INFANTILE MORTALITY in a MINING AREA

AN ANALYTICAL STUDY

(WITH PARTICULAR REFERENCE to NEO-NATAL MORTALITY)

A T H E S I S

PRESENTED for the degree of M.D.

UNIVERSITY of GLASGOW.

by

JOHN FERGUSON M.B., Ch.B. (Glasgow) 1928.

MEDICAL OFFICER of HEALTH, BIDDULPH URBAN DISTRICT.
STAFFORDSHIRE.

HON. CLINICAL ASSISTANT, HAYWOOD HOSPITAL,
STOKE-on-TRENT.

in GENERAL PRACTICE.

P R E F A C E

The subject matter of this thesis includes for analysis a considerable volume of detailed statistics. By its very nature and without sacrifice of its value, the subject does not permit of simple exposition. The author has appreciated the difficulty which must present even to the expert reader. Under these circumstances the following method of presentation has been considered most suitable. The thesis has been prepared in two books referred to as Volume I and Appendix.

Volume I contains the full text, divided into six main parts as set out in the table of contents. Part IV only calls for further explanation. This represents the actual original inquiry and is subdivided into ten sections. The first consists of Definition of Terms ; each further section deals with a specific aspect of the inquiry. For easy reference and to ensure continuity in the course of reading a summary has been appended to each section. The essentials of these summaries are collected in Part V to form a general summary. This method involves some repetition but it does achieve a degree of clarity which could not be attained otherwise.

Appendix contains

Maps

Diagrams

Graphs

Tables.

Page references to these are made in the text. This permits the reader to correlate subject matter and illustrations conveniently and simultaneously.

Sectional summaries appear on

and

C O N T E N T S

PART IV. - Continued.

- o - o - o - o -

PART I - The GENERAL BACKGROUND of the INQUIRY

1. INTRODUCTION

In Great Britain the average size of the family began to decline about the year 1870. By the beginning of the present century there was increasing evidence of a definite downward trend of the population. This has since become more real and to-day has caused serious alarm to our Statesmen.

As shown in the following table there is as yet no decline in the total number of the population but rather a substantial contraction in the normal rate of increase.

TABLE I POPULATION of GREAT BRITAIN †

1801	10,500,956.	Census Population.
1821	14,091,757.	Census Population.
1850	20,646,145.	Mid Year Estimate.
1875	27,560,129.	Mid Year Estimate.
1900	36,686,000.	Mid Year Estimate.
1925	43,802,000.	Mid Year Estimate.
1945	47,792,000.	Mid Year Estimate.

During the nineteenth century each successive Census shewed that the total number of the population had increased by rather more than ten per cent, but by the beginning of the present century that increase was greatly diminished until in the decade 1929-1938 it was only four and a half per cent.

† REGISTRAR-GENERAL - Personal Communication 1946 (September).

In March 1944, His Majesty's Government, having noted the trend, appointed a Royal Commission on Population with the following terms of reference :-

> " To examine the facts relating to the present population trends in Great Britain, to investigate the causes of these trends and to consider their probable consequences; to consider what measures, if any, should be taken in the national interest to influence the future trend of population; and to make recommendations " (Royal Commission on Population 1945).

An interim Statement by the Commission in September 1945 (Royal Commission on Population 1945) is significant, " ------ up to the outbreak of war in 1939 ----------, it appeared extremely probable that the population of Great Britain would shortly begin to decline ".

But the alarm is not due merely to a decline in actual total numbers. No less important is the problem of loss of balance in the age composition of the population. Many factors have contributed to this. The enlightened public health policy of the last one hundred years has resulted in the survival of a steadily increasing number of men and women to the age of sixty years and over. On the other hand two world wars have, within thirty years, (1914-1945) cut off

considerable numbers of men in the very prime of procreative manhood. In the Great War 1914-1918 the United Kingdom Forces lost no less than 750,000 men. The country was thereby not only deprived of them but of their progeny. In the second World War 1939-1945, though the casualties were less numerous, they were none the less serious. This loss of balance in the age distribution of the population in Great Britain is revealed by the fact that in 1939 there were approximately two million persons less under the age of twenty years than in 1919, and fewer under age twenty than between ages twenty and forty. These are the chief male reproductive age groups (20 to 40) and the ages of low death rates. If the birth rate continues to decline or remains at its present level, greater numbers will, in the next twenty years, pass into the over sixty age group and fewer will replace them in the vital twenty to forty age groups. Furthermore, unless there is an actual increase in the number of children born per person in the twenty to forty age groups, the total number of births must inevitably decline.

Three factors are fundamental in determining the trend of a population.

1. The total number of children born; size of family;
2. The proportion of these children who survive to reproductive age; and

3. The dominant role of the female in the perpetuation of the race; the special need to prevent a fall in the net reproductive rate (that is, the number of girl babies which women between the ages of fifteen and forty-five may expect to produce); and to ensure that as many females as possible survive up to and through the years of fertility.

Normally more males than females are born. In England and Wales over a period of fifty years masculinity ranged between 1032 and 1060 per thousand female births. (Currie, J.R. Hygiene 1938). But death takes a heavier toll of male infants in the first year of life whereas at the other end of the scale the female tends to survive the male.

Reference has already been made to the relative dearth of men and women in the young age groups and the increasing preponderance of men and women in the advanced age groups. This implies a scarcity of labour during the ages of maximum economic productivity with a relative excess of men and women no longer capable of full productive capacity. If we are to continue as a great nation, irrespective of power politics, our supreme need is for an increasing number of births; an actual increase in the size of the family. There are signs that, for the present at least, the birth rate is on the upgrade. In England and Wales, according to the Registrar General's Quarterly

Return (No 389, 1946, p.1), during the first quarter of 1946 there was an excess of some 3000 live births over the corresponding period of 1945; a rise in the birth rate from 16.9 to 17.2. For the second quarter of 1946 the Registrar-General (Brit. Med. J. 1946) records an abnormal increase of 28,675 births in England and Wales, equivalent to a birth rate of 19.2, the highest in any June quarter since 1925. In Scotland,during the second quarter of 1946, the birth rate was 20.2 as compared with 17.6 in the corresponding quarter of 1945, an increase of 2.6. During the next few years still further increase in the number of births is probable. For this the following reasons may be adduced.

1. the return of large numbers of young service men and women to civilian life.
2. the abnormally high incidence of marriages registered since June 1945.
3. a period of high wage standards among the working classes.

A similar trend, for the same reasons, was observed in the immediate post war period of the Great War (1914-1918). This proved temporary; the high birth rates recorded in 1920 and 1921 were not maintained. As to whether or not history shall repeat itself it is impossible to forecast. It may be that new social factors embraced in Social

Insurance shall, at least temporarily prolong and maintain the favourable upward trend.

But again mere increase in numbers, a higher birth rate, is not enough. We must ensure that a much greater proportion of these children is born mature and healthy and fitted to survive the hazardous first year of life. This involves

1. the skilled care and supervision of the mother throughout the whole period of pregnancy and after, that is, competent and well organised ante-natal and post-natal care, and indeed during the whole of the child-bearing years,
2. the care of the infant and especially the premature infant in an environment best suited to ensure its survival, and
3. education of the general public on the value of scientific birth control and family spacing to the health of the mother and her infant. During the past twenty years there has been a demand for such skilled scientific guidance but, unfortunately, it has been most effective among those of the higher intellectual and economic levels and least effective among the irresponsible and vicious section of the community. Woodbury, in an exhaustive analysis of the more important causes of death under the age of one year in 1915, found

that infants born after an interval of but one year following a preceding birth faced a mortality one and a half times that of infants born after intervals of two years or more. The lowest mortality for the entire first year of life was enjoyed by infants born four or more years after a previous childbirth (Woodbury,R.M. 1926). There is little doubt that this teaching influenced professional and lay opinion in the succeeding thirty years. In 1944, however, Eastman, in an important monograph entitled, " The Effects of the Interval between Births on Maternal and Foetal Outlook " queried the conclusions of Woodbury, whose studies twenty eight years earlier, were based on a very low income group. He submitted data based on material for the years 1936-1943 which suggested that child spacing meant maternal ageing and maternal ageing involved higher risks to the mother and child; that the longer the interval between pregnancies the more likely was the mother to suffer from hypertensive toxaemia of pregnancy with resulting increase in neo-natal mortality. He concluded with a plea that youth is the greatest talisman the pregnant woman can possess, and is a greater ally to her own health

and that of her infant, than is child-spacing.

(Eastman, N.J. 1944)

Since later marriages and planned parenthood are so widely practised in this country, confronted as it is by a fall in the actual birth rate, one of the aims of social security must be to foster earlier marriages and larger families. This must be encouraged within the framework of a society free from want and insecurity, and educated in the effects which family spacing entails to the health of the mother, the survival of the infant and the decline of the population. This, together with the improved care of the pregnant woman and the extension of facilities for the care of the infant, particularly the premature infant, will serve the dual purpose of contributing towards an increase of the population and a reduction in the number of deaths in the first year of life. It has been shewn in Holland that a high birth rate does not necessarily involve a high infant death rate. But in our present society, where the size of the average family, stated to be about two, (Royal Commission on Population 1945) permits of no margin for wastage by death in infancy it is of primary importance that the infantile mortality rate, that is, the number of children in a population dying under the age of one year per 1000 registered live births, should be still further reduced.

2. OBJECT of PRESENT INQUIRY.

The purpose of this investigation is

1. To enquire into the causes of infantile mortality over the period of twenty five years, 1921 - 1945, within the Urban District of Biddulph, a mining community situated within the Administrative County of Stafford;
2. to consider what measures are necessary to safeguard still further the health of the mother and her infant whereby a greater saving of infant life can be achieved.

My qualifications for the work are these. Since 1931, I have been engaged in general medical practice in this area and, during the last five years, have performed the duties of part-time Medical Officer of Health to the Urban District. In the course of my work I have been impressed by the number of deaths occurring among prematurely born infants and the frequency with which they form the major component of the annual crude infantile mortality rate. Although the scope of my inquiries will, in general, only provide data on the more obvious aspects of infantile mortality, I propose to devote particular attention to the causal factors underlying the neo-natal mortality rate and to discuss how these causes may be reduced. Admittedly my field

is narrow, but no record of experience or contribution to the subject may be ignored if it makes a sincere approach to the problem and proves of value, however slight, to other workers in this field of preventive medicine. The general practitioner encounters the problem at its most intimate point, namely in family life. This being so, his experience, within its recognised limits, is worthy of close consideration.

This thesis is a record of the observations I have been able to make as a general practitioner and as a public health officer to a local authority. These observations are recorded and reviewed in relation to the published work of others in the field. I have tried to make reasoned criticism where necessary and have ventured to suggest how the efforts of the family practitioner could be usefully stimulated and utilized towards further progress in the reduction of infantile mortality.

3. GEOGRAPHICAL TRENDS of INFANTILE MORTALITY 1895 -1945.

Since continuous records of infantile mortality began in England and Wales more than one hundred years ago very little improvement occurred in the rates until the beginning of the present century. Noticeable improvement has taken place since then. Whereas fifty years ago, that is in 1895, the infantile mortality rate in England and Wales was 153 per 1000 registered live births and reached the high peak of 163 in 1899, partly due to a hot dry summer and a diarrhoeal death rate of 40 out of the total rate, in 1945 it was down to 46 per 1000 live births. Between 1900 and 1920 it declined from 154 to 104 per 1000, and although in the past 25 years the fall has been mainly downward it has been subject to annual fluctuations. The subsequent annual rates however, have never exceeded the rate of 83 recorded in 1921. Improvement has been maintained and the falls in the rates have been reasonably satisfactory. But even the rate of 46 in 1945 for England and Wales was still much higher than the latest published rates (1943) in such European countries as Sweden with a rate of 29, Holland and Switzerland with rates of 40; and on a world scale, New Zealand with a rate of 31 for its white population and a combined rate of only 39; and the United States of America with a rate of 40. Although

the trends vary within each country they are mainly downward with the exception of Italy and France and the British Province of India (Appendix Table page 1). The industrial countries of Europe, for example, France, Germany and Italy have, in general, higher rates than the agricultural ones such as Holland, Norway and Sweden, and among the Dominions, New Zealand and Canada. They are not marked by any steady year to year decline, as found among the more agrarian countries, except in the case of Germany prior to 1939. In the United Kingdom, Scotland, with more severe climatic conditions, greater poverty and unemployment and poorer housing conditions in her industrial centres, produced the highest infantile mortality of the individual countries until 1941. Northern Ireland has had higher rates since then. In the 1934-1938 quinquennium Scotland had " the highest infantile mortality rate of seventeen countries, including the Dominions, the United States of America and all the countries of Western Europe, except Spain and Portugal " (Department of Health for Scotland, 1946). In 1945 the comparatively high rate of 62 was the lowest ever recorded. Japan and India have rates only to be compared with nineteenth century United Kingdom rates. In the United States of America, infantile mortality has declined at a faster rate than in this country or any European country, except Sweden, namely from

74 per 1000 in the 1921-1925 quinquennium to 40 in 1943, compared with 78 to 52 over the same period in the United Kingdom.

It is by analysis of rates better than our own and a study of the methods by which the decline has been achieved that we shall improve the position in our own country, city or town. Martin, for example, comments on the trends of mortality in London and New York when the rates in London fell from 76 per 1000 in 1920 to 47 in 1939, whilst those in New York fell from 85 to 37 over the same period, in these words " In the U.S.A.,---------- probably a part of the greater improvement in that country is due to the success attending the efforts made by ante- and post-natal clinics to increase maternal efficiency ----- to raise the standard of medical care by post graduate education in paediatrics and obstetrics for practising physicians; and in New York and some other cities minimal standards for maternity services are enforced as public health regulations ". (Martin, J.W. 1945). Similarly, McNeil attributes the low death rates in four of the leading towns in the United States, New York, Chicago, Philadelphia and Detroit, to " active planned concerted action between the public health authorities, the maternity hospitals and the general practitioners " and he cites the campaign in Chicago against prematurity as the culmination of preventive

measures which reduced the infantile mortality from 74 in 1925 to the low figure of 34 in 1938 (McNeil C. 1942). In a note on the trends of infantile mortality in Greater London and New York between the years 1938 and 1942, Stocks remarks that at no time did the London rate reach the lower levels of New York; that, in fact, as shown in Table 2, in 1942 the London rate (46.6) was 62 per cent above the New York rate (28.8) (Stocks, P. 1944).

TABLE 2

INFANTILE MORTALITY RATES per 1000 LIVE BIRTHS

LONDON and NEW YORK 1938 - 1942

YEARS	GREATER LONDON	NEW YORK	G.L. percentage of N.Y.
1938	49.8	38.3	130
1939	43.7	37.1	118
1940	46.9	34.9	134
1941	52.1	30.8	169
1942	46.6	28.8	162

These figures for New York, and those previously quoted for certain countries with similar low infantile mortality rates, would suggest that in this country even at the present time there is a lack of integration between the medical and administrative services, preventing that continuity of supervision of the mother and her infant, personally and sociologically, upon which a reduction of maternal as well as infantile mortality depends. Until there is that

integration, the differences in rates and the speed of their fall will vary, in different countries and cities, with the facilities provided and utilized and with the conditions of life within each country. Woolf and Waterhouse have stated that " every authority agrees that infantile mortality falls steeply with improved standards of living, housing conditions, education, public health and sanitation ". (Woolf, B. and Waterhouse, J. 1945).

The citations to American practice (page 13) have indicated that the improvements in the crude infantile mortality rates in that country owe much to the close correlation of the purely medical and environmental influences. In this country, on the other hand, the comparatively unfavourable level of the rates would seem to imply, inter alia, that the association of these influences as material factors in control are not fully appreciated. It is my purpose to emphasise this point and to insist on the need for much closer attention to the integration of these influences in an approach to the problem.

4. THE INFLUENCE of SOCIAL MEDICINE on INFANTILE MORTALITY.

In spite of the somewhat unfavourable comparative infantile mortality rates, there is little doubt that in this country the practice of medicine - curative and preventive - has achieved a standard of perfection unrivalled in any other country, and in the field of Social Medicine it is in the forefront. Under the proposed legislation for Social Insurance and a comprehensive medical service further great advances are hoped for, including a further reduction in infantile mortality. Towards this, active and vital contributions can be made

1. by Central and Local Government, guided by leaders in Social Medicine, to ensure good housing in well planned cities and rural areas, with modern sanitation, adequate water supplies and improved standards of living,
2. by educationalists, to ensure a wider knowledge among the people of the principles of healthy living, and
3. by the medical profession - the specialist, the hospital consultant, the local authority health services and the general practitioner - to ensure the better care of the mother and her child " at all times, in health and in sickness ".

Much has already been achieved by previous social legislation, for to-day the infantile mortality rate in

England and Wales is below 50. In 1900 it was three times this figure. Since infantile mortality is commonly regarded nowadays as one of the most sensitive indices of the existence of health consciousness in a community, its reduction represents success over poor environmental conditions, in the field of Preventive Medicine and better protection of the lives of individuals within the community, in the field of Social Medicine. This sociological interest in the individual began with the Health Visitor arranging for the care of the expectant mothers at clinics and supervising the care of infants in their homes. Of late years the Health Services have widened their social field and undertaken the supply of proprietary milk products, of vitamin supplements, of layettes and creches and advised on coupons and points, and provided day-nurseries.

These represent advances in Social Medicine directed to protect the health of the mother and her infant from a time even before birth. They therefore cannot fail to have an important influence on further reductions of infantile mortality. Indeed, it is to these achievements that much of the satisfactory present day rates is due.

Much more still remains to be done and closer liason between social, preventive and curative medicine is the keystone of the problem. As will be demonstrated later, the study of the causes of death confirms this. Deaths occurring in the first month are mainly, in origin,

ante-natal, and improved maternity services and nursing care of the premature infant would prepare the way for progress towards their reduction. The causes operating from the end of the first month to the end of the first year are chiefly attributable to respiratory, infectious and gastro-intestinal diseases; they are dependent more on environmental than intra-uterine factors, of which overcrowding and poor housing conditions, faulty infant feeding and inadequate diets are the more important. Each group of causes, though basically different, is inextricably linked with the preventive, curative and social aspects. When its treatment is properly integrated, stable rates at a lower level may be expected.

PART II - The SCOPE of the INQUIRY.

5. A PRELIMINARY SURVEY of the EXTENT and SCOPE of the PRESENT INQUIRY.

Fifty years ago, in this district, namely in 1895, the infantile mortality rate was 140. At the beginning of the present century it was 165 and by 1920 it had fallen to a low figure of 49. This was a phenomenal rate, for it had never previously been below 84 (1914) and only the year before (1919) it stood at 98. The speed of the fall during the first two decades of the twentieth century was slightly less rapid than that of England and Wales and the rates were subject to much greater annual fluctuations (Appendix - page 2). As examples of these the following table gives some comparative figures.

