the high risk of males and females in the 6 to 10 year old age group relative to modern figures. This age group would have survived the high risk infant and early childhood period, but would not have reached their teens when they could be vulnerable to non-natural events and tuberculosis as causes of death.

6.4 EPIDEMIOLOGICAL ASPECTS OF THE STUDY

Incomplete, unreliable or absent health-related data are problems faced by epidemiologists in many settings. This investigation into Mamre mortality made use of church records at a time when there was not an adequate vital registration system. The utilisation of such unconventional sources does not, however, have a wide application.

The use of data sources not intended for epidemiological purposes presents a number of problems. One of the problems in this study was that not all relevant variables were recorded (for example, cause of death). Data collection was extremely labour-intensive, making this methodology unsuitable for studies of large populations or for the collection of routine population vital events. In addition, the quality of the data is usually unknown before the collection of data, and unreliable and biased data could render the effort a waste. A further problem is that the number of individuals studied in a year is usually too small to monitor sudden changes in risks, thus requiring the accumulation of many years of data, or the combination of data from different areas or communities.

However, alternative sources, besides providing potentially useful data, also point to existing community infrastructure which could be used to collect basic epidemiological information. For example, in communities where official statistics are not routinely collected, churches and other similar bodies, already established in the community and probably recording some of their own information, could co-ordinate the collection of such data. In order for such an effort to be successful, the institution/group should have non-biased access to all

sections of the community, and the duty of recording must be given to a highly literate, conscientious and motivated individual or group who would be present in the community for a number of years.

In many developing countries, a representative sample of communities or parishes could be monitored through non-traditional data sources for use as either demographic rates or as comparative information to validate that obtained by government sources.

The usefulness of labour-intensive data collection efforts is enhanced if the data can be used for a number of purposes. This demands that data capture and access is carefully planned. The collection of variables not directly related to the study is thus more than justified on condition that the information be used at some point, either by the original researcher or by others.

In the case of this study, the data has been made available to the community on request in the form of genealogies which often go back to the 1820s. This facility has been well-received by both the surviving cohort members, and by the offspring of the cohort members. Besides the possibility of using genealogies for the purposes of genetic studies, the study provides temporal continuity of information about the community: in fact, some members of the latest cohort (1900-1909) have been the subjects for a variety of research investigations in the late 1980s. Thus, the results of the study provide insight into the past on both an individual and community level. Additional analyses promise to further describe historical demographic and health trends in the Mamre community.

CONCLUSION

The Mamre Moravian Church records proved to be a detailed and well-kept source of historical demographic data, reflecting the well-organised and cohesive nature of the community during the 1800s. This investigation demonstrates the feasibility and usefulness of micro-demographic studies in stable communities, where the motivation to record ensures the collection of information that is not routinely recorded by the official registration system.

Investigations into the quality of the data revealed biases in the data and ensured more appropriate interpretation of the results. Limitations in the quality of the data were mainly due to the incompleteness of birth registration and follow-up of subjects.

Mamre was characterised by high mortality rates and low life expectancy at birth. Infant and maternal deaths accounted for many of the deaths in the community.

All measures of mortality investigated showed a substantially lower burden of mortality in Mamre than that of 'coloured' people in the Cape Colony at the time. The converse was true when Mamre figures were compared to those of 'whites'. The relatively high life expectancy found in Mamre between 1837 and 1909 coincides with the favourable economic situation, living conditions and lifestyle of Mamre mission dwellers compared to their farm-dwelling and urban 'coloured' counterparts. In this respect, this thesis makes a contribution to South African historiography in taking the image of missions further. The case of Mamre points to the fact that not only did mission dwellers have greater access to land, education

and economic autonomy compared to other peasants, but that they also had a correspondingly higher life expectancy.

There is no evidence of a substantial change in the level of mortality in Mamre between the 1837-46, 1870-79 and 1900-09 cohorts. Other sources report an improved mortality picture for Mamre following the implementation of district maternity and preventative child health services in the 1930s and 1970s respectively. This recent drop in mortality occurred despite the poor environmental health facilities that existed in Mamre until 1987.

Through studying the mortality and survival in an historic community, this thesis highlights the need for the integration of epidemiological and demographic approaches. Implicit in this is the sharing of methodology as well as an holistic understanding of health and its determinants. The use of methods from other disciplines ensures new applications and developments within the epidemiological field. The use of non-traditional data sources for the monitoring of vital events is a case in point.

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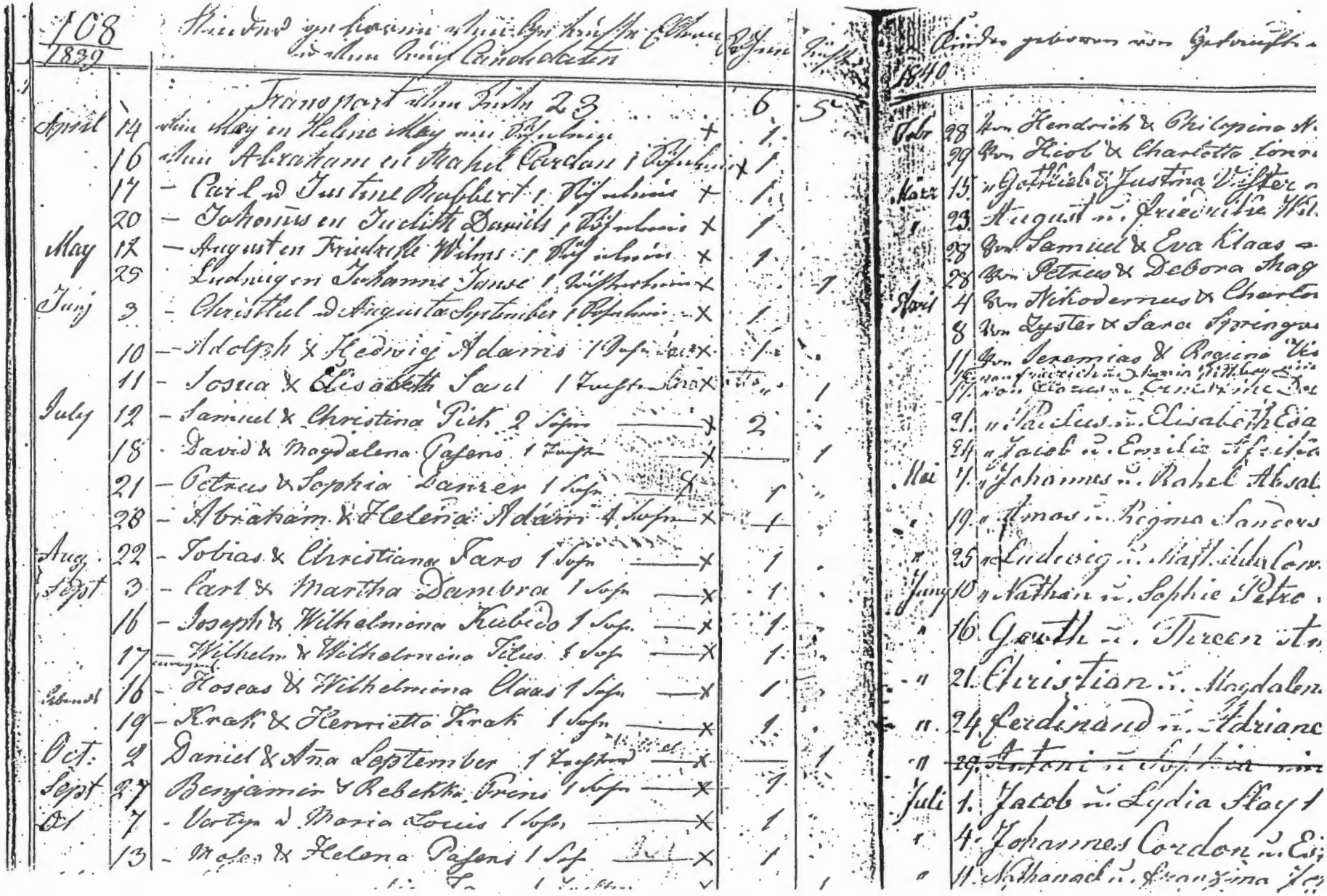
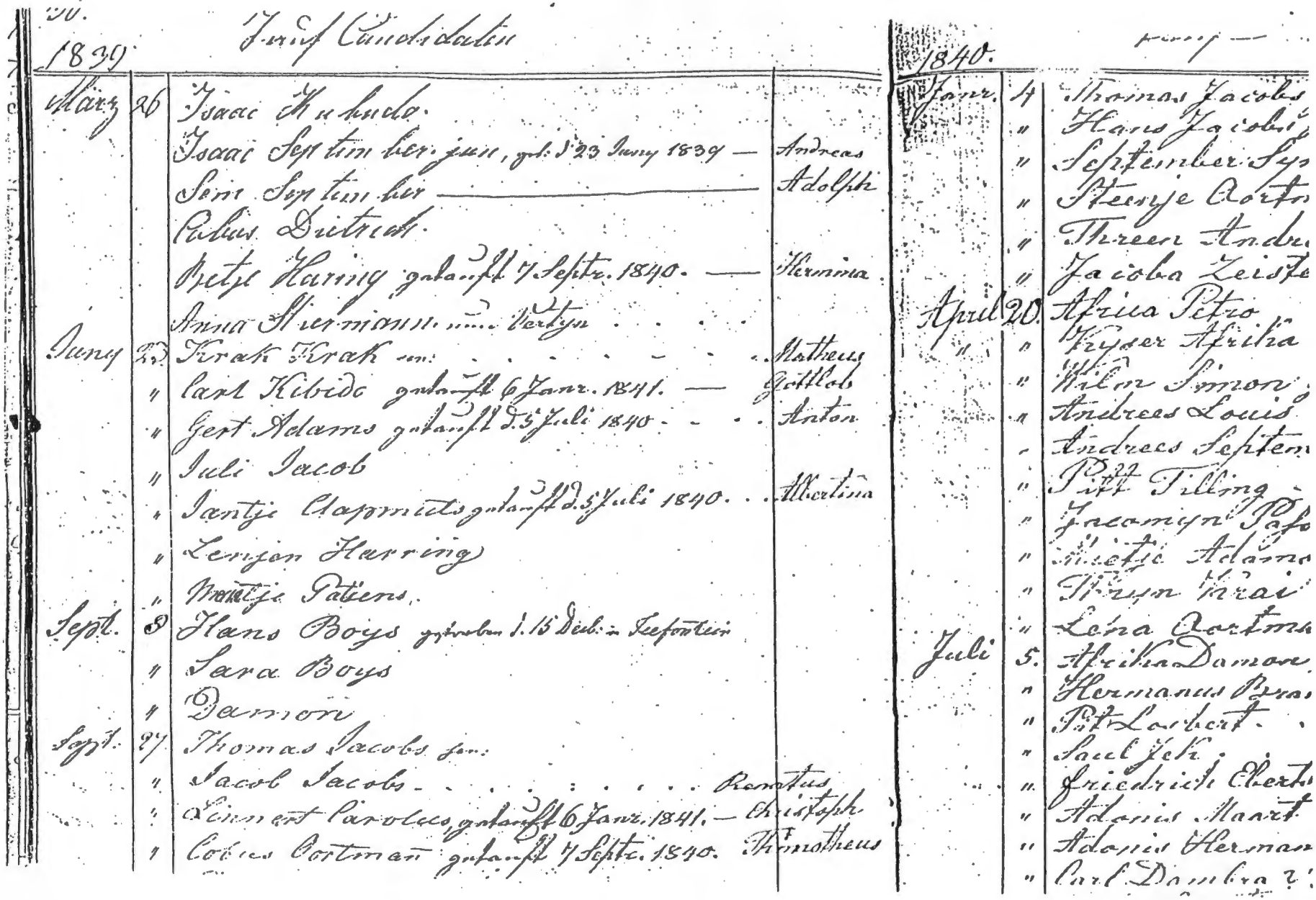