TABLE 3

SOME INFANTILE MORTALITY RATES 1900 - 1920

YEARS	BIDDULPH URBAN DISTRICT	ENGLAND and WALES.
1903	98	132
1906	166	132
1909	127	109
1912	110	95
1915	90	110
1918	119	97

It is worthy of note that in only six years in England and Wales between 1900 and 1920 and in nine years in this area were the infantile mortality rates lower than 100 per 1000

registered live births. Bearing in mind the statistical fallacies of small numbers, no further comment will be made on these figures beyond stating that the local rates corresponded with those of the country as a whole and each was very high, judged by present day rates of mortality.

The study of infant deaths since 1920 forms the subject of this thesis and particular attention is directed to the deaths of infants occurring under the age of one month, that is, in the neo-natal period.

The material that is available has determined the extent and scope of the study. I have been able to assemble data which permit investigation and discussion of the following problems.

1. The crude infantile mortality rates.
2. Stillbirths, neo-natal and post-natal mortality rates.
3. Sex incidence in infantile mortality.
4. Infantile mortality during the war years 1939-1944.
5. The effect of multiple births on infantile mortality.
6. Illegitimacy in relation to infantile mortality.
7. An analysis and study of infantile mortality by certified causes of death.
8. The effect of the order of birth on infantile mortality.
9. Economic and social factors in infantile mortality.

1. THE CRUDE INFANTILE MORTALITY RATES.

The period of 25 years, which the inquiry covers, has been selected because any shorter period would involve numbers so small and quantitative rates so few as to have little statistical value. By comparison, countries, cities and large towns can supply ample clinical and statistical data for periods as short as one year or a quinquennium, from which a valuable scientific contribution can be made to the subject. Even over the period chosen, the total infant deaths numbered only 273, of which 148 occurred in the neo-natal period and 105 in the post-natal period. In addition, there were 167 stillbirths, making a total of 440 foetal and infant deaths. These numbers are adequate to a reasoned discussion of the trends of mortality and to comparison with other areas; and a period of 25 years is ample for a close study of the crude infantile mortality rates. The time factor does, however, prejudice full investigation of all the problems. For example, there is very little data available, from the records, of birth weight and a lack of full clinical data on the health of all expectant mothers. Indeed, seldom do we find in the published literature, material that permits an attack on all, or even many, of the problems within

the scope of one contribution. More often a selection is made by the investigator according to his aptitude and previous training and to the opportunities for research at his disposal.

2. STILLBIRTHS, NEO-NATAL and POST-NATAL MORTALITY RATES.

The division of the mortality rates into their neo-natal and post-natal components and the analysis of them provide important indications of the trends of mortality. The first year of life has been separated by McNeil into periods which he terms " the first three ages of childhood " (McNeil,C. 1943)

(1) the first, from birth and including birth to the end of the first month is termed the neo-natal period.

(11) the second, from the end of the first month to the end of the sixth month, and that relevant part of the third age, from then to the end of the first year are together termed the post-natal period.

Deaths occurring at or before birth are designated stillbirths or foetal deaths. It is important at this stage to refer to the data which are available locally for their study. Foetal mortality is considered an essential part of neo-natal mortality. The data for stillbirths in this

district are incomplete. They are, of course unobtainable before the compulsory notification of stillbirths was introduced in 1927. Statistics are available since 1929 only, but there is a lack of clinical material. It has, therefore, only been possible to deal with the problem from the statistical standpoint and relate it to the neo-natal rates from 1929. This is regretted and militates against a complete interpretation of the neo-natal mortality. I am fully cognisant of the similar ante-natal and intrapartum hazards responsible for foetal and a proportion of neo-natal deaths, and of the need to relate the aetiology of one to that of the other and to consider them as one problem. Indeed, McNeil in a paper on " Prematurity and the High Scottish Infant Death Rate" insists that any inquiry into neo-natal mortality which does not include stillbirths is incomplete (McNeil C. 1942). Also, no information is available in local annual reports (Craig, J. 1929 - 1939) to indicate the age of maturity in the stillborn. The official certificate under the Births and Deaths Registration Act 1926 merely states that the maturity is more than twenty eight weeks. The law permits the issuing certificate to be signed by the attendant midwife,

often without medical supervision, and so neither a maternal nor foetal cause is recorded for future reference. The statistics then, so far as stillbirths are concerned, are based mainly on the returns to the Sanitary Authority from which numbers, rates and sex incidence have been extracted. Those of neo-natal mortality among live births have been the subject of a careful field investigation and data of mortality rates are presented and reviewed at different ages of death within the first month. Similar separation and study of the rates of mortality have been undertaken for the entire post-natal period. The trends of mortality are therefore accurately assessed over the years covered by the inquiry.

3. SEX INCIDENCE in INFANTILE MORTALITY.

I have included figures which permit of a short survey of sex incidence and have compared the local ratios with those of the country as a whole. The preponderance of male deaths, and the supreme importance of securing the survival of the female in order to procreate future generations, emphasise the need for improved preventive measure to combat infantile mortality.

4. INFANTILE MORTALITY during the War Years, 1939 -1944.

The trends of infantile mortality locally during

the war years have been compared with rates in certain towns and cities in England and Wales, grouped respectively as dangerous and reception areas. Infantile mortality was apparently influenced to some extent by the war conditions prevailing in particular parts of the country. This district was classed as a reception area.

5. The EFFECT of MULTIPLE BIRTHS on INFANTILE MORTALITY and ILLEGITIMACY in relation to INFANTILE MORTALITY.

The effect which multiple births have on infantile mortality and the influence of illegitimacy on it have been discussed, and compared with national statistics. Where they have not seemed to influence mortality, the reasons for this have been stated. The difficulties in estimating foetal mortality associated with plural pregnancies arise from the same factors which preclude a full assessment of the general problem of foetal deaths to which reference has already been made. (page 23).

7. An ANALYSIS and STUDY of INFANTILE MORTALITY by the CERTIFIED CAUSES of DEATH.

The causes of infantile mortality analysed in this inquiry are the certified causes extracted from the death certificate. They have been fully discussed in relation to their effect on the crude mortality rates and in the two major components of the crude rates. Attention has been directed to certain

imperfections in the methods of certification and to the difficulties which arise, during research, in correlating the stated (usually clinical) causes of death occurring in domiciliary practice (and by far the greater number of deaths was certified from this source) with the anatomical causes published in hospital reviews. Opportunities are more favourable in practice for the accurate diagnosis of post-natal causes of death than of neo-natal causes. It is to be remembered that the Registrar-General is dependent for his statistical data of infant deaths, on the certified cause which he extracts from the death certificate, the information on which is supplied largely by general practitioners, who have usually little or no facilities for establishing a post-mortem diagnosis.

8. The EFFECT of the ORDER of BIRTH on INFANTILE MORTALITY.

Information on the serial order of birth in relation to infantile mortality is based here on figures arrived at after a difficult field inquiry. The system of birth registration per se in this country prevents conclusions being reached on this problem. No reference to birth order is made on the birth certificate such as is to be found in the United States of America. Birth order is, however, known to affect neo-natal mortality, therefore I have

considered it worthy of inclusion in a district investigation, in spite of the difficulties encountered in obtaining sufficient statistical evidence.

9. ECONOMIC and SOCIAL FACTORS in INFANTILE MORTALITY.

The period selected has enabled me to review infant deaths over varying periods of industrial change, through prosperity, unemployment and poverty to more stable conditions and returning prosperity, namely from the immediate post war period of the 1914-1918 War to the present time; and to discuss them in relation to social conditions, designated by the Registrar-General as Social Class Mortality. (Registrar-General - Decennial Supplement 1931). It forms an important section of a work of this kind within an industrial working class district.

One of the advantages of a field inquiry within a defined administrative area is that the investigation deals with infant deaths drawn from a cross-section of the population and not merely from a section of it as does, for example, a hospital, where figures from a high proportion of abnormal and emergency cases may give a false, or at least exaggerated, impression of the incidence of pathological states. It is true to say that the aggregate of hospital reviews forms a very substantial part of the total

published information available on the subject. Fewer investigations have been conducted under field conditions in cities, towns or rural districts. These generally cover a period of one year only, namely the International Inquiry (English Section) on Infant Mortality in Sunderland and Croydon and in selected rural districts of Staffordshire and Oxfordshire during 1927. (Campbell, J. 1929,) the studies of Cruickshank in Glasgow (Cruickshank, J.N. 1930) and that of Spence and Miller into infantile mortality in Newcastle-upon-Tyne in 1939 (Spence, J.C. and Miller, F.W.J. 1941). Hospital studies, in general, cover longer periods and deal with the more highly specialised sections of the problem such as the anatomical causes of death confirmed by necropsies, (Bundesen, H.N. et al., 1938; MacGregor, A.R. 1943) the hospital care of the premature baby, (Crosse, V. Mary 1945) the effect of various analgesic and anaesthetic agents on the survival of the infant, (Lund, J.C. 1942) the prevalence of infective processes in institutions (Benians, T.H.C. 1943) and dietetic experiments on the importance of the expectant mother's nutrition (Ebbs, J.H., Tisdall, F.F. and Scott, W.A. 1941; Utheim-Toverud, K. 1939). Field investigations confine themselves more to the studies of rates of mortality, comparative mortality rates, (Martin, W.J. 1945) age incidence and sex factors, and the influence of

of climatic, environmental and social conditions and the birth rate, on infant deaths.

It is with these last considerations that the major part of this work is concerned, for " the infantile mortality rate is probably the best index we possess to the social circumstances of an area, for the rate tends to be higher in places where bad housing, overcrowding, defective sanitation, coupled with maternal ignorance and neglect, are found ".(Jameson,W.W. and Parkinson, G.S. A Synopsis of Hygiene 1939) . I have made use of hospital statistics sufficient to relate them to the problems of infantile mortality within this district.

PART III

THE GEOGRAPHICAL AREA of the INQUIRY.

6. The BIDDULPH URBAN DISTRICT.

1. SITE.
2. ACREAGE.
3. NATURAL FEATURES.
4. CLIMATE.
5. GEOLOGY.
6. POPULATION.
7. ECONOMIC POSITION.
8. GENERAL SANITARY CONDITIONS.
    1. WATER SUPPLY.
    2. SEWAGE and SEWERAGE.
    3. HOUSING.
    4. GENERAL HYGIENE.
    5. MILK.
9. INTELLIGENCE.
10. PUBLIC HEALTH ADMINISTRATION.
11. MEDICAL and HOSPITAL SERVICES.

- - - o o o O o o o - - -

6. The BIDDULPH URBAN DISTRICT.

1. SITE.

The Urban District of Biddulph, a coal mining community in which this investigation has been carried out, consists of the civil parish of that name, lies wholly within the administrative County of Stafford, one of the West-Midland Counties of England, and occupies its north north-west corner adjoining the Cheshire border. The County is largely industrial. (Appendix, pages 3 and 4

2. ACREAGE.

The district has an area of 6674 acres, or a little less than 10½ square miles, plus 30 acres covered by water (Craig, J. and Ferguson, J. 1928-1945) and has increased by approximately one third in the fifteen year period 1920-1934. There has been no increase in the acreage since 1934. The acreage relative to that of Staffordshire and of Staffordshire to England and Wales is represented diagrammatically in Appendix page 5 .

3. NATURAL FEATURES.

It is a district of hill and vale. The chief natural feature is the Biddulph Valley, fan-shaped and embracing two-thirds of the area. The fall of the valley is towards the northern or narrow end and the gradient falls over a distance of 3½ miles from

a maximum of 671 feet at the southern end by gradations through 630 feet, 550 feet and 500 feet, in the populous part of the village to the Cheshire boundary, where it is only 370 feet above the water level at Liverpool.

The conspicuous west side of the valley rises in a millstone ridge to 1092 feet, and along the east side another millstone ridge runs due north attaining a maximum height of 1017 feet above sea level. The western ridge acts as a watershed between the Dane-Weaver-Mersey Rivers' system and the Trent water system. The drainage of the main valley runs to the River Dane and by way of the River Weaver to the River Mersey and the Irish Sea. A strip on the east and west drains to the River Trent. This river rises on the eastern millstone ridge, named Biddulph Moor, and runs by way of the River Humber, into the North Sea. The elevations of from 1017 feet to 1092 feet and the surrounding hills may be regarded as the most westerly offshoots of the Pennines.

4. CLIMATE.

The district is exposed to the north winds. The prevailing winds are south-westerly but most of the district is sheltered from these. The eastern millstone ridge is exposed to the east winds which frequently prevail between January and March, while the valley is ill-protected from north and north-west

winds. Heavy snow storms with deep drifts are common in winter. The mean annual rainfall over 17 years, for which figures are available (Craig,J. and Ferguson, J. 1928-1945), is 35.65 inches and, although an excessive rainfall is not a characteristic of the district, periodic heavy rainstorms are recorded and a feature of the weather is the number of dull sunless days. The summers are either very hot and dry, or very wet.

5. GEOLOGY.

The NorthStaffordshire coalfield is triangular in shape with the apex just falling into the Biddulph valley, and its base extending to 10 to 12 miles south beyond the administrative boundary and including the North Staffordshire " Potteries ". The strata rest on the millstone ridges and have a definite dip to the south, although the general surface of the valley slopes towards the northern gap. Originally, the gritstones and coal measures were horizontal but now they dip from north to south in the Biddulph valley where there are numerous outcrops. The measures of the Biddulph Trough basin are cradled between the two millstone grits. (Appendix page 6)

6. POPULATION.

The district has undergone an industrial urbanisation in the past 60 years. Taking the census

figures alone, the population shows increases from 5,290 in 1881, to 6,247 in 1901, 7,425 in 1911, 7,936 in 1921, 8,346 in 1931. The Registrar-General's mid-year estimate for 1941 was 9,597 and for 1945 10,310. The graph (Appendix page 7) plotting the growth of the population and its relation to the number of inhabited houses, shows a gradual but steady increase in population between 1921 and 1930 with a drop in 1926 and subsequently in the triennium 1931-1933 when "preceding years of industrial unrest and unemployment caused migration to the adjacent rural districts and towns and to the Yorkshire coalfields". (Craig, J. 1933). The rapid increase in 1934 followed a boundary extension, when an adjoining rural parish was added to the original district; the subsequent rises followed the building programmes of 1933-1938.

7. ECONOMIC POSITION.

Coal mining has always been the staple industry. There is one colliery locally, employing between 800 and 900 males of all mining occupational orders, and employment is available for a further indeterminate number at adjacent collieries beyond the administrative boundary. The miner is indigenous, coming from a long line of colliers. Until 1926, a large iron and

steel works adjoined the local colliery but finally closed down in 1928 and never re-opened as such. In 1937, the buildings were reconditioned and engineering shops for general engineering and the manufacture of mining machinery were opened on the site, and have prospered considerably during and since the war years, finding continued employment for some 400 of the male population. The iron works originally employed 500 men of all ages, part of whom, in the older age groups, formed a "hard core" of unemployment during the 1930s though some 200 of the younger men, mostly married, found irregular employment in the coal mines, in house-building and non-skilled occupations. Other subsidiary sources of employment are sandquarrying, ribbon manufacture and the provision of public services. It was estimated in 1938 (Craig, J. 1938) that there was an insured population of 3590, of which 300 were women. During the years 1941-1945 there was an average employed population of 3000, of which 450 were women (Ministry of Labour and National Service 1946)*. The district has always found employment for the married and unmarried female population though not with the regularity of male employment. In the industrial employment of women, many continue to work after marriage or, after many

* Ministry of Labour and National Service, Biddulph - Personal Communication - July 1946

years of household duties, return to local industry. Fustian or velvet cutting was for many years a small but stable local industry. It began to decline about 1932; by 1938 it had completely ceased and has not been revived. Silk mills in the adjacent town of Congleton employ many married women and girls in the manufacture of uncoated textiles. During the war years female employment was maintained at a high level in local Royal Ordnance Factories. In periods of depression and unemployment it became economically necessary for many young married women to seek gainful employment either to supplement the family income or to maintain the entire home. This was particularly so in the decennium 1926-1935, whereas it was the urgent demands of the war effort which compelled full employment in the quinquennium 1940-1944. The occupation of fustian cutting was an arduous one, silk and allied trades less so. Although the peak rates of infantile mortality occurred within this decennium, namely 115 per 1000 live births in 1928 and 102 per 1000 live births in 1931, the lowest rate ever recorded also occurred in this period namely 25 per 1000 live births in 1930. The relation of the employment of married women in industry to infantile mortality is discussed in the section dealing with economic and social

factors. House building between 1933 and 1937 provided temporary employment for males of all ages and lowered the level of unemployment from 40 per cent at which it had stood since the closure of the ironworks in 1928, to about 25 per cent. (Craig, J. 1936). Farming is carried on throughout the district. There are only a few moderately large farms. The large majority are smallholdings occupied by colliers and cultivated by them and their families, so that the number of farm servants is not great. Many properties are in a poor state of repair and require modernising. The district as a whole is industrial with a rural belt on its eastern and south-eastern outskirts. The population is scattered over various villages and hamlets and is mainly of the working class, male skilled workmen forming the largest group of employed labour. The district has suffered periods of extreme poverty especially in the middle and late nineteen twenties, but has prospered more steadily in the past ten years, with a high level of employment coinciding with the war years, 1940-1945.

8. GENERAL SANITARY CONDITIONS.

1. WATER SUPPLY.

93.8 per cent of the houses have a piped supply of water from public water mains direct to the premises. At the year ending 31st December 1945, there were 2,747 inhabited houses in the

administrative area of which only 169 were without a piped supply. These are serviced from wells and springs, and are all situated in the rural parish transferred in 1934. (Ferguson, J. 1945). The principal water supply through the distributing mains is derived from two sources (1) underground springs in the first millstone grit and consisting of a well and pumping station, and (2) natural springs delivered by gravitation to an open reservoir having a capacity of 166,000 gallons. The water is delivered to the consumer by gravitation after pumping to this reservoir and to a covered reservoir with a 188,000 gallons capacity. It has been adequate for all domestic and industrial needs until July 1941; intermittent shortages have been apparent since then, due mainly to decreased yield. The supplies have been chlorinated since July 1944. The quality has always been excellent bacteriologically and chemically, except one small supply which had a solvent and erosive action on lead until July 1944, when the necessary hardening plants were laid down. No deaths have been recorded in the district from lead poisoning either from this source or from employment in the adjacent pottery towns where, for many years, it was one of the major causes of specific occupational mortality.