Appendix 1 : Copy of page of rough diary registering Mamre birth in 1839.



Appendix 2 : Copy of Rough diary showing arrivals in Mamre in 1839, including that of Hans Clapmuts.

MAMRE CHURCH RECORDS PROJECT

MRC

Surname(s):	**Christian Name(s):**	**Date of Birth:**	**Date of Baptism:**
Married: (last)		**Place:**	**Place:**
Maiden:		**Source:**	
		Date of Death:	**Type:**

Relation	**Name(s)**	**Marriage ID**	**Other Information**
Father			
Mother			
Spouse 1.			
2.			
3.			
Siblings			
Children			

X ☐

Individual ID Number: Surname | Book | Page | Line | Sex | DOD | Category

Date of Opname:	Nagmaal:	Marriage(s): Date: / Place:	Church Suspension: / Readmission:	Date of Death: / Place:
		Date: / Place:	Suspension: / Readmission:	Cause: / Source:
		Date: / Place:		Buried:

Category:

1. Always lived in Mamre
2. Left Mamre
3. Inkomer (newcomer to Mamre)
4. Convert
5. Registered in Mamre, but lived elsewhere
6. Left and returned
7. Other

If DOD unknown, **latest known date alive:**

If left Mamre: **Date of Departure**

If inkomer: **Date of Arrival**

If convert: **Date of Admission**

Source of Validation:	Reference Number:
1. Church Register	
2. Burial Records	
3. Medical Certificates	
4. Baptismal Records	
5. State Archives	
6. Master's Office	
7. Miscellaneous Lists	
8. Diaries	
9. De Bode	
10. Huisvriend	
11. Tombstones	
12. Family	
13. Other	

MAMRE CHURCH RECORDS PROJECT MRC

Marriage ID: M ⊢ Surname ⊢ Marriage Year ⊢ Number

Surname: _____

Date of Marriage: ⊢⊢⊢⊢⊢⊢⊢⊢ **Place:** _____ **Source:** _____

Relation		**Name**	**Crossreferences** (indivual or other ID's)
Husband			
Wife			
Child	1.		
	2.		
	3.		
	4.		
	5.		
	6.		
	7.		
	8.		

APPENDIX 5

MALE QUINQUENNIAL MORTALITY RATES FOR MAMRE COHORTS 1837-1846,1870-1979 AND 1900-1909

Age	Mamre 1837-46	Mamre 1870-79	Mamre 1900-09
0	0.316	0.364	0.300
5	0.082	0.101	0.036
10	0.021	0.041	0.006
15	0.023	0.047	0.039
20	0.061	0.069	0.022
25	0.052	0.037	0.065
30	0.059	0.030	0.103
35	0.078	0.032	0.076
40	0.086	0.077	0.036
45	0.094	0.096	0.052
50	0.106	0.040	0.073
55	0.102	0.083	0.112
60	0.114	0.091	0.143
65	0.205	0.201	0.229
70	0.194	0.191	0.270
75	0.320	0.265	0.372
80	0.529	0.407	0.493
85	0.750	0.688	0.960
90	0.769	0.800	1.000

APPENDIX 6

FEMALE QUINQUENNIAL MORTALITY RATES FOR MAMRE COHORTS 1837-1846,1870-1979 AND 1900-1909

Age	Mamre 1837-46	Mamre 1870-79	Mamre 1900-09
0	0.298	0.399	0.240
5	0.042	0.073	0.026
10	0.045	0.042	0.046
15	0.034	0.045	0.057
20	0.051	0.041	0.026
25	0.127	0.107	0.086
30	0.057	0.034	0.013
35	0.093	0.055	0.041
40	0.087	0.081	0.029
45	0.079	0.089	0.074
50	0.065	0.100	0.048
55	0.070	0.141	0.117
60	0.175	0.100	0.095
65	0.091	0.185	0.064
70	0.267	0.136	0.159
75	0.318	0.368	0.193
80	0.600	0.583	0.468
85	0.833	0.000	0.819

APPENDIX 7

APPROXIMATE LOWER AND UPPER 95% CONFIDENCE INTERVALS FOR MALES BORN IN MAMRE 1837-1946, 1870-1979 AND 1900-1909

Age	1837-1846		1870-1879		1900-1909	
	Lower	Upper	Lower	Upper	Lower	Upper
0	0.241	0.391	0.292	0.435	0.229	0.370
5	0.036	0.127	0.055	0.147	0.007	0.065
10	0.000	0.045	0.010	0.073	0.000	0.019
15	0.000	0.050	0.011	0.082	0.007	0.071
20	0.015	0.108	0.023	0.115	0.000	0.047
25	0.006	0.099	0.000	0.074	0.019	0.111
30	0.006	0.112	0.000	0.065	0.041	0.166
35	0.014	0.141	0.000	0.068	0.018	0.133
40	0.016	0.156	0.019	0.136	0.000	0.078
45	0.017	0.170	0.028	0.165	0.000	0.105
50	0.019	0.192	0.000	0.086	0.008	0.138
55	0.011	0.193	0.015	0.151	0.027	0.196
60	0.012	0.215	0.017	0.165	0.042	0.244
65	0.060	0.350	0.085	0.317	0.091	0.367
70	0.036	0.352	0.064	0.319	0.099	0.441
75	0.094	0.546	0.098	0.433	0.137	0.608
80	0.176	0.882	0.162	0.653	0.090	0.896
85	0.138	1.000	0.273	1.000	0.000	1.000

APPENDIX 8

APPROXIMATE LOWER AND UPPER 95% CONFIDENCE INTERVALS FOR FEMALES BORN IN MAMRE 1837-1946, 1870-1979 AND 1900-1909

Age	1837-1846		1870-1879		1900-1909	
	Lower	Upper	Lower	Upper	Lower	Upper
0	0.219	0.378	0.317	0.481	0.171	0.308
5	0.008	0.077	0.029	0.117	0.000	0.052
10	0.008	0.081	0.008	0.076	0.011	0.081
15	0.000	0.068	0.008	0.082	0.017	0.097
20	0.005	0.096	0.000	0.081	0.000	0.055
25	0.050	0.203	0.031	0.182	0.025	0.146
30	0.000	0.114	0.000	0.083	0.000	0.039
35	0.017	0.169	0.000	0.119	0.000	0.089
40	0.009	0.166	0.000	0.161	0.000	0.070
45	0.000	0.159	0.000	0.178	0.008	0.140
50	0.000	0.141	0.000	0.200	0.000	0.102
55	0.000	0.150	0.015	0.266	0.028	0.205
60	0.043	0.307	0.000	0.215	0.010	0.179
65	0.000	0.196	0.020	0.351	0.000	0.138
70	0.078	0.455	0.000	0.294	0.039	0.279
75	0.078	0.559	0.090	0.647	0.047	0.339
80	0.200	1.000	0.142	1.000	0.137	0.800
85	0.088	1.000			0.000	1.000

APPENDIX 9

Male and female person years, deaths and death to person year rations per age category for Mamre cohorts: 1837-4846, 1870-1879 and 1900-1909.