2. SEWAGE and SEWERAGE.

The water carriage system and sewage disposal works were laid down in 1900 and only minor additions have been made since, but not all the district is connected direct to the sewage works, owing to inadequacy of water storage. The conservancy system prevails in old properties even in the central area and the sewage works are seriously overloaded and the effluent unsatisfactory. Many of the properties erected between 1933 and 1938 are sewered to cesspools. The provision of a complete water carriage system with extended sewage disposal facilities is one of the major needs of the district. Of the 2,747 inhabited houses, 1,507 have approved water closets, 261 of which are sewered to cesspools; there are 1,184 privy pails and 51 privies. Only a few privies and privy pails are converted to water closets annually and the Local Authority makes no contribution towards the cost of conversion. (Ferguson, J. 1945). The properties without water carriage have their sewage disposed of by direct labour.

3. HOUSING.

The housing of the people has not kept pace with the natural and migratory increase in the population during the past 25 years, except in the 1933-1937

period. There were many cases of overcrowding in the twenties, 4.2 per cent of overcrowding in 1936 and apparently substantial overcrowding during 1940-1945 when, indeed, few young married couples had homes of their own, though no actual figures are available for this period. The building boom of the thirties provided 645 new houses of all types, many poorly constructed and none to rent. Many of the older properties are in constant need of repair mainly from defective brickwork and dampness. Local authority or council houses constructed between 1924 and 1927 number 186 and absorb about 800 of the population. The average number of inhabitants per house occupied works out at 3.71 (1939), was 3.91 in 1936 and 4.65 in 1927 and as high as 5.1 in 1922. Congestion, however, is noticeable at the present time, in many houses, in spite of the most recently available figure of 3.71.

4. GENERAL HYGIENE.

The general health of the people is reasonably satisfactory. Tuberculosis has not increased beyond a normal variation. In the last decennium the standard of living has improved. Wages are not high, though they have been increased and are stabilised in the

mining industry and there are alternative trades and occupations. Wherever there is employment of married women among the working classes the family income is kept well above subsistence level. There has been no widespread unemployment since 1936.

5. MILK.

The conditions for the handling and distribution of milk are not ideal but have improved during the past 25 years. The district has many local retailers. Most of the smallholders send their bulk supply out of the area for pasteurisation. One large firm supplies pasteurised milk to its customers. There is only one farm with a Tuberculin Tested herd. The majority of retailers are accredited dealers and a few are still permitted to sell unclean milk. There is need for extensive reconditioning of premises and facilities for cooling milk and sterilisation of utensils. None of the smallholdings in the rural part of the area has a piped supply of water. Breast feeding is attempted by all mothers except a small minority; economic hardship, faulty maternal diets, ignorance and carelessness and the employment of married women in industry are the common causes of early weaning. Generally speaking the lower in the social scale the more difficult it is to persuade the mother ante-natally and in the puerperium of her

responsibilities towards her infant.

9. INTELLIGENCE.

Prior to the introduction of road transport in the 1920^{s} the district was practically a 'closed' area, with access to the towns a day's journey. Such social activities as existed centred in the church halls of the various denominations. Although public education has been general since 1870 and there are four elementary day schools, adult education at evening classes was unknown until 1925 and these facilities, together with access to secondary and technical schools in the adjoining towns, have materially increased the level of intelligence of the adult population.

10. PUBLIC HEALTH ADMINISTRATION.

(A diagrammatic tabulation of all essential public health, hospital and medical services supplying the area is included in the appendix, page 8).

The district Medical Officer of Health is a part-time official - a general practitioner - responsible to the local Sanitary Authority for the general sanitary administration of the district. This has been the practice for the past fifty years. There is one Sanitary Inspector who, until 1941, was employed in a part-time capacity, but the appointment is now full time. The County Medical Officer of Health is responsible for the special health services namely Maternity and Child

Welfare, School Medical Services, Tuberculosis and Venereal Diseases. There is close co-operation between the County and Local Authorities. There is one County Welfare Centre within the area, with a County Health Visiting Committee and two full time Health Visitors who reside locally. The Welfare Centre is housed in one of the church halls and has no facilities or equipment for special work. It was established in 1919 under the Maternity and Child Welfare Act 1918 and one session of two hours each week is devoted to ante-natal and infant welfare work. In addition, visits are paid to expectant mothers and to children under one year, and advice given.

11. MEDICAL and HOSPITAL SERVICES.

There are no maternity or other hospitals within the area. Domiciliary midwifery is widely practised. The population is served by three resident general practitioners, one to about 3,500 of the population, and four resident midwives, one of whom combines district nursing in the rural area. There is no district nurse responsible for general nursing in the urban portion of the area. Until fifteen years ago all normal confinements were carried out in the patients' homes. Now there are facilities for the hospital care of normal private cases, but not for normal hospital class patients. Specialised obstetrical help is obtainable under the

Midwives' Acts 1918 and 1926 for all abnormal cases irrespective of their economic position, and with general-hospital facilities where necessary. Two consultant obstetricians appointed by the County Council under these Acts serve a population of almost 100,000. There are no special domiciliary facilities for the care of the premature infant and no nurses or health visitors specially trained to deal with this problem: nor is there any unit attached to the neighbouring hospitals which provides separate accommodation for the premature baby. There is a lack of adequate provision for the hospital care of pregnant women. There is no maternity hospital, except a private annexe of 20 beds to one of the general hospitals, which receives only private ' booked cases' for confinement, under the care of the family doctor. Obstetrical emergencies are admitted to one of the general hospitals, 10 miles distant and to one cottage hospital, 12 miles distant, where their treatment is supervised by obstetrical specialists. To these hospitals also are admitted ante-natal and puerperal morbid cases but then only to the general wards. The Public Assistance Institution,9 miles distant, receives only those patients referred through the public assistance office. They are attended by the medical officer of the institution, who is a general practitioner. He has facilities for obtaining the services of an obstetrician under

arrangement with the County Council.

There is no children's hospital nearer than Manchester 30 miles distant and it is little used by patients from this district. Two wards are set aside for the care of children and infants in each of two of the Stoke-on-Trent general hospitals and they are under the supervision of consulting surgeons and physicians. In these hospitals there are special departments of ophthalmology, oto-rhino-laryngology, dermatology, radiology, gynaecology and pathology. All other medical work in the general hospitals is carried out by general physicians. There is no paediatrician attached to any of the general hospitals. Orthopaedic work is carried out in one special hospital of 30 beds and in addition two wards in one of the general hospitals are utilised for this specialty.

7. DEFINITION of TERMS.

Before proceeding with the detailed statistical study of infantile mortality, it is important at the outset to have certain uniformity of definition of the terms used in that study. By so doing, comparison of records will thereby be rendered reasonably accurate and will not be nullified by a multitude of definitions applicable at any time to any community.

Although there is no unanimity in certain definitions there is, in others, an accepted standard which is of universal application. Of these latter, reference has already been made to one of them, namely the infantile mortality rate.

The infantile mortality rate is the number of deaths of infants in a community under one year of age per 1000 registered live births. It is calculated annually as follows :-

$$\text{INFANTILE MORTALITY RATE} = \frac{\text{INFANT DEATHS during the year}}{\text{NUMBER of LIVE BORN INFANTS registered during the year.}} \times 1000$$

Strictly speaking one year's rate is not comparable with those of other years unless the birth rate remains fairly constant. All the infantile mortality rates in this study are obtained on the basis of the deaths under one year in the course of a year and the births in the course of the twelve months in which the deaths occurred. In all years in England and Wales, except 1921, the infantile

mortality rates have been calculated in this way and therefore permit of a recognised precise basis of comparison of mortality rates elsewhere.

The neo-natal mortality rate is the number of infant deaths registered under one month of age per 1000 registered live births.

The post-natal mortality rate is the number of deaths registered between one and twelve months of age per 1000 registered live births.

An infant in vital statistics is recognised as a child under the age of one year.

Infantile mortality is the death of a child under one year of age.

A stillbirth is defined in England and Wales under the Births and Deaths Registration Act 1926 (16 and 17. Geo.5,c.48) Section 7 (2) (1) in the following terms : " 'Stillborn' and 'Stillbirth' shall apply to any child which has issued forth from its mother after the twenty eighth week of pregnancy and which did not, at any time after being completely expelled from its mother, breathe or show any signs of life. "

The neo-natal period is synonymous with McNeil's "the first age of childhood" (McNeil C. 1943) and comprises the first month of life and includes birth. His plea that it should include stillbirths has been adopted in this inquiry.

The terms premature birth, prematurity and premature baby, in their strict sense, should include all infants born before they have reached full maturity (Crosse V. Mary 1946) These are tooindefinite for precise comparison of records, so the recommendation by the International Committee of the League of Nations at Geneva in 1937 that " any infant weighing 5½ lbs or less at birth is regarded as a premature baby regardless of the period of gestation" is now the generally accepted definition and is the one used here.

Social Class, in its relation to infantile and occupational mortality, has been defined in England and Wales by the Registrar General in his Annual Review of 1911 and his Decennial Supplements of 1921 and 1931. Using the census returns of these years he grouped males and females according to their occupation into five social classes. These occupational orders indicate the father's social status in relation to the mortality of legitimate infants, or that of the mother when the infant is born out of wedlock. The pertinent local occupations within each social class are detailed in the section of this study dealing with economic and social factors in infantile mortality. Occupation alone is not thought directly to influence infantile mortality. " It may be stated as a broad generalisation that infant mortality depends in the first place on physical and mental selection of the parents,

which are responsible to a large extent for the inherited physical stamina, the scale of income, the diet and other attention given to the infant, and to a slighter extent for the housing conditions, all these factors being collectively expressed in the social classification. " (Registrar-General's Decennial Supplement 1931). The social classification used in this study is based on that in Table 4A of the Registrar-General's Decennial Supplement, England and Wales 1931, Part IIa Occupational Mortality, (pages 220-226). This permits comparison of national and other records. Broadly, the five social classes are :-

Class I The upper, professional and middle classes.

Class II The lower middle classes.

Class III All skilled workmen.

Class IV Semi skilled labour.

Class V All unskilled labour.

The subject matter of this thesis is such that it does not deal with the more controversial aspects of definitions. For example, there is no precise or accepted definition of upper and lower weight limits for premature stillbirths or a lower weight limit for premature live births, which McNeil advocates. (McNeil, C. 1942). Nor is there agreement on minimum weights which would justify a definition of previable or abortion. Henderson suggests birth weights below 1250 grammes should be considered previable, (Henderson, J.L. 1945) but Baird argues that "since

some infants of this weight survive and many live for days they can hardly be classified as abortions " (Baird, D. 1945). He agrees with McNeil that there is a better case for having a lower weight limit for stillbirths. As recently as 1938, Ronsheim classed all infants born between 28 and 38 weeks as premature if they weighed less than 5½ lbs (2400 grammes) and all others as full term irrespective of their birth weight (Ronsheim, J. 1938) and De Lee observes that too often in the past what constitutes a stillbirth, a live birth and a neo-natal death was apparently a matter of choice. (De Lee, J.B. 1938).

It is apparent that there is need for international agreement on many still disputed definitions within this subject, though much more uniformity has been obtained in the last decade, even if the last word on the subject has not yet been heard.

In order to make comparisons as accurate as possible I have adhered in the text to the most generally accepted definitions.

8. The CRUDE INFANTILE MORTALITY RATES.

The crude infantile mortality rates, calculated annually, serve as numerical indices which signify, over periods of time, the trends of mortality.

In this industrial area, with its population ranging between 8000 and 10,000 inhabitants over the past 25 years, the level of the rates, and especially any downward trends are measures of the efficiency of the infant welfare and other medical services, of the social and economic conditions under which the people live and of the effective co-operation of the mother in the practice of mothercraft and maternal efficiency.

Their comprehensive investigation forms the focal point from which the study of all the other practical problems involved in infant deaths proceeds. Their trends are, in the end, the important index of improvement or decline in the health standards within the area. Before proceeding with the study of the local mortality rates an indication of the trends of infantile mortality for the administrative industrial county of Stafford is important. The administrative portion of the county is composed of twenty five urban districts and ten rural districts, excluding, of course, the County Boroughs. Thirteen of the urban districts are mainly mining communities and three of the rural ones have important coal workings within their boundaries. A comparative

analysis of the county and national infantile mortality rates since 1930 demonstrates that the county infant death rate is slightly above that of the average for the country as a whole, (Carruthers, W.D. 1944)

TABLE 4

COMPARATIVE INFANTILE MORTALITY RATES 1930 - 1945

STAFFORDSHIRE and ENGLAND and WALES.

YEAR.	STAFFORDSHIRE.	ENGLAND and WALES.
1930	64	60
1931	70	66
1932	69	65
1933	69	64
1934	57	66
1935	66	57
1936	67	59
1937	61	58
1938	57	53
1939	58	50
1940	55	55
1941	63	59
1942	52	49
1943	50	49
1944	48	46
1945	47	46

and each has shewn steady improvement over the past fifteen years. It would be unusual, in a district of this type, to find a definite similarity in the annual rates, closely comparable with those in the above table, permitting any forthright opinion on the trends of mortality. Much greater detailed study of the rates is necessary to express opinions on them. In fact, no such similarity is to be found.

A close scrutiny of the graph plotted for the local annual rates (Appendix page 9) reveals that there have been wide ranges of difference in the yearly figures in the past quarter of a century. This is particularly apparent in the first sixteen years (1921-1936). Disregarding the abnormally low rate of 25 in 1930 "which constitutes a record which may not be reached again for many years" (Craig, J. 1930), in only two years were the rates below 50, and they were widely separated in time, being respectively 48 in 1922 and 44 in 1934. In the majority of the remaining thirteen years the rates were subject to wide annual fluctuations, with high peaks in 1928 (115), 1931 (102) and 1935 (90). Most of the rates in other years were above 60. Although it is apparent that there has been little or no significant improvement in the annual rates prior to 1936, some amelioration has since taken place, namely in the decennium 1936-1945. It appeared probable from a study

of the graph that the rate was reaching a lower, stable level in the immediate pre-war years, for it did not exceed 44 (1937) in the period 1936-1939. It suffered rapid successive rises, however, in the next three years (1940-1942). The figure of 66 in 1941, the highest in this period, coincided with a period of maximum physical and mental stress on the population, occasioned, no doubt, by the unaccustomed system of food rationing, the 'shift' method of employment among female as well as male workers and the strain of 'black out' conditions. Since then, it has shown further irregular decline and in the last year of the inquiry (1945) was only 38 per 1000 live births. But although,broadly speaking, the rates have been lower in the last decade there are still annual fluctuations which, if less violent, are yet unstable. They require closer examination. This is undertaken in the investigation of the components of the annual rates. While it is generally accepted that averages have little statistical value, the improvement in the crude rates in the past ten years is given a certain weight when the mean values of the rates in the two consecutive decennia, namely 1926-1935 and 1936-1945, are examined. In the first, the mean infantile mortality rate was 71.2; in the second it was 45.7. This is a substantial difference, and is accounted for by the lower range in the rates for individual years in the last decade. This is set out

in the following table.

TABLE 5

INFANTILE MORTALITY RATES-BIDDULPH URBAN DISTRICT.

	1926 - 1935	1936 - 1945	
YEARS	RATES	RATES	YEARS
1926	72	33	1936
1927	71	44	1937
1928	115	43	1938
1929	64	37	1939
1930	25	57	1940
1931	102	66	1941
1932	61	58	1942
1933	68	28	1943
1934	44	53	1944
1935	40	38	1945

The standard deviation values in the respective periods are 26.6 (1926-1935) and 15.4 (1936-1945). The mean coefficient of variability has remained fairly steady, the values being 37.8 per cent (1926-1935) and 35.2 per cent (1936-1945) indicating that as infantile mortality falls, the relative disparity between the best and the worst years remains unchanged.

A comparison of the local annual rates with those of England and Wales (Appendix page 10) demonstrates that the national rates over the period 1921-1945 were

roughly within the same range, but were more stable and showed a gradual and steady improvement. There were no violent annual fluctuations. Although there is room for further improvement, the decline from 83 in 1921 to 46 in 1945 must be regarded as favourable. It represents the 1945 percentage as 55.42 of 1921. The corresponding local rates were 94 (1921) and 38 (1945), giving the 1945 percentage as 40.42 of 1921. Rising national rates are recorded in the first two full years of the recent war (1940 and 1941) since when there has been a slow decline. The reduction in the national rate over the war years, from 50 in 1939 to 46 in 1945 was much better than had been anticipated as the war progressed.

Thus far, the investigation of the crude infantile mortality rates has done nothing more than to indicate the broad trends, and the evidence assembled suggests quantitative rates which show in the graph plotted for individual years (Appendix page 9) a series of irregular waves, the crest of each successive wave not always being lower than that of the one before. It does, however, suggest, apart from the abnormally high peaks of 1928, 1931 and 1935 and a smaller high peak in 1941, that there has been some progressive decline in the rate, bearing favourable comparison with that of the country as a whole. This is apparent over the years 1932-1945, for in this period the trough of the waves is on the whole much lower

than the yearly troughs in the period 1921-1931, with the exception of the low rate in 1930. Too close a study of the graph is apt to be confusing, for there is an instability about the rates which makes their meaning difficult to assess. It is, however, reasonable to infer that the trend is downward but fluctuating and that this favourable lower range began in 1936. In order to obtain a more precise, and less perplexing, assessment of the local trends of mortality, I have separated the twenty five year period into its five component quinquennia and have plotted, (Appendix page 11) and tabulated the mean rates for each quinquennial period.

TABLE 6

INFANTILE MORTALITY RATES - BIDDULPH URBAN DISTRICT.

QUINQUENNIAL PERIODS 1921 - 1945

QUINQUENNIAL PERIODS	MEAN INFANTILE MORTALITY RATES.
1921 - 1925	70
1926 - 1930	69
1931 - 1935	73
1936 - 1940	43
1941 - 1945	48

It is now apparent that in the fifteen year period 1921-1935 the rates have remained uniformly high round a figure

of 70, and that they do not vary beyond a maximum range of 4. A marked decline begins in the fourth quinquennium (1936-1940) with the mean rate only 43, and is maintained at a slightly higher level (48) in the last quinquennium (1941-1945).

The 1941/45 percentage of 1921/25 is 68.55.

The 1936/40 percentage of 1921/25 is 61.42.

A comparative analysis of the rates of certain other countries over the same quinquennia shows declining rates in the successive five yearly periods. They are less rapid than in this district, but each shows some decline since the 1936-1940 period, although the rate of the decline varies.

TABLE 7

MEAN QUINQUENNIAL INFANTILE MORTALITY RATES 1921-1945.

	1921-1925	1926-1930	1931-1935	1936-1940	1941-1945	1941-1945 percentage of 1921 - 1925.
BIDDULPH URBAN DISTRICT	70	69	73	43	48	68.55
UNITED KINGDOM	78	70	65	59	47	60.25
ENGLAND AND WALES	76	68	62	56	50	65.79
SCOTLAND	92	85	81	76	69	75.00
NORTHERN IRELAND	82	79	78	77	76	92.65
UNITED STATES of AMERICA (white population)	71	63	54	47		66.19 ✓

✓ 1936 - 1940 percentage of 1921-1925.

Attention has already been directed to the fact that there are thirteen urban districts in Staffordshire in which coal mining is the major industry (vide supra page 51). All are situated in or adjoining the South Staffordshire Coalfield, except Biddulph and the contiguous urban area of Kidsgrove (North Staffordshire Coalfield); and the municipal borough of Tamworth (Mid-Warwickshire Coalfield). (Appendix page 6). None has a population comparable with this district, except Kidsgrove (14,080) and Tamworth (12,120), each of which has in addition a rural or semi-rural belt and subsidiary industries. They are the only districts within the administrative county suitable for a useful comparative analysis of the crude infantile mortality rates. The 'Black Country' towns of the South Staffordshire Coalfield are all highly industrialised with populations and annual live births ranging between two and four times those of this district. Each of the three rural districts, previously referred to as having coal mining as an important industry, has a far larger population than this district and is therefore unsuitable for accurate comparison of the mortality rates.

I have, therefore, prepared a composite graph representing the annual infantile mortality rates for the two urban districts of Biddulph and Kidsgrove and the municipal borough of Tamworth (Appendix page 12).

The yearly rates for each district follow a similar trend, violent oscillations being a feature, particularly in the period 1921-1935, without any tendency to a declining rate except, perhaps, in the case of Tamworth. Kidsgrove recorded the very high unenviable rate of 127 in 1927. Tamworth has, on the whole, improved rates and a lower range over this period with a peak of only 96 in 1927. The favourable downward trend observed in the Biddulph mortality rates over the last decade (1936-1945) (Appendix page 9) characterises those of the two other districts. They do, however, show similar instability but less gross variations either in themselves or one with another. Tamworth shows the greatest fluctuations in this period and the rates have a slightly higher range. Over the 25 years, Kidsgrove shows the greatest relative improvement, for the mortality figures were far in excess of those of the other districts between the years 1921 and 1927 and indeed continued unstable but with a lowering range until 1934.

The analysis of these annual crude infantile mortality rates demonstrates that over the past 25 years, the rates for this district bear favourable comparison with those of two mining areas of approximately similar type and within the same administrative county. The truth of this is further tested by a study of the mean

rates for quinquennial periods since 1921.

TABLE 8

MEAN QUINQUENNIAL INFANTILE MORTALITY RATES 1921-1945.

DISTRICTS	1921-1925	1926-1930	1931-1935	1936-1940	1941-1945
BIDDULPH	70	69	73	43	48
KIDSGROVE	90	82	63	57	47
TAMWORTH	72	67	54	53	54

The mortality rates for Kidsgrove Urban District have declined to a lower level than those of the other areas and through a much wider range. Though the rates for Tamworth Municipal Borough are more stable, they are higher in the last quinquennium (1941-1945) and show no improvement in the last fifteen years (1931-1945).

No doubt similar factors influencing the maintenance or decline of the crude mortality rates operate in each of the urban districts. The districts are administered by the same central public health authority and have similarly constituted local sanitary authorities. Possibly, differences in housing conditions, in sanitation, standards of living and intelligence contribute to variations in the mortality rates. But these variations are not widely divergent; and it may be that this comparative analysis will prove useful. For although the further detailed study of infant deaths will only be

directed to this district, it will lead finally to conclusions, designed to promote their reduction, which may justifiably be applied to the two other urban districts.

SUMMARY.

There are wide annual fluctuations in the local crude infantile mortality rates (1921 - 1945), greatest over the period 1921-1936.

Peak rates occurred in 1921 (92), 1928(115), 1931 (102) and 1935 (90).

The favourable downward trend began in 1936; the rates, however, remained unstable although the range was lower than in any previous period. The quinquennial rates confirm this.

The rates compare favourably with those of England and Wales, with those of the administrative county and with those of two selected industrial urban districts of comparable size within the county.

The only favourably low stable rates are recorded in the years 1936-1939. This level is not maintained during the war years, 1940-1945, though the annual oscillations are less violent than in previous comparable periods.

The graphs plotted for the crude infantile mortality rates suggest slight, progressive but irregular decline in the past ten years.

9. STILLBIRTHS, NEO-NATAL and POST-NATAL MORTALITY RATES.

Although the evaluation of the crude mortality rates has indicated, in a general way, some reduction in mortality in the last decennium, it affords no clue to the reasons underlying this reduction, nor to the irregular rises and falls in many of the yearly rates since 1921. Some method of division of the gross rates according to the age at death of the infant is, therefore, necessary initially for a proper appraisal of this instability. Farr, as long ago as 1885, wrote in his "Vital Statistics" that " as tests of sanitary conditions, the death rates in age groups under one year ----------, are more important than the rates in any other age period." (Edge, P.G. 1944). Since sanitary conditions include personal, community and environmental hygiene, the components of the yearly rates may be said to throw more light on the distribution of deaths, the age at death and the cause of death than the crude infantile mortality rates themselves. At least, they form the first steps in their study. Moreover, they can be assessed as exact numerical indices and are easily measurable; and they express the crude mortality rates in defined age periods within the first year. Variations in the component rates will signify in what age periods improvement has or has not kept

parallel to the general improvement. All subsequent investigations can, therefore, be concentrated on the particular age period contributing most to the total crude infantile mortality rates, and its relationship, if any, to sanitary conditions, examined.

Since it is the usual practice of the Registrar-General to separate the deaths within the first year into defined periods, it will be convenient to adopt his classification in this inquiry. Deaths occurring within the first year are divided broadly into two groups.

Group 1. Deaths occurring within the first four weeks. These are termed neo-natal deaths.

Group 2. Deaths occurring from the end of the first four weeks to the end of the first year. These are termed post-natal deaths.

For the purpose of the more detailed study of infantile mortality rates at different ages of death of the infant, I have subdivided Group 1. into

(a) deaths occurring under one day.

(b) deaths occurring between one day and one week.

(c) deaths occurring between one week and one month.

and Group 2 into

(a) deaths occurring from four weeks to three months.

(b) deaths occurring from three months to six months.

(c) deaths occurring from six months to nine months.

(d) deaths occurring from nine months to twelve months.

The deaths occurring in Group 1 form a line of division which represent, roughly speaking, those due to maternal and obstetrical factors; and Group 2 deaths include those arising mainly from infections.

Group 1. In order properly to present the size and shape of the problem, the investigation of the deaths of live born infants within the first month must include, so far as local statistics permit, that large mass of potential life lost by stillbirth. When it is considered that, in this mining area, out of a total of 273 deaths occurring between 1921 and 1945, 148 or 54.2 per cent occurred within the first four weeks of life, the problem of the causes, prevention and reduction of neo-natal mortality is manifestly the major one. But when to it, the stillbirths are added, the deaths apportioned to the neo-natal period as defined by McNeil (vide supra page 47) rise steeply in numbers and percentages and introduce an even more serious problem. The numbers of stillbirths, in this district, are known

only since the beginning of 1929. From then until the end of 1945, no fewer than 167 stillbirths were registered. This, at once, increases the number of infants either born dead, or viable but dead within four weeks, to 315 out of a total now raised to 440. The percentage number of deaths in the neo-natal period is thus increased from 54.2 to 71.6 - a formidable rise. Even these figures underestimate the total wastage of neo-natal life during the past 25 years, for the compulsory notification of stillbirths was not introduced until 1927, under the Births and Deaths Registration Act 1926. No returns were therefore to be expected for the first six years of the inquiry, but there was, in fact, none for the first eight years. Allowing for this omission, the stillbirths form slightly more than one third (or 38 per cent) of the known total loss of infant life. If complete figures over the twenty five years had been available, the percentage loss of infant life from stillbirths would probably have been in the region of 50 per cent. Complete figures of the number of infants stillborn and the number born alive but dying within the first year are, however, available over the years 1929 to 1945. They are respectively 167 and 164 and are analysed in the following table.

TABLE 9

ANALYSIS OF STILLBIRTHS 1929-1945 BIDDULPH URBAN DISTRICT.

YEAR	NUMBER OF STILLBIRTHS	NUMBER OF LIVE BIRTHS	STILLBIRTHS PERCENTAGE of LIVE BIRTHS.	NUMBER of DEATHS under 1 year.	STILL-BIRTH RATES.
1929	11	171	6.4	11	1.26
1930	12	159	7.1	4	1.48
1931	7	167	4.2	17	0.83
1932	7	165	4.2	10	0.84
1933	6	147	4.1	10	0.72
1934	8	158	5.1	7	0.88
1935	16	177	8.04	16	1.62
1936	12	180	6.6	6	1.26
1937	9	182	4.9	8	0.92
1938	12	186	6.4	8	1.22
1939	5	176	2.8	7	0.51
1940	13	174	7.4	10	1.35
1941	17	212	7.01	14	1.74
1942	7	225	3.1	13	0.71
1943	9	209	4.3	6	0.90
1944	10	188	5.3	10	0.98
1945	6	190	3.1	7	0.58
TOTALS	167	3066	5.3 Mean	164	-

The stillbirth percentages are high in all years except 1939, 1942 and 1945. The total number of stillbirths is greater than the total number of infant deaths.

In this same seventeen year period (1929-1945) the deaths in the first week numbered 75 and the total for the entire neo-natal period numbered 95. If to this latter figure are added the stillbirths, they may be said to represent the deaths from neo-natal and obstetrical causes; and from the aggregate of the total neo-natal deaths namely 167 (stillbirths) and 95 (neo-natal deaths) the fact emerges that in the period 1929-1945, out

of a total number of 331 stillbirths and infant deaths, no less than 262 of these or 79 per cent occurred in the neo-natal period. If we omit the stillbirths, the percentage falls to 57.7.

TABLE 10

STILLBIRTHS and NEO-NATAL DEATHS 1921-1945.
BIDDULPH URBAN DISTRICT.

AGE PERIOD	1921-1945	1929-1945
TOTAL INFANT DEATHS.	273	164
TOTAL NEO-NATAL DEATHS.	148	95
NEO-NATAL PERCENTAGE OF TOTAL DEATHS.	54.2	57.7
INFANT DEATHS PLUS STILLBIRTHS.	-	331
TOTAL NEO-NATAL DEATHS INCLUDING STILLBIRTHS.	-	262
NEO-NATAL PERCENTAGE OF INFANT DEATHS AND STILLBIRTHS.	-	79.0

The percentages of neo-natal mortality among live born infants show no marked variations in the 25 year period (54.2) and the 17 year period (57.7), but the percentage is markedly raised, namely by 21.3 in the 1929-1945 period by the inclusion of stillbirths. The inevitable omission of these deaths in the first eight years of the inquiry still gives a corrected neo-natal percentage of 71.6 of the total known mortality over the twenty five years.

It is thus apparent that the high neo-natal mortality attributable to stillbirths after viability, renders the study of their causation of primary importance. The paucity of data, however, prevents this. Accurate conclusions cannot, therefore, be reached. Much information, fortunately, is available on the aetiology of the actual loss of life in the neo-natal period, contrasting with that of the potential loss from stillbirths in the same period. The application of this knowledge to the problems of foetal deaths should ensure a reasoned discussion on neo-natal mortality in all its aspects.

Since the study of the components of the yearly infantile mortality rates, that is, the neo-natal and post-natal mortality rates, cannot be accurately investigated if the stillbirths are included, no further reference to stillbirths will be made at this stage. Their significance as an integral part of the neo-natal mortality of this district is now sufficiently clear.

Groups 1 and 2. One important fact so far disclosed is that 54.2 per cent of deaths of live infants in the past 25 years occurred within the first four weeks of life, that is, in the neo-natal period.

I have prepared a graph showing the yearly neo-natal and post-natal infantile mortality rates between 1921 and 1945. (Appendix, page 13). This reveals that in 12 years

the neo-natal mortality exceeded the post-natal mortality; that in 5 years the rates were equal and that in the remaining 8 years the post-natal rates exceeded those in the neo-natal period. An important feature of the trend of post-natal mortality is that the excess mortality assigned to this period occurred mainly in six years between 1922 and 1929, since when it has been much more favourable and has exceeded the neo-natal mortality only in 1939 and 1943. It would appear from a study of the graph that while in the last ten years (1936-1945) there has been some improvement in the neo-natal mortality rates, this has not equalled in any way the lower more stable rates of the post-natal period. It is also manifest that over the entire period (1921-1945) the neo-natal rates are much more unstable and show very little real reduction even in the last quinquennium (1941-1945) by comparison with those twenty years before (1921-1925). In the intervening years they make by far the greatest contribution to the total crude mortality rates. Indeed, the 1930s produced the highest proportion of neo-natal deaths, and in six years, namely 1930, 1931, 1933-1935 and 1938, the mortality far exceeded the post-natal mortality. This period saw marked extension of unemployment benefits to men and women after several years of privation, with a consequent levelling

up of home comforts amidst enemployment, which had, in the late twenties become stabilised at 40 per cent; a steady increase in house building from 1933, with less overcrowding, and the provision of new houses for the married wage earners; increased employment of women in silk mills, and from 1935 onwards more regular employment of men in the coal mining industry. Although increased family income, better standards of living and amenities do not seem in themselves to play any part in lowering the neo-natal rates, they may effect a reduction in the post-natal rates, the maintenance of which is due to deaths from infections, and is dependent more on the social conditions and economic status of the family. The increasing employment of women, and of married women, forced by circumstances to supplement the family income, led often to undue hardship when pregnancy supervened, with consequent maternal ill-health, premature confinements, and infants too weak to survive.

Three of the war years, 1940, 1941 and 1942, produced high neo-natal mortality rates when female employment was at its height; and in 1943 and 1945, comparatively high post-natal rates coincided with marked overcrowding, when young married couples lived in circumstances least suited to the care of their infants. In 1925, 1926 and 1927 raised post-natal mortality rates coincided with a period of national depression, a major

coal stoppage, destitution relieved by the Board of Guardians, and much poverty and unemployment. (Craig,J. 1929) The housing shortage was acute. Overcrowding was one of the major problems in three years of the first quinquennium 1921, 1923 and 1925, when post-natal mortality rates were high. It seems indisputable that the irregular higher neo-natal mortality rates are the major element in the uneven decline in the crude mortality rates. It may be said with truth, that, had the decline in the neo-natal rates kept pace with the post-natal rates, the total rates would have been stabilised at much lower levels.

In order to place in proper perspective the incidence of mortality in the two age groups, I have prepared five tables of mortality arranged in sub-divisions according to the age at death of the infant (Appendix pages 14,15,16,17,18). Each table comprises five consecutive yearly periods since 1921. A broad division is first made of neo-natal and post-natal deaths, separated for sex, numbers and mortality rates. The neo-natal group (Group 1.) has been further arranged in three divisions, namely, deaths under one day, from one to seven days and from one week to four weeks. The post-natal group (Group 2)has been separated into four periods (vide supra pages 64 and 65).

The tables demonstrate the contribution which each sub-division makes to the component rate, and their

analysis reveals the following important facts.

GROUP 1. NEO-NATAL MORTALITY.

(a) Deaths under one day were not a major factor in mortality except in seven years, namely 1929, 1935, 1936 and 1942 - 1945, when they produced mortality rates of 17, 34, 11, 32, 4.7 and 16 respectively, and neo-natal percentages ranging between 50 and 100 per cent, with a mean of 65. The mean neo-natal mortality under one day over the 25 year period was 11.05 per 1000 registered live births.

(b) Similarly, deaths between one and seven days formed the major portion of the neo-natal mortality rate in only ten years and were irregularly distributed over the period. Four high rates occurred respectively in 1921, 1924, 1927 and 1928, three in 1933, 1934 and 1938 and three in 1940, 1941 and 1943. The mean infantile mortality rate was 13.5. An important fact emerges from the study of (a) and (b). In no less than eighteen years, the majority of neo-natal deaths occurred within the first week. In fact, in 1933, 1936, 1941 and the triennium 1943-1945, all the deaths in the neo-natal period occurred in the first week. The mean figure over the twenty five year period demonstrates that the percentage of neo-natal deaths occurring

in the first week is as high as 65.8. The mean infantile mortality rate for first week deaths is 24.2. In his Aberdeen review of 1938-1944, Baird assigns an infantile mortality rate of 28.00 for first week deaths (Baird,D. 1945).

(c) The neo-natal mortality in the period one to four weeks showed rates which on the whole were lower than those of the two other earlier age periods. The mean rate was 9.14 in a total neo-natal rate of 33.34. The mean percentage of neo-natal deaths was reduced to 27.4. Three important facts were revealed by the analysis of this group, (1) that they contributed the highest rates in only four years, namely 1922, 1926, 1930 and 1939 (2) that in five years they showed nil returns, namely 1936, 1941 and 1943-45 and (3) that in the remaining 16 years they contributed a mean percentage of 24.5 to the total neo-natal rates and a mean infantile mortality of only 9.5.

TABLE 11

MEAN RATES OF NEO-NATAL MORTALITY in AGE PERIODS 1921-1945 BIDDULPH URBAN DISTRICT.

AGE PERIOD	MEAN NEO-NATAL RATE	TOTAL DEATHS
UNDER ONE DAY.	11.05	51
1 to 7 DAYS.	13.15	58
1 week to 1 month.	9.14	39
TOTAL. BIRTH to 1 MONTH.	33.34	148

Over twenty five years, 109 deaths in the neo-natal period, or 73.6 per cent, occurred within the first week. Of an average neo-natal death rate of 33.34, a proportion as high as 24.2 was attributable to mortality within seven days of birth. Since neo-natal mortality is the larger component of the crude rate, the analysis has demonstrated that it is the deaths in the earliest part of the neo-natal period which require the closest study.

GROUP 2 POST-NATAL MORTALITY.

The mean post-natal mortality rates over the 1921-1945 period were more or less stable in the four age groups, and highest in the 6 - 9 months group. The mean total rate for the post-natal period was less (27.45) than that of the neo-natal period (33.34). These gross mean rates do not give any accurate picture of trends of mortality in the different age groups in a particular period except that they show little variation in range and are lower than in the neo-natal period.

TABLE 12.

MEAN RATES OF POST-NATAL MORTALITY IN AGE PERIODS 1921-1945 BIDDULPH URBAN DISTRICT.

AGE PERIOD	MEAN POST-NATAL RATES	TOTAL DEATHS
4 weeks to 3 months.	6.74	32
3 to 6 months.	6.38	29
6 to 9 months.	7.40	34
9 to 12 months.	6.95	30
TOTAL. 4 weeks to 12 months.	27.47	125
TOTAL MEAN INFANT MORTALITY. BIRTH to TWELVE MONTHS.	60.81	273

GROUPS 1 and 2. NEO-NATAL AND POST-NATAL MORTALITY.