1837-1846 MAMRE COHORT : MALES

PERSON YEARS, DEATHS AND DEATH TO PERSON YEAR RATIO PER AGE CATEGORY

AGEGROUP	PERSON YEARS	DEATHS	DEATH RATIO
1	214.0233	42	0.1962403
2	176.9589	21	0.1186716
3	164.1294	3	0.01827827
4	166.2218	3	0.01804818
5	162.5017	2	0.01230756
6	160.2827	4	0.02495591
7	154.6831	3	0.01939449
8	151.4846	4	0.02640532
9	147.9014	2	0.01352252
10	146.2505	0	0
11	145.3922	0	0
12	144	1	0.006944444
13	141.9411	2	0.01409035
14	138.2793	0	0
15	138.9411	0	0
16	136.3114	0	0
17	132.7858	0	0
18	129.9493	2	0.01539061
19	124.7837	0	0
20	122.2307	1	0.008181253
21	118.794	0	0
22	116.6899	0	0
23	114.2081	2	0.0175119
24	108.5982	2	0.01841651
25	104.9822	3	0.02857627
26	98.53525	2	0.0202973
27	93.75702	0	0
28	93.3039	2	0.02143533
29	90.3039	1	0.01107372
30	88.75222	0	0
31	87.60096	0	0
32	85.55989	1	0.01168772
33	83.22724	1	0.0120153
34	82	1	0.01219512
35	80.42574	2	0.02486766
36	78	2	0.02564103
37	76	1	0.01315789
38	74.70021	1	0.01338684
39	72.67762	0	0
40	72	2	0.02777778
41	70	1	0.01428571
42	69	1	0.01449275
43	68	3	0.04411765
44	65	1	0.01538462
45	64	0	0
46	64	0	0
47	64	0	0
48	64	1	0.015625
49	63	4	0.06349206
50	59	1	0.01694915
51	58	1	0.01724138
52	57	2	0.03508772
53	53.9473	1	0.01853661
54	51.61259	2	0.03875023
55	49	0	0
56	49	2	0.04081633
57	47	0	0
58	47	0	0
59	47	2	0.04255319
60	45	1	0.02222222
61	44	0	0
62	44	1	0.02272727
63	43	0	0
64	43	0	0
65	43	4	0.09302326
66	39	1	0.02564103
67	38	3	0.07894737
68	35	1	0.02857143
69	34	2	0.05882353
70	32	1	0.03125
71	31	0	0
72	31	3	0.09677419
73	28	2	0.07142857
74	26	1	0.03846154
75	25	0	0
76	25	2	0.08
77	23	0	0
78	23	1	0.04347826
79	22	2	0.09090909
80	20	3	0.15
81	17	2	0.1176471
82	15	4	0.2666667
83	11	2	0.1818182
84	9	1	0.1111111
85	8	0	0
86	8	3	0.375
87	5	1	0.2
88	4	2	0.5
89	2	0	0
90	2	0	0
91	2	1	0.5
92	1	0	0
93	1	0	0
94	1	0	0
95	1	1	1
96	.	0	.
97	.	0	.
98	.	0	.
99	.	0	.
100	.	0	.