For the reasons just discussed a table (Table 13) has been prepared to show the trends of mortality in the two age groups - the neo-natal period from birth to one month, and the post-natal period from one month to twelve months - arranged for the five quinquennial periods. A study of the graph plotted to show the crude rates in consecutive quinquennia (Appendix page 19) reveals marked flattening of the curves with no skew peaking, and a marked fall in the rates in the 1936 - 1945 decennium after regular high waves in the previous three five yearly periods.

TABLE 13

TRENDS OF MORTALITY IN QUINQUENNIAL PERIODS IN THE TWO AGE GROUPS 1921-1945 BIDDULPH URBAN DISTRICT.

QUINQUENNIAL PERIODS.	MEAN INFANTILE MORTALITY RATES.	MEAN NEO-NATAL RATES. (BIRTH TO ONE MONTH).	MEAN POST-NATAL RATES. (ONE TO TWELVE MONTHS).
1921 - 1925	70	34 (48.6%)	36 (51.4%)
1926 - 1930	69	37 (53.6%)	32 (46.4%)
1931 - 1935	73	45 (61.6%)	28 (38.4%)
1936 - 1940	43	23 (53.5%)	20 (46.5%)
1941 - 1945	48	27 (56.3%)	21 (43.7%)

The mean rates for the two major components of the mean total rates show high rates for the neo-natal period in the first three quinquennia followed by a proportionate fall in the fourth quinquennium in keeping with the fall

in the mean crude rates, and succeeded by a rise (27) in the last quinquennium. The mean rates in the post-natal period, which mean, in effect, mortality rates from infections, show a gradual but steady decline from 36 in the first quinquennium to 21 in the fifth, and the mean rates are lower than those in the neo-natal period with the exception of the period 1921-1925. When the mean total rates rise or are maintained at a high level, the disproportion between the major component rates as shown in the table is apparent except in the first quinquennium. It seems that the more unstable neo-natal rates keep the gross rates high, and any decline is due more to the steady fall and lower rates in the post-natal period. The table also shows that much greater improvement has been effected in the post-natal rates, and had a similar proportional improvement occurred in the neo-natal rates the gross figures would have been much better.

The composite graph which illustrates the total yearly rates, superimposed on which are the quinquennial rates for the two major components - neo-natal and post-natal - (Appendix, page 19) confirms the well known fact stated by Gale that the decline of mortality in the neo-natal period has been very much less than that of the mortality due

to infections. (Gale, A.H. 1945). In the same graph in which the rates for the five quinquennial periods are also plotted, the decline in both components is less regular in the neo-natal period than in the post-natal, which has much lower total rates except in 1921-1925. When the yearly rates only are plotted the decline is much less obvious for the waves are more irregular, and tend to be confusing. An examination of this graph (Appendix, page 19) together with the tables for the five quinquennia separated for individual years, shows that the post-natal rates contributed most to the total rates in only 9 years, (1921, 1923, 1925, 1926, 1927, 1929, 1939, 1943 and 1945); that the reduction in mortality in the post-natal group was least marked in the twenties, but has improved ever since, and that the neo-natal rates are still the major cause of high infantile mortality and that even over a quarter of a century the decline has not kept pace with the fall in the post-natal rates.

TABLE 14

ANNUAL NEO-NATAL and POST-NATAL MORTALITY

BIDDULPH URBAN DISTRICT 1921-1945

YEAR	NEO-NATAL MORTALITY RATES.	POST-NATAL MORTALITY RATES.	TOTAL INFANTILE MORTALITY.
1921	38	56	94
1922	30	18	48
1923	27	38	65
1924	43	18	61
1925	34	49	83
1926	24	48	72
1927	26	45	71
1928	88	27	115
1929	29	35	64
1930	19	6	25
1931	66	36	102
1932	30.5	30.5	61
1933	40	28	68
1934	38	6	44
1935	51	39	90
1936	16.5	16.5	33
1937	22	22	44
1938	26	17	43
1939	16	21	37
1940	35	22	57
1941	42	24	66
1942	40	18	58
1943	9.4	18.6	28
1944	26.5	26.5	53
1945	19	19	38

In eight years the post-natal rates exceeded the neo-natal rates. In five years the rates were equal.

It may be said that twenty five years is too short a period for division into quinquennia from which dogmatic conclusions can be drawn. I have, therefore, prepared a graph (Appendix, page 20) which plots the average of the rates for each of two successive yearly periods (1921-1944). This may be regarded as a compromise and not wholly satisfactory, since mortality may be high in two successive years or low in two successive years, but it may give a better picture of general trends over a period of only twenty five years than the quinquennial method. The graph begins with a rate of 70 (1921-1922) and finishes with a rate of 40 (1943-1944), and goes through less violent fluctuations than the yearly graph, but is less regular than the quinquennial curve. It confirms the improvement from 1931 with the only real rise thereafter in 1941-1942. The high peak of 1927-1928 coincides with the highest mortality figures (115) of 1928, and the rapid drop in 1927-1930 coincides with the lowest recorded rate (25) in 1930. It is much less confusing than the yearly curves, and demonstrates high rates in the first decennium, improved rates in the second and signs of still more improvement in the first half of the third decennium. It gives a better picture of the years of high rates than does plotting for quinquennial periods only.

The separation of the total rates for the two successive yearly periods into their two main components - neo-natal and post-natal - (Appendix page 20) shows wider fluctuations than the quinquennial rates, and higher neo-natal than post-natal rates except in three periods namely, 1921-1922, 1925-1926 and 1943-1944. The decline in the post-natal rates has been much more regular, and there is marked improvement in the second decennium, (1931-1940) and prospects of further improvement in the third. It should be noted that the neo-natal rates show a tendency to decline in the last decennium but are less stable than the post-natal rates. The high peaks (1927-1928 and 1931-1932) coincide with high crude rates to which the neo-natal mortality makes the major contribution, as indeed it does in all two yearly periods except the three mentioned. Falls in neo-natal rates often coincide with falls in total rates. There is even some improvement in the neo-natal rates apparent in each successive decennium, and it confirms the impression gained from the quinquennial data that if these figures could be further reduced the total infantile mortality rates would be much better.

The raw material so far sifted for trends of mortality and the division of the rates into age groups would seem to suggest that the infantile mortality rates for this district are not abnormally high, that

they have shown a decline over the twenty five years and have certainly shown an improvement in the post-natal mortality rates, especially in the last decade.

The causation of neo-natal mortality seems to be the major problem. Without neglecting to follow up the favourable influences which have contributed to the decline in the post-natal rates, the conditions maintaining neo-natal mortality need very close scrutiny. The graph (Appendix, page 13) plotted for yearly neo-natal and post-natal rates shows very irregular fluctuations in the annual neo-natal mortality, marked over the first fifteen years and unstable over the remainder of the period. Moreover, there seems to be little or no relation between the rates from year to year in the two groups, as if each group were susceptible to entirely different influences.

The solution of plotting curves in quinquennial periods succeeds in ironing out these violent fluctuations, but obscures sudden changes of mortality, The " two successive yearly period " method gives a better, more accurate over all picture of the trends, and does not flatten the curves to the point of eliminating the changes.

TABLE 15

NEO-NATAL MORTALITY 1938-1943.

	1938	1939	1940	1941	1942	1943
BIDDULPH URBAN DISTRICT	26	16	35	42	40	9.4
ENGLAND & WALES	28.30	28.27	29.61	29.00	27.23	25.22
SCOTLAND	35.70	36.50	37.20	39.90	35.10	32.90
ABERDEEN	34.10	35.5	44.5	45.5	37.30	39.90
GLASGOW	36.70	37.50	40.01	48.80	44.1	37.20
EDINBURGH	25.30	32.80	34.40	33.80	25.06	24.95
GREATER LONDON	22.7	23.4	25.0	27.1	24.9	-
NEW YORK	24.7	24.8	24.4	22.0	21.0	-

It is evident from the table on neo-natal mortality (1938-1943) that the local rates compare favourably with the country as a whole, and with some cities in it, and Stocks postulates a time within the next ten years when a goal of 17 for the neo-natal mortality and 8 for the rest of the first year of life, giving an infantile mortality rate of 25, might well be aimed at. (Stocks, P. 1944).

SUMMARY. STILLBIRTHS, NEO-NATAL and POST-NATAL MORTALITY RATES.

An analysis of the infantile mortality rates in defined age periods has been undertaken.

The periods are, respectively, neo-natal (Group 1) and post-natal (Group 2).

Each Group has been further sub-divided into component age periods in order to present mortality rates at varying ages of death.

The error of omitting foetal deaths from neo-natal mortality has been established.

Over twenty five years (1921-1945), out of a total mortality of live born infants of 273, 148 or 54.2 per cent occurred in the neo-natal period. The inclusion of 167 stillbirths since 1929 increased this percentage of deaths of viable infants to 71.46. In the period 1929-1945 the total neo-natal percentage of deaths of infants live born and of viable infants stillborn was as high as 79.

The component mortality rates (neo-natal and post-natal) have been graphically represented and studied in annual, biennial and quinquennial periods. In seventeen years, the neo-natal mortality rates exceeded or equalled the post-natal rates. In only eight years did the reverse order prevail.

During the twenty five year period under review the crude infantile mortality rates have shewn improvement. This is largely due to the steady falls and stability of the post-natal component. The mortality of the post-natal period exceeded that of the neo-natal period mainly in the 1920s. Since then there has been a slow decline in post-natal mortality, the rates of which since 1936 have been stabilised around a figure of 20. The 125 post-natal deaths are fairly evenly distributed over the period 1 - 12 months.

Neo-natal mortality rates by comparison display a

higher range, more unstable annual fluctuations and a tendency to irregular decline only in the past ten years. In eighteen individual years the majority of neo-natal deaths occurred within seven days of birth. It is this neo-natal component which maintains the total crude mortality rates and retards the rate of decline.

10. SEX INCIDENCE IN INFANTILE MORTALITY.

It will have been observed from an examination of the tables of mortality (Appendix, pages 14,15,16,17,18) that the deaths have been arranged, inter alia, into sex incidence at selected periods within the first year. In the period under review (1921-1945) the over all sex ratio was 158 boys to 115 girls, or three boys to two girls. In five years only, 1924, 1925, 1931, 1939 and 1943, was the mortality among girls greater than that among boys, and in a ratio of slightly less than two to one. Currie observes that, "Infant mortality is higher throughout for boys than for girls. It includes the neo-natal deaths which occur in the first month of life ----------". (Currie, J.R. Hygiene 1938).

Taking the local neo-natal and post-natal mortalities by sex, the same preponderance of boys over girls prevails. In the neo-natal period the ratio was 90:56, and in the post-natal period 68:59.

The hazards of excess mortality in the first year of life appear to affect boys more than girls. The reason may be that there are more male than female births and consequently more males at risk. In this district over the twenty five years there was a total of 4,538 live births, 2,328 males and 2,210 females, equivalent to a ratio of 102 males to 100 females.

Roberts states that " Male births are usually greater in number than female births in the ratio of about 104 to 100". (Roberts, Ll. 1941).

SUMMARY

The local sex ratio of mortality among infants follows the generally accepted findings, namely that males suffer a slightly greater mortality than females in the first year of life.

11. INFANTILE MORTALITY during the WAR YEARS 1939-1944.

The impact of total war between the years 1939 and 1945 was not experienced with equal force in all parts of the country. Some areas were vulnerable and suffered casualties, homelessness and evacuation. They were thus denuded of a vital proportion of their resident population. Others, by contrast, lived throughout in comparative safety with the minimal upheaval that the exigency of war imposed. On them, often, devolved the duties of officially receiving and billetting evacuated persons, including families, with a consequent abnormal increase in their total population.

It is instructive, therefore, and not without importance, to compare the rates and trends of mortality during the war years in certain towns and cities in England and Wales specified as dangerous, evacuation or reception areas and to discuss the influence of war conditions on the mortality rates. This district was officially designated a reception area.

I have accordingly prepared a table of the rates of infantile mortality for six of the war years (1939-1944) for this district, for England and Wales and for certain cities in England. (Table 16). In his Annual Review of 1937, the Registrar-General gives rates of infantile mortality for England and Wales; those for

the five year period (1933-1937) have been incorporated in the table (Registrar-General 1937). They serve as a basis of comparison with those of subsequent years.

TABLE 16

INFANTILE MORTALITY RATES 1933-1937 AND FROM 1939-1944.

	1933-1937	1939	1940	1941	1942	1943	1944
ENGLAND & WALES	59	50	57	60	51	49	46
BIDDULPH URBAN DISTRICT	56	37	57	66	58	28	53
BIRMINGHAM	64	70	72	75	57	55	42
COVENTRY	53	55	67	56	64	50	49
LIVERPOOL	84	71	87	110	76	81	58
MANCHESTER	74	62	72	89	66	61	55
NEWCASTLE-upon-TYNE	85	63	65	78	61	64	51
OXFORD	38	23	41	35	34	33	25
SHEFFIELD	57	48	56	70	50	56	42
STOKE-on-TRENT	82	61	62	63	51	63	52

The year 1940, in each instance, shows an increase in the infantile mortality rates. In 1941, all the rates are high except in the case of Coventry and Oxford, the former probably from mass evacuation following the casualties it suffered and the latter from its residential nature and comparative security. The rate for this district (66) followed the similar high trend of all the other areas, doubtless from the increasing stress of the third full year of war. Liverpool rates are consistently

high except in 1944. All the areas except the Biddulph Urban District show declines in their 1944 rates. Locally this is due to the exceptionally low rate of 28 recorded in 1943. The 1944 rate does, however, show an actual reduction over the rates for the earlier war years.

The reductions in the infantile mortality rates in the earlier years of the war, as Gale says " are surprising, if housing conditions and overcrowding are decisive factors." (Gale, A.H. 1945). Rather would it be expected that the widespread employment of married women would affect the rates unfavourably. The trends manifested in the table would seem to discount this too. It may be, as Gale suggests, and as I have put forward in the section dealing with economic and social factors in infantile mortality, that greater prosperity and increased family income, together with an increasing consciousness of the value of priority protective foods for the mother and the infant are particularly important influences. The low rates in 1944 would seem to imply that the benefits of these would not be apparent until the later wartime years. It is significant that the only low local rate of note in this period is in 1943 (28) when these conditions of prosperity prevailed, in spite of much overcrowding and

domiciliary midwifery in difficult circumstances. Full use, too, was being made by then of the extra allowances of milk and vitamin supplements by the large majority of expectant and nursing mothers. There was little doubt that they were becoming more receptive to dietary instruction. The meagreness of existing rations perhaps facilitated the desire as well as the need for these protective products.

A significant fact established from a study of the above infantile mortality rates is that every rate in 1944 is lower than the corresponding mean rate for the 1933-1937 quinquennium, and in almost all the selected towns it is substantially lower. Even such severely damaged areas as Manchester, Newcastle-upon-Tyne and Sheffield record this substantial reduction and in the case of Newcastle-upon-Tyne and Liverpool to a greater degree than such official "safe" areas as Oxford and Stoke-on-Trent.

SUMMARY.

The effects of the war on infantile mortality have not been wholly bad.

The rates do, indeed, suggest that improved dietary care and the increased lay and medical knowledge of essential protective foods may be a major factor in maintaining lower rates in years to come.

It does not appear that overcrowding by itself has increased mortality in the first year of life during the period covered by the recent war.

12. The EFFECT of MULTIPLE BIRTHS on INFANTILE MORTALITY.

The inquiry hitherto has dealt with the problems of infantile mortality in their broader aspects, for example the rates and trends of mortality. It has not been possible to progress much beyond a quantitative review of the stillbirths as they affect the neo-natal mortality, though their relation to it is fully established. A much more searching inquiry has, however, been possible into the causes of death among live born infants. It is with these particular causal factors that this section and the three subsequent ones are concerned. They comprise all the available known aetiological data on the subject within this district. It is from the conclusions drawn from their detailed study that recommendations towards further progress in the reduction of infantile mortality can be made.

273 deaths occurred among live born infants between 1921 and 1945. Of these deaths 158 were male and 115 female. In no case was the sex unknown. Although the total number of multiple births is not known, 15 deaths occurred among infants in association with multiple births. The multiple births were in each case twin births. The cause of death in every case, except one, was prematurity, with congenital heart disease as a secondary cause in one case; one

second twin died of bronchitis. In all the other cases of multiple births, both infants died. I can only trace this one instance from the records in which one twin died and one survived. The causal factor of premature birth in all other cases is, no doubt, the reason for this non-survival of either twin. The percentage of total infant deaths is 5.5, that is, 15 deaths out of the total of 273. A Ministry of Health inquiry in 1927 into the general causes of infantile mortality gives figures of multiple births, and the percentage deaths among them as 13.8 (Campbell, J. 1929). According to Potter and Crunden, in the University of Chicago, the combined foetal neo-natal death rate for 660 reportable twin infants was 13.3 per cent and prematurity was the outstanding cause of death. They did not find, however, that the second twin had an increased birth hazard. (Potter, E.L. and Crunden, A.B. 1941). When it is realised that one out of every 42 children born in England and Wales in the second half of 1938 was a twin, in a total of 310,000 live births, the percentage of infant deaths among twins must be small in comparison with that among single births. (Registrar-General, 1938).

The incidence of infantile mortality in this district among multiple births is small. Prematurity increases the hazards to both infants. Even if statistics of

stillbirths in association with multiple pregnancies were available, it is doubtful if the percentage would reach the level of those quoted.

The probability that the onset of premature labour will terminate a twin pregnancy is well known. The age of maturity necessary for the survival of a twin infant is thought to be less than that for a single born infant. The dangers to the infant from multiple pregnancy should not be greater than with single births given reasonable facilities for ante-natal, obstetrical and infant care. With further advances in these, it should be possible to effect a greater reduction in infant deaths occurring directly as a result of multiple pregnancy.

SUMMARY

5 per cent of the total infantile mortality occurred locally over twenty five years in association with multiple births.

In all cases, except one, prematurity was the certified cause of death.

When pregnancy terminated prematurely neither twin survived.

13. ILLEGITIMACY in relation to INFANTILE MORTALITY.

138 illegitimate live births were registered in this district from 1921 to 1945, of which 76 were boys and 62 girls. Ten infants died under one year of age or 7.2 per cent. This represents an infantile mortality rate, both sexes, of 72.46 per 1000 illegitimate live births. Separated for sex, the male illegitimate infantile mortality was 90.8 and the female rate 48.3. Out of a total of 4538 registered live births only 0.23 per cent of infant deaths occurred in association with illegitimacy.