1837-1846 MAMRE COHORT : FEMALES

PERSON YEARS,DEATHS AND DEATH TO PERSON YEAR RATIO
PER AGE CATEGORY

AGEGROUP	PERSON YEARS	DEATHS	DEATH RATIO	AGEGROUP	PERSON YEARS	DEATHS	DEATH RATIO
1	174.8172	28	0.1601673	55	43	0	0
2	152.6235	17	0.1113852	56	43	2	0.04651163
3	144.7269	5	0.03454783	57	41	1	0.02439024
4	144.7235	4	0.02763892	58	40	0	0
5	144.6557	2	0.01382593	59	40	0	0
6	142.9774	3	0.02098234	60	40	0	0
7	138.013	1	0.007245694	61	40	1	0.025
8	137.5044	1	0.007272492	62	39	0	0
9	136	0	0	63	39	3	0.07692308
10	135.9576	1	0.007355236	64	36	2	0.05555556
11	134	2	0.01492537	65	34	1	0.02941176
12	132	0	0	66	33	1	0.03030303
13	132.3621	1	0.007555034	67	32	1	0.03125
14	131.6564	2	0.01519106	68	31	0	0
15	128.82	1	0.007762771	69	31	0	0
16	126.1595	2	0.01585295	70	31	1	0.03225806
17	121.4031	2	0.01647404	71	30	1	0.03333333
18	113.6496	0	0	72	29	2	0.06896552
19	107.1506	0	0	73	27	2	0.07407407
20	102.1513	0	0	74	25	1	0.04
21	101	0	0	75	24	2	0.08333333
22	99.33949	4	0.04026596	76	22	1	0.04545455
23	94	0	0	77	21	1	0.04761905
24	94	1	0.0106383	78	20	1	0.05
25	93	0	0	79	19	2	0.1052632
26	91.33812	5	0.05474165	80	17	2	0.1176471
27	84.48323	1	0.01183667	81	15	1	0.06666667
28	79.38193	1	0.01259733	82	14	3	0.2142857
29	77.37509	1	0.01292406	83	11	3	0.2727273
30	75.10062	3	0.03994641	84	8	1	0.125
31	72	2	0.02777778	85	7	1	0.1428571
32	68.99521	1	0.01449376	86	6	0	0
33	67	0	0	87	6	1	0.1666667
34	67	0	0	88	5	1	0.2
35	66.16016	1	0.01511484	89	4	2	0.5
36	65	1	0.01538462	90	2	1	0.5
37	64.03901	1	0.01561548	91	1	0	0
38	63.35934	2	0.03156598	92	1	0	0
39	60	2	0.03333333	93	1	0	0
40	58	0	0	94	1	0	0
41	57.88433	2	0.03455167	95	1	0	0
42	55	1	0.01818182	96	1	0	0
43	54	2	0.03703704	97	1	0	0
44	52	0	0	98	1	0	0
45	52	0	0	99	1	1	1
46	51.76865	0	0	'00	.	0	.
47	50.47228	1	0.01981286				
48	49	2	0.04081633				
49	47	0	0				
50	47	1	0.0212766				
51	46	1	0.02173913				
52	45	0	0				
53	45	1	0.02222222				
54	44	1	0.02272727				

1870-1879 MAMRE COHORT : MALES

PERSON YEARS, DEATHS AND DEATH TO PERSON YEAR RATIO PER AGE CATEGORY

AGEGROUP	PERSON YEARS	DEATHS	DEATH RATIO
1	278.3867	51	0.1831984
2	228.4367	28	0.1225723
3	203.4148	16	0.07865702
4	191.7077	6	0.03129764
5	187.8987	2	0.01064403
6	186.3833	5	0.02682644
7	182.6715	5	0.02737154
8	178.3696	3	0.01681901
9	176.5654	3	0.01699087
10	174.0513	3	0.01723629
11	171.2019	4	0.02336422
12	166.3655	2	0.01202172
13	163	1	0.006134969
14	162	0	0
15	157.2964	0	0
16	153.011	2	0.01307096
17	148.3149	1	0.006742413
18	145.8542	1	0.006856161
19	143.3457	3	0.02092843
20	138.8741	0	0
21	136.8152	4	0.02923652
22	128.5359	1	0.007779926
23	123.4887	1	0.008097907
24	122.1123	1	0.008189186
25	116.8446	2	0.01711675
26	109.5291	2	0.01825999
27	107.1314	0	0
28	107	1	0.009345794
29	105.5941	1	0.009470225
30	103.232	0	0
31	102.0096	1	0.009803001
32	99.86379	1	0.01001364
33	97.59959	0	0
34	96.10609	0	0
35	96	1	0.01041667
36	95	0	0
37	95	0	0
38	95	1	0.01052632
39	93.18207	0	0
40	93	2	0.02150538
41	91	0	0
42	91	3	0.03296703
43	87.07529	1	0.01148431
44	86	1	0.01162791
45	85	2	0.02352941
46	83	3	0.03614458
47	80	1	0.0125
48	79	1	0.01265823
49	78	2	0.02564103
50	76	1	0.01315789
51	75	0	0
52	75	1	0.01333333
53	74	1	0.01351351
54	73	0	0
55	73	1	0.01369863
56	72	0	0
57	72	0	0
58	72	3	0.04166667
59	69	3	0.04347826
60	66	0	0
61	66	0	0
62	66	2	0.03030303
63	64	2	0.03125
64	62	1	0.01612903
65	61	1	0.01639344
66	60	2	0.03333333
67	58	1	0.01724138
68	57	3	0.05263158
69	53.21081	1	0.01879317
70	52	5	0.09615385
71	47	3	0.06382979
72	44	3	0.06818182
73	41	0	0
74	41	1	0.02439024
75	40	2	0.05
76	38	3	0.07894737
77	35	2	0.05714286
78	33	2	0.06060606
79	30.33812	1	0.03296183
80	29	2	0.06896552
81	27	4	0.1481481
82	23	2	0.08695652
83	21	2	0.0952381
84	19	1	0.05263158
85	18	2	0.1111111
86	16	3	0.1875
87	13	3	0.2307692
88	10	4	0.4
89	6	1	0.1666667
90	5	0	0
91	5	0	0
92	5	2	0.4
93	3	1	0.3333333
94	2	0	0
95	2	1	0.5
96	1	1	1
97	.	0	.
98	.	0	.
99	.	0	.
100	.	0	.