The number of deaths showed no relation to the war years, only two occurring during that period. Illegitimacy is a predisposing cause of non-survival. There is usually a greater lack of care and attention given to unmarried expectant mothers. After birth, illegitimate infants are often denied the care and attention necessary for their survival. It cannot be said that illegitimacy is an important causal factor in infantile mortality in this area, nor can it be considered a factor of any importance compared with other influences. Apart from the war years, eight of the deaths occurred respectively in 1921 (two), 1922, 1924, 1928, 1929 and 1938 (two). Among the ten illegitimate live infants, no fewer than seven died from prematurity, the degree of maturity in no

instance exceeding 30 weeks. Two of the cases of prematurity followed ante-partum haemorrhage, the infants surviving respectively one minute and four hours. Two weeks was the longest duration of life among the illegitimate deaths from prematurity. In the five other cases the infants survived only 4 hours, 6 hours (two), 1 day and 4 days. One infant weighed only 2½lbs and may be considered previable. In four of these seven cases, no previous preparation had been made for the confinement and the midwife attended on an emergency summons. Of the three others, one was a breech delivery. Death followed 6 hours later from Asphyxia Pallida; there had been no prior ante-natal care. One died of convulsions after 4 months in a poor home, where it had almost certainly been improperly fed, and the third died of pneumonia in the care of an unsatisfactory foster mother. Five of the mothers were in domestic service, including one designated "housekeeper", and four were employed in local fustian and silk mills. One was the daughter of a farmer and employed by him. In each case the mother was unmarried. One case, therefore, occurred in Social Class II and the nine others in Social Class III.

TABLE 17

ILLEGITIMATE DEATHS by SOCIAL CLASS of MOTHER.

BIDDULPH URBAN DISTRICT 1921-1945.

SOCIAL CLASS II	SOCIAL CLASS III
Farmer's Relative.	Domestic Servants. (5)
	Machinists. (3)
	Velvet Cutter. (1)

In view of the extremely small number of illegitimate deaths, it is doubtful if it is worth while distributing them by social class. They do seem, however, in this district to be related to illegitimacy as observed by the Registrar-General in his Decennial Supplement for Occupational Mortality for England and Wales 1931. (Registrar-General, 1931. pages 383/384). He states there that illegitimate deaths registered between 1930 and 1932, by social class were seven times greater among Class III workers than Class IV (semi-skilled) or Class V (unskilled); and Class II were lower than all classes except Class I. In fact, the figures given for domestic servants (1930-1932) are higher than in any other class or in any other occupation, namely 3,446, the next worse being 221 among unskilled workers (Class V). These findings are in proportion to those for this district.

Similarly, the Registrar-General's causes of death among skilled workers (Social Class III) compare in relative frequency with those registered here, the order of frequency in both cases being premature births, pneumonia, convulsions and birth injury, but owing to the very small number of illegitimate live births the local rates are not strictly comparable.

TABLE 18

ILLEGITIMATE INFANTILE MORTALITY BY CAUSE OF DEATH.

	PREMATURE BIRTH.	PNEUMONIA.	INFANTILE CONVULSIONS.	BIRTH INJURY.
BIDDULPH 1921-1945	50.7	7.3	7.3	7.3
ENGLAND and WALES. 1930-1932.	34	12	3	3

It is of interest to record that the percentage deaths of legitimate infants (1921-1945) per 1,000 live legitimate births was 6.04 with a mean infantile mortality of 60.81. The percentage deaths among illegitimate infants was 7.24, and the infantile mortality per 1,000 illegitimate live births 72.46.

SUMMARY

Mortality among illegitimate infants (7.2 per cent) is higher than among legitimate born infants (6.04 per cent.

Only 0.23 per cent of all infants live born, died in association with illegitimacy.

It is not a major factor in infantile mortality in this district.

The majority of the deaths occurred in infants born to social class III workers, mainly domestic servants. The Registrar-General states that illegitimate deaths are seven times greater in this class than any other, and greatest among infants of domestic servants than in any other occupation.

Prematurity is the greatest single cause of deaths, contributing an infantile mortality rate of 50.7 out of a total rate of 72.46, and the period of survival is very short.

The circumstances of the death of illegitimate infants suggest that they receive less care than legitimate born infants.

14. An ANALYSIS and STUDY of INFANTILE MORTALITY by the CERTIFIED CAUSES of DEATH.

Reference has already been made, (vide supra, page 82) whilst discussing neo-natal and post-natal mortality rates, to the apparent dissimilarity in the rate of decline of each group, suggesting that the differences may be due, amongst other things, to different causes.

It is with the analysis of the causes of death that this section deals. The study of them is based on the information extracted from the death certificate. The fact that the scope of the investigation has been limited by the material available and by a lack of post-mortem and hospital facilities within the area, makes it necessary to analyse the deaths in this way. It is to be remembered that the certified cause is not necessarily the true cause of death.

It is the usual practice to separate the certified causes of infant deaths broadly into three groups, as suggested by Jameson and Parkinson, based on certification with or without post-mortem examination. (Jameson,W.W. and Parkinson, G.S.1939)

1. Developmental conditions, including injury during birth, prematurity, debility, convulsions, malformations,etc.

2. Respiratory diseases.

3. Gastro-enteritis.

The first group comprises " various vague and ill-defined causes of death, where often a definite diagnosis is most difficult to obtain" (Campbell, J. 1929). It corresponds to the deaths occurring in the neo-natal period. The second and third groups include infants dying usually after the first month and before the end of the first year. They correspond to the deaths occurring in the post-natal period and include, besides respiratory and intestinal diseases, the common infectious diseases such as measles and whooping cough, together with tuberculosis, meningitis and a few miscellaneous conditions.

For the purpose of this present study of infantile mortality by certified cause of death, I have grouped my causes into two classes only, the first group as it is designated above, and groups two and three together as the second group. This has been rendered necessary by the comparatively few deaths available for analysis even over a period of twenty five years. It has enabled me to divide the causes of death into two groups only,

(1) NEO-NATAL, corresponding roughly to Group 1, and

(2) POST-NATAL, corresponding to Groups 2 and 3,

and so to ensure a reasoned discussion of the total infantile mortality, of the deaths apportioned into group causes, or, when appropriate for the purpose, into single causes, where it is considered that these influence the rise or fall in mortality rates. It is not widely believed that single causes do so.

A table of the principal causes and their mortality rates (Appendix page 21) has been prepared to show the number of deaths from the principal causes, the percentage number of deaths from these causes and the infantile mortality rates. The high percentage and rates of Cause 1 (Prematurity) indicate that prematurity is the chief cause of death. When Cause 4 (Congenital Malformation and Debility) is added to it, they account for practically one half (49.8 per cent) of the certified causes of death under one year of age. Unfortunately, these are the causes which react most unfavourably on the infant because of its poor vitality or defective development. Although some of the developmental anomalies are no doubt unavoidable, for no cases of German measles have been recorded in association with them, far better facilities than at present exist in domiciliary practice, or even in local general-hospitals, are essential if a reduction in the death rate from prematurity is to be accomplished. Cause 2 (Respiratory diseases) includes, mainly, deaths from broncho-pneumonia

and bronchitis. They have the second largest mortality rates of all the principal causes of death. I have excluded from this group the terminal respiratory complications of whooping cough and measles. Among the Non-Infective and other Infective illness (Cause 3), I have included convulsions per se where no indication is given on the death certificate of the aetiology, only the apparent terminal sign. Five were stated to be associated with dentition and three with marasmus. Where there was a stated primary respiratory or infectious cause the death was assigned to it. The acute infectious diseases (Cause 5) include mainly whooping cough and measles, and to a much smaller degree, meningitis. Influenza is an extremely uncommon certified causal factor among the infant deaths and occurs only on one occasion in each of two years, 1926 and 1927. Scarlet fever and diphtheria have not once been certified as a cause of mortality in the first year of life. The low percentage and mortality rate from gastro-intestinal diseases (Cause 6) are the more striking, for I have included among them, not only the acute diarrhoeal diseases, but the congenital and surgical ones as well. Of the other causes of death (Cause 7) birth injury is apparently a negligible certified causal factor, for it only occurs as a primary cause on two certificates. This,

together with a few ill-defined causes, contributes a percentage of only 4 to the total deaths and an infantile mortality rate of only 2 per 1000 registered live births. This examination of the causes of death extracted from the death certificate discloses that they conform generally to the experience of the country as a whole.

Tables of infantile mortality (1921-1945) have been prepared to show the NEO-NATAL and POST-NATAL deaths by age and certified cause of death, that is deaths falling into Groups 1 and 2 respectively. (Appendix pages 22 and 23)

GROUP 1 (NEO-NATAL DEATHS).

A study of the table of neo-natal deaths (Appendix page 22) reveals that 148 deaths occurred in the neo-natal period. Of these, no less than 101, or 68.2 per cent, were due to prematurity for they were certified in such terms as "Prematurity", "Premature Birth" and " Premature Debility". No indication was given of the cause of the prematurity, if known,(for prematurity itself is seldom a true cause of death), based on "the extreme liability of the premature infant to death from birth injury, infection and foetal deformity during the first four weeks of life". (Crosse, V.M. 1945). The preponderance of deaths from prematurity in the entire

first year of life, namely 39.5 per cent, is relatively small by comparison with the deaths from this cause in the neo-natal period, namely 68.2 per cent. This predominant position of "Prematurity" as a certified cause of death is the outstanding feature of the neo-natal mortality. It far surpasses the aggregate of all other causes of death assigned to the neo-natal period. A review of the mortality in the first month of life arranged in five quinquennial periods (Appendix page 24) confirms that, in each quinquennium, the total neo-natal rates are high when the prematurity rate is high. Any improvement is manifested by a lower gross neo-natal rate except in the quinquennium 1931-1935. Prematurity as a cause of death shows no downward trends, and accounts respectively for percentages of the total neo-natal mortality of 51,65, 62,62 and 81 in each successive quinquennium, and 68.2 per cent of the total deaths in the neo-natal period over twenty five years. Of all causes of deaths under one year, prematurity is responsible respectively for percentages of 26,45,39,35 and 47 in successive quinquennia, and 39.5 per cent of all deaths.

The percentage of 68.2 for neo-natal deaths in association with premature births is 10.9 per cent higher than that recorded by Crosse(57.3 per cent) in Birmingham City Hospital in 1943 (Crosse,V.M.1946)

and 8.2 per cent higher than Abrahamson (60 per cent) gives in the United States of America (Abrahamson, H. 1941). The United States Bureau of the Census gives 47 per cent of neo-natal deaths from prematurity (Crosse, V.M. loc cit 1946) and Beck reports 60 per cent of neo-natal deaths among premature births. (Beck, A.G. 1941). The local figures are also in excess of the total figures for prematurity as a cause of neo-natal mortality recorded by Baird in Aberdeen during the years 1938-1944, namely 338 premature deaths out of a total of 747 neo-natal deaths, or 45.2 per cent. (Baird, D. 1945). Over the same years (1938-1944) the local premature infantile mortality rate was 21.01 compared with 17.1 in Aberdeen. Crosse's studies in Birmingham confirm the findings that when prematurity deaths are high, the neo-natal rates are high, and that this cause of death has been reduced in the City of Birmingham since 1938, namely from 62 per cent in the period 1938-1941 to 24.3 per cent in 1944. No reduction has been effected in these rates in this district. Indeed the rate (22.47) for the last quinquennium (1941-1945) is much in excess of the rate (16.96) for the first five year period (1921-1925).

As "nearly three quarters of all neo-natal deaths occur in the first week and about half of them on the first day" (Holland, E. 1944) and as the comparative

percentages for this district are respectively 73 and 34, and almost 90 per cent are attributable to prematurity, any moderate improvement in neo-natal mortality in the past twenty five years is more due to a reduction in the deaths in the last three weeks of the neo-natal period than to a reduction in any of the individual causes. It is certain that no reduction has been effected locally in deaths from prematurity, for it forms 72 per cent of all the deaths in the first two weeks of the neo-natal period. "If all premature births could be eliminated the neo-natal death rate could be more than halved". (Crosse, V.M. 1946). When it is considered that 87 per cent of all the neo-natal deaths in the area occur within the first two weeks of life and of these, 72 per cent are certified in association with premature births, the problem resolves itself into control of the premature onset of labour and is mainly a maternal and obstetrical one. From the facts already set forth, it is only by an attack on this major cause of infantile mortality that most progress will be made. Probably a proportion of premature infants are born malformed or mentally enfeebled, which Nature discards after a varying period of precarious and useless existence. The vast majority are, however, born fit and would otherwise have been capable of normal uninterrupted development but for the lack of full facilities for

1. the care of the pregnant woman,
2. the conduct of abnormal and difficult obstetrics in the most favourable surroundings, and
3. the prevention of the new born from infection, to which it is extremely susceptible.

For these facilities to be put into the hands of the general practitioner, in domiciliary work, under the present system is impossible. Too often " unaided, and in unsuitable surroundings, he may have to deal with complications that would test the promptness and skill of the most eminent specialists". (Holland,E.1944). Wide extension of the existing maternity services, with facilities to the general practitioner for post-graduate study and access to beds in maternity hospitals, and a closer liason with the local authority ante-natal services, together with the provision of properly trained nurses for the care of the infant and particularly of the premature infant, would so increase the quality of the technical services as to lessen greatly the wastage of infant life from prematurity. Only by evolving a closely integrated medical, obstetrical and paediatric service can this ultimately be achieved. In this district under the existing midwifery and ancillary services no reduction at all has resulted in the neo-natal mortality among prematurely

live born infants over a period of twenty five years.

Congenital malformation and development defects are together the second commonest cause of neo-natal deaths recorded on the death certificate. They form, however, only 9.46 per cent of the total neo-natal mortality. Pulmonary atelectasis, as a certified cause, accounts for only five per cent. It would appear that birth injury is a very minor cause. The deaths from congenital malformations, pulmonary atelectasis and birth injury occurred, with but one exception, only in the neo-natal period. It is seldom possible to find such full information on a death certificate as in hospital and post-mortem records. It may be that the certified cause of death lacks a stated infant or anatomical cause, for example in prematurity, or it may be, that the certificate represents an understatement, perhaps from unwillingness to certify facts, such as in case of birth injury following forceps delivery or breech extraction, in premature and full time births. There seems little doubt that in domiciliary practice, the neo-natal causes of death are less likely to be so accurately certified as those occurring after the first month.

The greatest single stated cause of death in this district occurs in the death certificate simply as "Prematurity".

Scarcely ever is a qualifying maternal or infant cause given for the prematurity. For this reason, comparison with the data found among the published literature on the subject is rendered less useful and often unsatisfactory. This applies, not only to the neo-natal period, but to the entire first year of life. For example, the investigations of Bundesen et al., in the Chicago Lying-in-Hospital, showed that among 2283 infants, an autopsy was necessary satisfactorily to establish the true cause of death. Their data indicated that cerebral haemorrhage, congenital malformations, pneumonia and asphyxia were the leading anatomical causes of infant deaths. (Bundesen, H.N. et al. 1938). Similarly, MacGregor, working on the anatomical causes of neo-natal and foetal deaths in the Simpson Memorial Pavilion, Edinburgh, found that intra-cranial haemorrhage was one of the principal causes, and asphyxia ranked as the most frequent of the common causes of death. (MacGregor, A.R. 1943). The discrepancy between the clinical certified causes and those anatomical causes is apparent. MacGregor found also that developmental malformations occurred in 15 per cent of the neo-natal deaths. In this area, the percentage was 9.5. In a clinical-pathological

study of infant and foetal mortality over an eleven year period (1931-1941) at the Chicago Lying-in-Hospital, Potter and Adair reviewed the mortality among 27,321 infants born. The total mortality was 4.28 per cent and of this, 81 per cent were subjected to post-mortem examination. They presented evidence to show that asphyxia occurred more frequently among all deaths than any other abnormal condition, that intra-cranial haemorrhage and major malformations each formed fourteen per cent of the total deaths, that pneumonia was the cause in only six per cent of all foetal and infant deaths, and that only four fatal cases of haemorrhagic disease were confirmed among almost 28,000 babies, an incidence of 1 in 7000. This last is a surprising finding in view of modern recommendations for the administration of vitamin K to every pregnant woman prior to her delivery. Among neo-natal deaths, the commonest cause was intra-cranial haemorrhage, with asphyxia almost as frequent. Major malformations were third and pneumonia assumed a constantly increasing importance with increasing age of the infant. Asphyxia was found to be the commonest cause of death among premature infants too. 25 per cent of " prematures" died apparently from inadequate development only, no specific lesion being

found. Birth trauma came third among the causes of death in premature babies, and malformations were fourth in about the same proportion, namely 13 per cent. (Potter,E.M. and Adair,F.L.1943). McNeil considered infection to be a major causal factor among deaths from prematurity (McNeil,C.1942). The disparity between the anatomical and the certified causes, which latter are usually based solely on clinical findings, is wider in the neo-natal group. They approximate more closely to the anatomical in the post-natal group of deaths, wherein the different causes can usually be certified more exactly, by reason of better opportunities for clinical study during life.

By comparison with the deaths in the post-natal group, those from the acute infections play a relatively unimportant part during the first month. Although "Convulsions" are found among the causes of neo-natal deaths in the same proportion as the infections, namely 5.5 per cent, they occur in the death certificates only in the 1920s. Their absence subsequently may be due in part to a gradual improvement in the assignment of deaths to the real causes instead of to the terminal event. The same single diagnosis of "Convulsions" occurs among the post-natal deaths only in the earlier years of the inquiry and is probably due to the same

causes, as well as, perhaps, to a decline in the deaths from the real causes themselves, usually infections.

GROUP 2 (POST-NATAL DEATHS). (Appendix page 23)

Generally speaking, the majority of the deaths in the post-natal group are from respiratory diseases, communicable infectious diseases and gastro-intestinal diseases. Only seven premature infants lived long enough to be included in this group. It is noteworthy that no case is certified from syphilitic infection. This conforms to some extent to the findings in the Staffordshire Section of the Ministry of Health Inquiry No. 55 (Campbell, J. 1929) when only one case was certified from this cause out of 111. It is unlikely to have contributed to the foetal mortality, for the disease is very rare at all ages within this area. Of the 125 deaths occurring after the first month of life, 64 or 51.2 per cent were certified from respiratory disease and the respiratory complications of infectious disease. Only four cases certified as tuberculosis are recorded during 25 years. Gastro-enteritis forms slightly more than ten per cent of the post-natal deaths. The dividing line between the neo-natal and the post-natal deaths is very clearly marked ------prematurity and congenital malformations forming the bulk (78 per cent) of the total wastage

among live born infants under one month of age, respiratory, infectious and intestinal diseases the bulk (61 per cent) in the subsequent period.

The conclusions to be drawn from these findings are:

1. that, in this district, the mortality among prematurely live born infants is high and that the excess of neo-natal mortality is due largely to the excess mortality from prematurity;
2. that there has been no reduction in mortality among prematurely born infants over the period of twenty five years (1921-1945);
3. that uncomplicated respiratory diseases and infectious diseases together cause the highest mortality rates after the first month; and
4. that gastro-intestinal diseases have comparatively low rates, but show no decline in the period reviewed.

ANALYSIS of DEATHS by SINGLE CAUSES.