1870-1879 MAMRE COHORT : FEMALES

PERSON YEARS, DEATHS AND DEATH TO PERSON YEAR RATIO
PER AGE CATEGORY

AGEGROUP	PERSON YEARS	DEATHS	DEATH RATIO
1	226.9747	39	0.1718253
2	193.7625	25	0.1290239
3	175.4148	17	0.09691315
4	157.9973	9	0.05696301
5	149.976	4	0.02667093
6	149.8884	4	0.02668652
7	148.2902	2	0.01348707
8	145.3812	0	0
9	145.2115	3	0.02065952
10	142.4319	2	0.0140418
11	140.8234	0	0
12	142.6947	3	0.0210239
13	140.6906	2	0.01421559
14	139	1	0.007194245
15	139.0527	0	0
16	138.0452	2	0.01448801
17	134.3094	1	0.007445497
18	132.6783	0	0
19	126.5298	1	0.007903278
20	117.1136	2	0.01707743
21	108.8316	1	0.009188506
22	103.5044	2	0.01932284
23	97.0527	0	0
24	89.34976	0	0
25	82.9603	1	0.01205396
26	79.38946	3	0.03778839
27	74.88022	4	0.05341865
28	68.41478	0	0
29	65.50582	0	0
30	62.51608	1	0.01599588
31	60.17385	0	0
32	59.00342	2	0.03389634
33	56.02464	0	0
34	55.5989	0	0
35	55	0	0
36	55	2	0.03636364
37	53	0	0
38	52.99863	0	0
39	51.04791	1	0.01958944
40	50	0	0
41	49.88159	0	0
42	49	1	0.02040816
43	48.23477	1	0.02073193
44	48	2	0.04166667
45	46	0	0
46	46	1	0.02173913
47	44.51061	2	0.04493311
48	42	1	0.02380952
49	40.58042	0	0
50	40	0	0
51	40	1	0.025
52	39	0	0
53	39	0	0
54	39	1	0.02564103

AGEGROUP	PERSON YEARS	DEATHS	DEATH RATIO
55	38	2	0.05263158
56	36	0	0
57	36	2	0.05555556
58	33.71663	1	0.02965895
59	32	2	0.0625
60	30	0	0
61	30	2	0.06666667
62	28	0	0
63	28	0	0
64	28	1	0.03571429
65	27	0	0
66	27	1	0.03703704
67	26	1	0.03846154
68	25	0	0
69	25	1	0.04
70	24	2	0.08333333
71	22	0	0
72	22	1	0.04545455
73	21	1	0.04761905
74	20	0	0
75	20	1	0.05
76	19	0	0
77	19	1	0.05263158
78	18	3	0.1666667
79	15	1	0.06666667
80	14	2	0.1428571
81	12	1	0.08333333
82	11	4	0.3636364
83	7	1	0.1428571
84	6	1	0.1666667
85	5	0	0
86	5	0	0
87	5	0	0
88	5	0	0
89	5	0	0
90	5	1	0.2
91	5	0	0
92	4	0	0
93	4	0	0
94	4	0	0
95	4	0	0
96	4	2	0.5
97	4	1	0.5
98	2	0	0
99	1	1	1
100	1		