The tables (Appendix pages 24 and 25) set out in greater detail single certified causes of deaths. They confirm certain facts. It is known that one of the most important causes of decline in the general

death rate in this country for all ages, during the past 50 years, has been the gradual control of epidemic and infectious diseases. This is applicable to the infant mortality rates from these causes within this district.

Among the infectious group of diseases, no deaths are recorded from diphtheria or scarlet fever. The figures for Measles are low throughout and coincide with epidemics in 1929, 1933 (a severe type of disease) and 1939. Whooping Cough, a serious disease in infancy, shows an actual rise in mortality rates in the 1931-1935 (3.68) and the 1941-1945 (3.90) quinquennia, higher than the corresponding rates for England and Wales, namely 2.5 and 1.25 in the same quinquennia. No doubt, the respiratory complication of broncho-pneumonia as the exciting cause of death, if included in the respiratory group, would have reduced the whooping cough death rate. I have, however, been careful to include all deaths from whooping cough, with or without complications, under the primary cause. As many more infants are at risk during an epidemic compared with the number at risk from bronch-pneumonia without whooping cough, the rates cannot be considered unduly high. The decline is less satisfactory than could be hoped for by comparison with a national rate of 1.2 in the period 1935-1938,

although it contributes a mean rate of only 2.45 per 1000 over 25 years out of a total mean local rate of 60.81. It indicates, however, that whooping cough is still a very serious disease under the age of one year.

A large proportion of the deaths occurring in childhood are attributed to Pneumonia. It is stated by Martin that about one seventh of all infant deaths, or, excluding the diseases in the neo-natal period, about one third, are assigned to this cause (Martin, J.W. 1945). The local figures are almost similar to these, being about one seventh (or 15 per cent) of all infant deaths, and slightly less than one third (or 30 per cent) of the deaths after the age of one month. But there has been a striking fall in the local infantile mortality rates from broncho-pneumonia in the last decade. They have declined by three quarters compared with the rates in the first three quinquennia (1921-1935) covered by the inquiry.

Despite the rather large reduction in mortality from this cause, the relative position of Bronchitis has not changed much, though the rates are all on a much lower level, and the rate of 2.22 in 1936-1940 compares favourably with that of England and Wales (2.15) in the same period.

There has been no noticeable decline in the rates for Gastro-enteritis, certainly no improvement in it.

It is the second most important cause of death after the first month and is accounted for largely by a high rate of 5.00 in the 1926-1930 quinquennium, associated with an outbreak of summer diarrhoea in 1928. But for this, and assuming this figure had averaged those of the other quinquennial periods, namely 2.37, gastro-enteritis would have occupied fifth place instead of second as a cause of post-natal infantile mortality. Again, although the levels of the rates are not high and gastro-enteritis accounts for only one twenty-fifth or 4.7 per cent of the total deaths at ages 0 - 1, the rate in the last quinquennium under review (1941-1945) is 50 per cent higher than that in the first (1921-1925). In England and Wales diarrhoeal diseases account for about one tenth of the total infantile mortality (Martin, J.W. 1945); in 1920-1924 the rate was 9.53 per 1000 and in 1935-1938, 5.92. Although the rates are higher for the country as a whole, the speed of their decline has been more rapid than in this district.

All forms of Tuberculosis are negligible as a cause of local infantile mortality, only four certified deaths occurring in twenty five years. They form only 0.88 of the mean total rate and compare favourably with rates for England and Wales of 1.61 (1920-1924) and 0.65 (1935 -1938). Their importance as a cause of death under the age of one year is less than other diseases, but they

rank second in frequency at this age as a cause of mortality during childhood.

NEO-NATAL MORTALITY among FULL TERM INFANTS.

It has not been possible, in this study, to record the premature mortality rates per 1000 premature live births, for no statistics of these are available. The national incidence of premature births ranges from five to ten per cent of all births. Figures are, however, available of the neo-natal mortality rates among full time infants. I have compared them with other figures, mainly hospital ones in this country. (Crosse, V.M. " The Premature Baby" 1946). Few figures are given either for comparable or large areas.

TABLE 19

NEO-NATAL MORTALITY RATES FOR FULL TERM INFANTS.

AREA	NUMBER OF LIVE BIRTHS.	NEO-NATAL MORTALITY RATES. FULL TERM per 1000 LIVE BIRTHS.	TOTAL.
BIDDULPH 1921-45 URBAN DISTRICT.	4,538	10.36	32.6
CITY OF BIRMINGHAM 1943.	19,376	11.2	25.6
EDINBUGH 1939-40 MATERNITY HOSPITAL.	4,886	21.8	48.3
ABERDEEN 1941-42. MATERNITY HOSPITAL.	3,156	18.9	60.2
BIRMINGHAM CITY MATERNITY HOME (Booked) 1931-43.	10,346	10.5	38.0

It would appear that the full term rates in this area

compare favourably with the hospital statistics and are much better than the high Scottish rates. The total local rates are, however, slightly less satisfactory, by comparison, when prematurity is included. The prospect of survival of a full term infant beyond the neo-natal period would not seem to be associated with any special dangers, on the basis of the above figures of mortality rates. A reasonable assumption is that the special precautions for the care of the premature infant are unnecessary for the full term child, for indeed, in this area, the mortality rates for these infants in the neo-natal period are an improvement on all the hospital figures quoted.

This study of the causes of infant deaths in the past twenty five years reveals that the certification of some causes is less comprehensive than it might be, even in the absence of specialised diagnostic and post-mortem facilities. For example, the inclusion of a maternal cause in association with mortality among prematurely live born infants, would open a wide field to the Registrar-General in his compilation of statistics, and permit of further research into those maternal pathological states most frequently encountered in association with prematurity. The

difficulties in controlling the maternal factor might, by this method, over the years gradually be lessened with benefits to mother and child far beyond anything so far achieved. A proper correlation of statistical material would inevitably assist the research worker in his quest to reduce maternal morbidity and so, directly, that large mass of infantile mortality dependent on it.

The high incidence of deaths from prematurity is disquieting. No reduction in it over the years covered by the inquiry is a measure of the failure of the several services responsible for its reduction. Without proper integration of general practitioner, local authority, hospital and consultant obstetric and paediatric services into a unified maternity service for the care of the expectant mother and her prematurely born infant, no reduction can be hoped for in this district. This discounts, too, that proportion of potential life, stated to be large, lost by abortion.

The reduction in mortality from respiratory disease, however, and the hoped for reduction from gastro-intestinal disease augur well for the future improvement in the crude mortality rates.

The major factor of deaths among prematurely born infants has in no sense been solved.

SUMMARY.

The certified causes of death have been analysed in two groups, namely Group 1. (Neo-natal) and Group 2. (Post-natal).

Prematurity is the principal certified cause of death and is the outstanding factor in neo-natal mortality (68.2 per cent). There is a definite aetiological division between neo-natal and post-natal deaths:

(a) Prematurity and congenital malformations together account for 78 per cent of neo-natal deaths,

(b) Respiratory, infectious and gastro-intestinal diseases together account for 68 per cent of post-natal deaths.

Syphilis, scarlet fever and diphtheria do not occur as a certified cause of infantile mortality and influenza and tuberculosis very rarely.

The disparity between the anatomical and the clinical certified causes has been fully reviewed.

The lack of a stated infant or maternal cause in association with premature deaths detracts from a full discussion on the underlying aetiology.

The excess of neo-natal mortality results from the excess mortality from prematurity.

Rates of mortality from the acute infectious diseases (whooping cough and measles) are influenced

by their epidemic incidence. Although whooping cough deaths contribute only 3.3 per cent to the mean infantile mortality rate, their decline is still unsatisfactory.

The substantial fall of 75 per cent in the mortality from broncho-pneumonia is the greatest single factor in the reduction of the post-natal rates and so, of the crude infantile mortality rates.

Gastro-enteritis, though second among the post-natal causes of death, is not a major factor in infantile mortality.

The certification of infant deaths in domiciliary practice is not sufficiently comprehensive, lacking a stated infant and/or maternal cause.

The inclusion of even an obvious clinical maternal cause, for example in association with deaths from prematurity, would permit the statistical compilation of a mass of information on maternal morbid states never hitherto revealed in its true incidence.

The problem of deaths from prematurity has not been solved in the period covered by the inquiry.

15. THE EFFECT of the ORDER of BIRTH on INFANTILE MORTALITY.

Prior to 1938 the distribution of births by birth order in England and Wales was not officially known. Many maternity and child welfare clinics incorporated the birth order in their card index records but, as far as is known, no extracts from these were used for any statistical purpose by the Registrar-General.

Under Statutory Rules and Orders 1938, No 569, " the Registrar-General, by virtue of section 3 of the Population (Statistics) Act 1938, and in exercise of the powers under the Births and Deaths Registration Acts, 1836 to 1929" was empowered to obtain through the registration officers particulars specified in the First Schedule to the Orders. These were, that the informant, at the registration of a birth, should be asked, in addition to the usual registration details, the age of the mother, the mother's previous children by her present husband or by any former husband, and the totals of living, stillborn and dead children. These additional particulars are not entered in the birth register nor on the birth certificate; they are confidential and are used only for the preparation of statistics by the Registrar-General. The local registrars do not retain copies in their custody and

have no powers to declare their contents to third parties.

I had great difficulty, then, in obtaining, for the purpose of my inquiry, full statistical data of the birth order of infants, or of the birth order of infants dying under the age of one year. It was, in fact, only possible to obtain figures for the position of infants in the family, for the last year of the inquiry, namely 1945. Although the birth rate of 18.42 in this year is slightly higher than in the previous year (18.34), by comparison with the previous ten years it cannot be considered a high rate, and since there are no comparative figures for birth orders in previous years, it is impossible accurately to assess the influence of the birth rate on the proportion of first, second and third born, and subsequent children.

It has been demonstrated, however, by McKinlay that the lower the birth rate in any area the higher the proportion of first, second and third born children, and the lower the proportion of later born; and conversely, high rates produce a lower proportion of first, second and third born and a higher proportion of later born. (McKinlay, P.L.1929). He states, for example, that where the birth rate is under 19.7 per 1000 of the population, 72.68 per cent of all infants

are either first, second or third born. In this district in 1945, the birth rate was 18.42 and the proportion of first, second and third born infants was 75.9 per cent, a figure close enough to McKinlay's to support and confirm his findings. When the birth rates in this area are examined (Table 20) it is apparent that there is a close similarity in the yearly rates from 1935, with the exception of high rates in the triennium 1941-1943. (see also Appendix page 26).

TABLE 20

BIRTH RATES per 1000 population
BIDDULPH URBAN DISTRICT 1935-1945.

YEAR	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	194
ANNUAL BIRTH RATE.	18.95	18.90	18.68	18.90	19.10	18.10	21.68	22.76	20.94	18.34	18.42

All rates, with these exceptions, are below the figure of 19.7 per 1000. It can be assumed, therefore, that in ten of the last thirteen years the birth order of the first, second and third born would be in a proportion of about 75 per cent over the later born infants, for the 1933 and 1934 birth rates were respectively 17.63 and 17.56. In view of McKinlay's further postulate that the proportion is only 56.55 per cent in areas where the crude birth rate is 25.7 or over, per 1000 of the population, it can be safely stated that the range in 1941-43 for the earlier born infants would be between 60 and 65 per cent. The birth distribution in numbers and percentages for this

district in 1945 is set out in Table 21.

TABLE 21

BIRTHS by ORDER of BIRTH in BIDDULPH URBAN DISTRICT1945

BIRTH ORDER	NUMBERS	PERCENTAGES	
1	69	36.3)	
2	42	22.3)	75.9
3	33	17.3)	
4	17	8.7	
5 & 6	19	10.0	
7 & 8	8	4.4	
9†	2	1.0	
TOTAL	190	100.	

BIRTH RATE 18.42

TABLE 22

BIRTHS by ORDER of BIRTH in STAFFORD RURAL DISTRICTS 1927

BIRTH ORDER	NUMBERS	PERCENTAGES	
1	588	33)	
2	653	25)	73
3	287	15)	
4 & 5	297	16	
6 & 7	124	7	
8†	82	4	
TOTAL	1843	100.	

BIRTH RATE 18.37

It is instructive to compare the 1945 figures of this district with those of five rural districts in Staffordshire in 1927, (Table 22), two of which, namely Leek and Newcastle-under-Lyme, adjoin this one. (Campbell, J. 1929). The close similarity of the respective birth rates should make the birth order figures comparable and it is found that the percentages of first, second and third born in the two districts are fairly close. The birth rate in this district for the twelve years prior to 1933 show only three rates, namely 28.77 per 1000 (1921), 25.6 (1922) and 24.23 (1925) high enough to reverse the preponderance of first, second and third births. In the other nine years the rates varied between 19.96 and 17.00 per 1000 of the population.

Broadly, it may be said, that, with few exceptions, the annual birth rate over 25 years has ranged between 18.0 and 19.5 per 1000. With these figures and McKinlay's

dictum, a higher proportion of earlier born infants is to be expected in most years and this, on the basis of the 1945 figures and the approximation of its birth rate to that of many other years, justifies the statement that this is probably true.

With these facts of distribution of birth order in mind, it should not have been difficult to determine the rate of mortality of infants under one year of age from the different causes, by order of birth. The figures of infant deaths in the year 1945 however - the only year in which the birth order of all live infants born could be obtained - are far too small to attempt to draw conclusions from them. For instance, there were only eight deaths, with a birth order of 1,1,2,2,2,3, 4,4 and causal factors of Prematurity and Convulsions (first born); Gastro-enteritis, Congenital heart disease and Prematurity (second born); Prematurity (third born); Tuberculous Meningitis and Prematurity (fourth born). The infantile mortality rates were 29,47,30 and 35 in ascending birth order. Although it is known, that, apart from first born children, the infant mortality increases with the serial order of birth, much more data are needed than can be found in a single year to justify conclusions being drawn.

In order to obtain figures of birth order among infants dying under the age of one year I found it

necessary to make a personal field inquiry in the homes of the people. I took pains to pursue this for as many years as possible. The difficulties increased with each year before 1939 and, finally, at 1935 I had obtained the birth order of dead infants in 105 cases out of a total of 107. This number may be said to represent a fair sample over the twenty five years and it has the merit of including four of the pre-war years. The number of deaths in some birth orders, even over eleven years, is excessively small and any calculation of infantile mortality rates, if possible, would be subject to large errors of sampling.

The birth order has been separated into 1st, 2nd, 3rd, 4th, 5th and 6th, 7th and 8th, and over, in Tables 23, 24 and 25. If any conclusions can be drawn merely from numbers they are these. Table 23 shows the number of deaths in order of parity of the mother. The deaths as a whole tend to be higher among first births than in the immediately subsequent group but, in this district, instead of rising steadily until the final group is reached, they increase only among third born children and thereafter decline as parity increases.

TABLE 23

INFANTILE MORTALITY by BIRTH ORDER
BIDDULPH URBAN DISTRICT
BIRTH ORDER among DEAD INFANTS 1935 -1945

PARITY of MOTHER	1	2	3	4	5 and 6	7 and 8	9 +
INFANT DEATHS.	30	19	25	17	7	3	4

It may be that the numbers are too small in each birth order and in any case it has been impossible to calculate death rates or the values X^2 and P, and without them, it cannot be stated with certainty what is the effect of birth order on the infantile mortality rate in this district. But the figures do, at least, seem to indicate that there is no preponderance of deaths among first born children.

TABLE 24

NEO-NATAL MORTALITY by BIRTH ORDER-BIDDULPH URBAN DISTRICT. 1935 — 1945

PARITY	1	2	3	4	5 and 6	7 and 8	9+
PREMATURITY	12	3	11	9	2	2	2
OTHER NEO-NATAL CAUSES	8	4	3	-	-	-	1
ALL PARITIES	20	7	14	9	2	2	3

Of 57 neo-natal deaths, 20 or 35.1 per cent occurred among first pregnancy infants, and the numbers of deaths in later born infants, namely 3 to 5 inclusive in birth order, were greater at 42.05 per cent than among second born children (12.3 per cent). From the 6th pregnancy onwards the neo-natal deaths were lowest at 10.5 per cent.

A comparison of the distribution of neo-natal deaths in this area (1935-1945) and among "booked" hospital cases in Aberdeen (1941-1944) quoted by Baird,

is valid in that his group and the numbers here are drawn mainly from the same social classes, namely III IV and V (Baird, D. 1945)

TABLE 25

COMPARATIVE NEO-NATAL MORTALITY by BIRTH ORDER.

PARITY	BIDDULPH URBAN DISTRICT	ABERDEEN HOSPITAL CASES
	1935 - 1945	1941 - 1944
1st PREGNANCY	35.1%	43.6%
2nd PREGNANCY	12.3%	24.3%
3rd, 4th and 5th PREGNANCIES	43.05%	23.8%
6th PREGNANCY	10.5%	8.3%

Neo-natal mortality among 2nd pregnancy infants shows a relatively favourable experience; there is a greater preponderance of 1st pregnancy deaths among "booked" hospital case, and a decline in mortality in both areas with the 6th and later pregnancies.

It is of importance at this point to give figures of the distribution of birth by order of birth for the only year, namely 1945, in which I have been able to obtain these data.

TABLE 26

NUMBER OF BIRTHS BY ORDER OF BIRTH
BIDDULPH URBAN DISTRICT. 1945

PARITY of MOTHER	1	2	3	4	5 and 6	7 and 8	9+	TOTAL
NUMBER of BIRTHS.	69	42	33	17	19	8	2	190

Although there is a greater number of 1st, 2nd and 3rd born children in this year, and that this is the probability in the eleven years from 1935, for the birth rate was seldom higher than 19.7 and then only slightly so, the mortality is not necessarily high with the greater number of children at risk in a particular birth order. It is much more dependent on the causes of death, on the influence of social and environmental conditions; and in the early birth order, on the ante-natal and neo-natal causes.

Table 27 sets out the numbers of deaths from various causes by order of birth.

TABLE 27

NUMBERS OF DEATHS by CAUSE and ORDER of BIRTH. BIDDULPH URBAN DISTRICT 1935-1945.