1900-1909 MAMRE COHORT : MALES

PERSON YEARS, DEATHS AND DEATH TO PERSON YEAR RATIO PER AGE CATEGORY

AGEGROUP	PERSON YEARS	DEATHS	DEATH RATIO
1	241.2526	31	0.128496
2	209.0082	18	0.08612102
3	191.2998	7	0.03659178
4	184.2245	12	0.06513791
5	172	4	0.02325581
6	167.7577	0	0
7	167	1	0.005988024
8	166	1	0.006024096
9	165	2	0.01212121
10	163	2	0.01226994
11	161	0	0
12	161	1	0.00621118
13	160	0	0
14	158.8693	0	0
15	157.104	0	0
16	155	1	0.006451613
17	152.4045	1	0.006561485
18	149.9521	1	0.006668797
19	148	1	0.006756757
20	147.7283	2	0.01353837
21	144.2834	0	0
22	141.6112	2	0.01412317
23	135.8528	0	0
24	134.0062	0	0
25	131.4073	1	0.00760993
26	127.4997	1	0.007843158
27	123.347	2	0.01621442
28	119.091	0	0
29	117.4216	2	0.01703264
30	114.2375	3	0.02626108
31	109.3977	1	0.009140962
32	106.4278	5	0.04698021
33	99.21903	3	0.03023614
34	96	1	0.01041667
35	94.67214	1	0.01056277
36	93	0	0
37	93	1	0.01075269
38	91.50856	0	0
39	91	2	0.02197802
40	89	4	0.04494382
41	85	2	0.02352941
42	81.35455	0	0
43	80.52704	1	0.01241819
44	78.74538	0	0
45	78	0	0
46	77.46749	1	0.01290864
47	75.42847	0	0
48	75	0	0
49	75	1	0.01333333
50	74	2	0.02702703
51	70.88433	0	0
52	69.29911	2	0.0288604
53	66	1	0.01515152
54	65	1	0.01538462
55	64	1	0.015625
56	63	0	0
57	63	1	0.01587302
58	62	1	0.01612903
59	60.20671	1	0.01660944
60	59	4	0.06779661
61	56	1	0.01785714
62	55	2	0.03636364
63	53	1	0.01886792
64	52	1	0.01923077
65	51	3	0.05882353
66	48	5	0.1041667
67	43	1	0.02325581
68	42	1	0.02380952
69	41	0	0
70	41	4	0.09756098
71	37	2	0.05405405
72	35	1	0.02857143
73	34	1	0.02941176
74	33	4	0.1212121
75	29	2	0.06896552
76	27	4	0.1481481
77	23	4	0.173913
78	19	1	0.05263158
79	18	1	0.05555556
80	16.30185	0	0
81	15.1232	1	0.06612356
82	13.78919	1	0.0725206
83	9.637919	1	0.1037568
84	7.408624	2	0.2699557
85	3.887064	1	0.2572636
86	1.21013	1	0.8263575
87	.	0	.
88	.	0	.
89	.	0	.
90	.	0	.
91	.	0	.
92	.	0	.
93	.	0	.
94	.	0	.
95	.	0	.
96	.	0	.
97	.	0	.
98	.	0	.
99	.	0	.
100	.	0	.

1900-1909 MAMRE COHORT : FEMALES

PERSON YEARS,DEATHS AND DEATH TO PERSON YEAR RATIO
PER AGE CATEGORY

AGEGROUP	PERSON YEARS	DEATHS	DEATH RATIO
1	206.8125	20	0.09670597
2	184.0992	12	0.06518223
3	171.2923	11	0.06421773
4	161.2026	2	0.01240675
5	159	4	0.02515723
6	155	0	0
7	155	3	0.01935484
8	152	0	0
9	152	1	0.006578947
10	151	0	0
11	151	2	0.01324503
12	149	1	0.006711409
13	148	1	0.006756757
14	147	1	0.006802721
15	146	2	0.01369863
16	144	2	0.01388889
17	141.1198	2	0.01417236
18	138	2	0.01449275
19	134.5236	2	0.01486728
20	129.7844	0	0
21	127.2334	1	0.007859571
22	119.4381	0	0
23	116.1034	0	0
24	111.1506	1	0.008996804
25	106.0869	1	0.009426232
26	100.345	0	0
27	97.60986	1	0.01024487
28	91.63244	4	0.04365266
29	84.59617	2	0.02364173
30	79.76386	1	0.01253701
31	78.23135	0	0
32	78.41889	0	0
33	77.58316	0	0
34	76.65229	0	0
35	75	1	0.01333333
36	73.3128	0	0
37	72.7447	1	0.01374671
38	71	1	0.01408451
39	70	1	0.01428571
40	69	0	0
41	69	2	0.02898551
42	67	0	0
43	67	0	0
44	67	0	0
45	67.19233	0	0
46	67.58795	3	0.04438661
47	64	0	0
48	64.67625	2	0.03092325
49	63	0	0
50	63	0	0
51	63.47023	0	0
52	63.31828	1	0.01579323
53	62	1	0.01612903
54	61	0	0
55	61	1	0.01639344
56	60	2	0.03333333
57	58	0	0
58	58	2	0.03448276
59	56	2	0.03571429
60	54	1	0.01851852
61	53	2	0.03773585
62	51	2	0.03921569
63	49	0	0
64	49	1	0.02040816
65	47.50103	0	0
66	47	1	0.0212766
67	46	1	0.02173913
68	45	0	0
69	45	0	0
70	45	1	0.02222222
71	44	2	0.04545455
72	42	2	0.04761905
73	40	1	0.025
74	39	0	0
75	39	2	0.05128205
76	37	2	0.05405405
77	36	1	0.02777778
78	35	1	0.02857143
79	31.56605	1	0.0316796
80	27.91581	2	0.07164399
81	22.94319	1	0.04358592
82	17.66119	2	0.1132426
83	13.32923	2	0.1500462
84	9.507187	2	0.2103672
85	6.287474	1	0.1590464
86	5	2	0.4
87	2.316906	1	0.43161
88	.	0	.
89	.	0	.
90	.	0	.
91	.	0	.
92	.	0	.
93	.	0	.
94	.	0	.
95	.	0	.
96	.	0	.
97	.	0	.
98	.	0	.
99	.	0	.
100	.	0	.