CAUSE of DEATH	BIRTH ORDER							TOTAL DEATHS by CAUSE.
	1	2	3	4	5 and 6	7 and 8	9/	
PREMATURITY	13	2	11	9	2	2	3	42
CONGENITAL MALFORMATIONS	7	2	3	1	2		1	16
BRONCHO-PNEUMONIA		7	2	2	1			12
GASTRO-ENTERITIS	2	2	2					6
WHOOPING COUGH and MEASLES	1	2	3	1				7
OTHER INFECTIONS	2	3	1	2	1			9
BIRTH INJURY	1							1
ALL OTHER CAUSES	2	1	3	2	1	1		10
TOTAL DEATHS	30	19	25	17	7	3	4	105

It indicates, even with small numbers, that first born children show a greater mortality in certain groups,

such as birth injury, which is usually an excessive cause of death among first born infants. Here the only case resulted from a first pregnancy. The figure for prematurely born first infants, though high, is relatively less than among later born premature infants, when ante-natal causes such as maternal toxaemia and ante-partum haemorrhage are more frequent. The birth orders of 3 and over account for the greater part of the deaths from prematurity. The mortality experience in congenital malformations is least favourable among first born infants in this series, but as a rule this factor follows no definite order. The infections, namely, respiratory, gastro-intestinal and communicable infectious diseases, tend to show excess in birth orders after the first, in keeping with the greater risk of infection in an environment where the infant is in the later birth orders. A slightly excess mortality is observed in the case of whooping cough and measles in 3rd born infants, although the "other infections", which include meningitis and convulsions, are fairly evenly distributed among birth orders 1 to 6.

The decline in the numbers of infant deaths after the 4th birth order may be due to

1. the absence of anything approaching real slum conditions within the area; and no gross overcrowding,

2. the introduction of sulphanilamide therapy in 1935 and its success in combating acute respiratory disease, commoner in birth orders after the first, even allowing for the fact that it is less effective under the age of one year,
3. the improved dietetic and medical care of the multiparous woman. It is my experience that, in the past ten years, she has become more conscious of the benefits of adequate ante-natal supervision, perhaps most markedly among social classes III and IV. This may be the controlling factor in the decline in the numbers of deaths from prematurity in the later birth orders. In the higher social classes there has always been a demand for continuous pre-natal supervision irrespective of the parity of the mother.

SUMMARY

The number of deaths proportionately tend to be in slight excess in the 1st birth order.

They are less in the 2nd birth order.

They increase in the 3rd and are still high in the 4th birth orders.

They do not increase thereafter, although the

real effect on any birth order cannot be correctly assessed in the absence of mortality rates.

Neo-natal mortality among 2nd pregnancy infants shows a relatively favourable experience.

There is a decline in neo-natal mortality from the 6th birth order.

Birth orders 3 to 5 show the greatest neo-natal mortality.

Deaths from prematurity are in excess from the 3rd birth order.

Congenital malformations have the least favourable mortality among 1st born infants.

Respiratory, infectious and gastro-intestinal diseases have an increased mortality in birth orders after the first.

16. ECONOMIC AND SOCIAL FACTORS IN INFANTILE MORTALITY.

The investigation of the economic and social factors forms an important section of the study of infantile mortality, especially in a working class district, for, broadly, the major causes of infant deaths and higher rates are to be found among the lower strata of society. The findings will be discussed in relation to the country as a whole and conclusions drawn on how far they approximate to or diverge from those deduced by the Registrar-General. They are also reviewed in the light of other published work.

The Registrar-General, in his Decennial Supplement England & Wales 1931 Part IIa Occupational Mortality, assesses the mortality of the infant by the social class of the father, and on Table 14, page 376, of this publication, he classifies the deaths and mortality rates of legitimate infants by sex, age and cause for each social class of the father and for all occupations according to the social class. The classification is that used originally by Stevenson for all occupations returned in the Census schedules of 1921 and incorporated by the Registrar-General in his Deccenial Supplement of 1921, but later varied in some of its details in his 1930-1932 statistical analysis of occupational mortality. Class I approximates to the professional and upper middle classes, Class II comprises intermediate groups such as

shopkeepers, clerks and farmers, or the lower middle classes, Class III represents all skilled workmen, Class IV consists mostly of semi-skilled workers and Class V includes all types of unskilled labour. The social status, based on the occupation of the father, adopted in this inquiry, is that used by the Registrar-General in Table 4A pages 220-266 of his Decennial Supplement England & Wales 1931 Part IIa Occupational Mortality.

The district under review in this inquiry is essentially a mining community, perhaps not so exclusively so in the last decade, with the increase in urbanisation and the opportunites offered for work in other forms of employment namely engineering, sand quarrying and ribbon manufacture, but the bulk of male labour is still employed in the coal mines. During the war years the industry was subject to the provisions of the Essential Works' Order and so, comparatively few males were called from it for active service. Consequently, there was very much less disturbance of the occupational orders applicable to the mining industry than would obtain among these orders in other working class districts where, perhaps, the bulk of the employed male population was normally on work which permitted them to volunteer or be conscripted for service in the armed forces. There have been, therefore, by reason of the type of work,

fewer changes in the social classes of the employed male population here; and as there has been no major prolonged stoppage in the industry for nearly twenty years the shift of social class of the male worker has not materially changed in that period. Of the two classes of skilled and semi-skilled labour (Classes III and IV) the majority is still employed in the mining industry.

At the outset, then, I found it necessary to obtain employment figures and occupations in order to analyse these occupations into social classes. It was not possible to obtain reliable figures over the whole period of the inquiry, but by a search of National Health Insurance medical record cards, on which is stated the occupation of the insured person, and the courtesy of the Ministry of Labour and National Service, and of various employers of labour within the district, and the application of local knowledge over a period of fifteen years, I was enabled, with considerable accuracy, to compile figures and occupations of the employed male population between the ages of 20 and 64 years, for the five years 1941 to 1945. This gave me an assessment of the marriageable and productive group necessary for my purpose.

TABLE 28

DISTRIBUTION OF OCCUPIED MALES. 20 - 64 YEARS.

1941 - 1945 BIDDULPH URBAN DISTRICT.

	1941	1942	1943	1944	1945
TOTAL OCCUPIED MALES 20-64 YEARS.	1960	2126	2024	2018	2025
TOTAL POPULATION — REGISTRAR-GENERAL'S MID-YEAR ESTIMATES.	9773	9883	9979	10,250	10,310

There is very little variation in the employed male population during the last four years. The figures represent a percentage average distribution of 19.6 of the total population, with a high figure of 21 per cent in 1942. From what has been already said of the similarity of employment in war and peace in this area, the above sample is one which would be proportionately the same for previous quinquennia, though perhaps the figures quoted may be higher, having regard to the high level of total employment during the war years.

In Table 29 the employed male population at the same ages has been separated into the different social classes. By reason of the occupations within the district and in the adjoining industrial areas, the numbers in Social Class I are too few to justify them being put into a class by themselves so they have been combined with those of Social Class II and throughout the investigation have

been treated as one class.

TABLE 29

SOCIAL DISTRIBUTION OF OCCUPIED MALES.

1941-1945 BIDDULPH URBAN DISTRICT

SOCIAL CLASS	1941	1942	1943	1944	1945
I and II	257	238	271	151	170
III	861	951	949	944	842
IV	650	757	630	752	821
V	192	180	174	171	192
TOTALS	1960	2126	2024	2018	2025

The occupational groups are distributed unevenly over the five social classes, almost one half falling into Class III (skilled workmen), and Class IV (semi-skilled workmen) yielding about one third of the occupied male population between the ages of 20 and 64 years. There is very little real variation in each class from year to year. An analysis of the social classes reveals that the main forms of employment in this district are as follow:

Taking Social Classes I and II as a unit they comprise the professions and a few other occupations peculiar to the district, namely colliery owners; farmers (and these include many with small holdings) and retail proprietors of commodities such as groceries, green groceries, meat, coal, milk, ironmongery and so on form the greater portion of this class. Motor garage proprietors, costing clerks,

draughtsmen, administrative and official staff of the Local Authorities and the Civil Service contribute a much smaller number.

Classes III and IV comprise by far the largest part of the employed male population and Class III is the largest single class in all years for which figures have been obtained. The increase in semi-skilled workers in 1944 and 1945, mostly in Royal Ordnance Factories, produced a temporary rise in the numbers of Class IV workers. An analysis of the birth registers from 1926, too, discloses an excess of births in social Class III in each year except 1944. This class is the group of the skilled workmen. Locally, the largest individual occupation in this class is that of coal hewer and getter and it includes the subordinate superintending staff in the coal mines, and yields almost half (or 48.6 per cent) of the total occupations in this group. The remainder, in order of frequency, are road transport motor drivers, skilled workers in engineering trades such as fitters and rivetters; bricklayers, joiners, plasterers, shop assistants retailing food and other commodities, gardeners and nurserymen, haulage contractors and a miscellaneous selection of artisans employed in the maintenance of public and personal services. It is worthy of note

(1) that in the nineteen twenties a large

proportion of this remainder was employed in the local iron works as puddlers, furnacemen, and skilled forge workers, and

(11) that very few males resident in the district are employed in the adjoining pottery industry.

By far the largest number of semi-skilled workers belonging to Class IV are employed below ground in the coal mines of the North Staffordshire coalfield, excluding hewers and getters. They include loaders, roadmen, datalers, packers, platelayers, and all surface workers above ground. The other important occupations in this class, within the area, are agricultural labourers, road transport assistants, conductors of public service vehicles, labourers to plumbers, plasterers, builders and bricklayers and in slight excess for this class during the war, other ranks in the Army.

Class V includes all general labourers, labourers and unskilled workers, navvies, and, in a minority, sand quarry workers and railway porters. It forms a small social class the community being essentially a colliery district.

TABLE 30

PERCENTAGE SOCIAL DISTRIBUTION OF OCCUPIED MALES-20 to 64 YEARS

1941 - 1945 BIDDULPH URBAN DISTRICT

SOCIAL CLASS	1941	1942	1943	1944	1945
I and II	12	11	13	8	8
III	44	45	46	46	40
IV	34	35	32	37	44
V	10	9	9	9	8
TOTALS	100.0	100.0	100.0	100.0	100.0

Classes III and IV taken together, form, in this district, between 78 and 84 per cent of the employed male population at the ages stated. The percentage is greatest among the skilled workers (Class III) except in 1945 when there was an excess of semi-skilled workers of ten per cent; and with the type of employment, it is not surprising to find the unskilled class in the minority. Semi-skilled labour increased over this five year period, whilst skilled labour was maintained until 1945 when it suffered a reduction of six per cent.

The problem now is, how to relate the part social conditions, in so far as social classes of the community determine these conditions, exert on infant deaths and their influences on the particular diseases from which infants die; whether they are the sole factors at work or whether they are merely a component of the larger economic problem of man's struggle with his environment; and how far they affect the health of the mother and in what manner.

In this district the level of economy in the social classes III and IV is not radically dissimilar. Rates of pay underground in the coal mines for skilled and semi-skilled workers do not vary to a degree that means a wide margin of safety for the one class (III) and mere subsistance for the other (IV). The home conditions, too, are not dissimilar and in both classes

the family income is often augemented by the employment of the mother in local industry. The unskilled workers, on the other hand, live on rates of pay lower than the others and often their employment is interrupted by periods of unavoidable idleness. Even where the mother is gainfully occupied the gross income is less. Moreover, many of these workers, now classed as unskilled, were formerly employed in skilled and semi-skilled occupations within the coal mining industry, and have subsequently been exposed to the hazards of irregular employment, maybe by reason of age, or of disablement or ill health. I am of opinion that there is, in this area, a lower level of economic stability among Class V males than in any other occupational order and that this has, in many cases, been aggravated by ignorance, unwise spending on essential foods and intemperance, with adverse repercussions on the health of the mother and the vitality of her infant.

In order, then, to assess the effect of social class on infantile mortality it was necessary to relate the number of legitimate births to the different social classes. By a search of birth registers and annual vital statistical returns I was able to record the numbers of legitimate live births from 1931 to 1945 - a period of 15 years. I then distributed these births into their different social classes according to the occupation of the father and from these data I obtained the percentage

distribution of legitimate births. From an analysis of the deaths in each social class a calculation of the infantile mortality rates was made for each social class, per 1000 legitimate live births, and their importance discussed.

TABLE 31

LEGITIMATE LIVE BIRTHS-1931-1945-BIDDULPH URBAN DISTRICT.

YEAR	TOTAL LEGITIMATE LIVE BIRTHS	TOTAL LIVE BIRTHS
1931	164	167
1932	156	165
1933	144	147
1934	151	158
1935	173	177
1936	175	180
1937	177	182
1938	185	186
1939	174	176
1940	173	174
1941	206	212
1942	215	225
1943	202	209
1944	180	188
1945	174	190

The increase in illegitimacy coincides with the war years, being greatest in the period 1941 - 1945.

TABLE 32

DISTRIBUTION OF LEGITIMATE LIVE BIRTHS TO THE DIFFERENT SOCIAL CLASSES - BY SOCIAL CLASS OF FATHER.

1931 - 1945 BIDDULPH URBAN DISTRICT.

YEAR	SOCIAL CLASS I and II	SOCIAL CLASS III	SOCIAL CLASS IV	SOCIAL CLASS V	TOTALS
1931	15	76	57	16	164
1932	13	87	44	12	156
1933	8	72	47	17	144
1934	9	81	53	8	151
1935	15	71	73	14	173
1936	23	75	65	12	175
1937	20	79	58	20	177
1938	27	75	68	15	185
1939	23	82	56	13	174
1940	23	78	55	17	173
1941	26	94	70	16	206
1942	25	100	76	14	215
1943	28	98	65	11	202
1944	14	87	68	11	180
1945	16	77	73	8	174

The distribution follows a definite pattern for each social class, the numbers being greatest in Classes III and IV, and the years with the excess of legitimate births (1941-1943) coincide with the greatest increase in these classes.

TABLE 33

PERCENTAGE DISTRIBUTION OF LEGITIMATE LIVE BIRTHS BY SOCIAL CLASS.

1931 - 1945 BIDDULPH URBAN DISTRICT.

YEAR	SOCIAL CLASS I and II	SOCIAL CLASS III	SOCIAL CLASS IV	SOCIAL CLASS V	TOTALS
1931	9	46	35	10	100.0
1932	9	55	28	8	100.0
1933	6	50	33	11	100.0
1934	6	54	35	5	100.0
1935	9	41	42	8	100.0
1936	13	43	37	7	100.0
1937	11	45	33	11	100.0
1938	14	41	36	9	100.0
1939	13	47	32	8	100.0
1940	13	45	32	10	100.0
1941	12	45	34	9	100.0
1942	11	46	36	7	100.0
1943	14	46	32	8	100.0
1944	8	48	38	6	100.0
1945	9	44	42	5	100.0

This percentage distribution of legitimate births discloses that the births are less in the upper and lowest classes and that the standard deviations are less, too, in these two classes, being respectively 2.68 and

1.88. The frequency distributions show no considerable differences in variability, the coefficients in each case being 25.6 per cent and 23.2 per cent. In the two major classes (III and IV) the percentage distribution is much greater, but here again there is no large standard deviation, while the frequency distribution is not widely spread out from the means of 45 and 35 respectively. The standard deviation for Class III is 3.26 with a coefficient of variability of 7.2 per cent, while the same figures for Class IV are 3.63 and 10.3 per cent. The figures in each class lie closely concentrated about their own mean and there is little variation between one observation and another. The subsequent infantile mortality rates calculated from the distribution of legitimate births should therefore be accurate for each social class and any variation by comparison with national or other rates will be due to the individual idiosyncrasies in the social conditions within the district, rather than to error in arithmetical calculations.

It was not easy to find comparable figures of birth distribution by social class within recent years for this district and other adjoining areas, in order to test differences or similarities in class distribution. I was, however, able to compile figures from this area, for the year 1927 and compare them with figures for the

administrative County of Stafford and the Stafford Rural Districts in the same year, extracted and modified from McKinlay in his Statistical Notes in Ministry of Health Inquiry No 55 1929 p. 52 and given in Table 34. (McKinlay, P.L.1929).

TABLE 34

PERCENTAGE SOCIAL DISTRIBUTION OF BIRTHS in the

1. ADMINISTRATIVE COUNTY of STAFFORD.) for the year
2. STAFFORD RURAL DISTRICTS.)
3. BIDDULPH URBAN DISTRICT.) 1927.

SOCIAL CLASS	STAFFORD ADMINISTRATIVE COUNTY.	STAFFORD RURAL DISTRICTS.	BIDDULPH URBAN DISTRICT.
I and II	10.5	14.6	7.6
III	44.4	37.0	52.7
IV	27.8	35.6	29.6
V	17.3	12.8	10.1
TOTALS	100.0	100.0	100.0

In the industrial urban district the births are greatest among the skilled and semi-skilled and least among the upper classes. In the rural districts the births are correspondingly greater among the upper and lowest classes and relatively less among the skilled workman, and class IV shows some excess over the other district, the whole area being residential (Classes I and II) and agricultural (Class IV). The administrative county, which does not include the large County Boroughs

of Burton-on-Trent, Smethwick, Stoke-on-Trent, Walsall, West Bromwich and Wolverhampton, shows births which are a reasonable cross section of the other two, except in class V. The low percentage birth distribution in the urban district among the unskilled workers is not in keeping with the figures of the county or the rural districts but adheres to a level which has been uniform in this district in the past twenty five years where the major forms of employment do not utilise unskilled labour. This is confirmed by the figures given and reviewed over the years 1931-1945, in numbers, percentages, standard deviation and coefficients of variability.

These preliminary results now permit of a calculation being made of the infantile mortality rates as they affect the different social classes. Here again it may be said that, in view of the extremely small numbers of births assigned to Class I, they have been added to Class II and the rates for the combined groups only are given (Appendix page 27)

From year to year in each social class the infantile mortality rates are very unstable and show no downward trend in any class. Classes I and II contribute only three rates in the last decennium and each is considerably lower than the same class rates in the first five years. Even one death in a class with

such few births magnifies the mortality rate out of all proportion to the associated social level and in a district of this kind the figures, as a factor in social class mortality, may be ignored. The causal factors are of much greater import.

It is perhaps an unusual finding that in nine of the years for which social class rates have been calculated namely, 1931, 1934, 1935, 1938, 1939, 1940, 1941, 1942 and 1945, the Class III mortality rates are greater than the corresponding ones in Class IV. It may be that the high occupational incidence of coal hewers and getters in this class, namely 48.6 per cent, is the causal factor, for the Registrar-General, discussing the mortality of infants according to the father's social class and occupation (Decennial Supplement, 1931, Occupational Mortality p 163 et seq.) says of miners in the period 1930-32 (Miners - Order III - p 169) "Coal hewers and getters and the subordinate superintending staff who comprise Order III (1), Class III, returned an infant mortality rate of 81.6 compared with 57.6 for Class III as a whole, a figure exceeding that of Class V. Miners in Class IV also returned high rates of 82.5 for their infants." Although the average rate Class III over the fifteen year period in the inquiry is 56.9, practically identical with the triennial rate given above, it is important to record that slightly more than half of the

occupations in this class is unconnected with skilled labour in the coal mines and is not associated with high infantile mortality rates. For example, skilled transport workers, consisting mainly of motor drivers, form a large proportion of Class III workmen in this district, and the Registrar-General assigns them only average rates for infancy. Salesmen and shop assistants in retail businesses give an infantile mortality rate in England and Wales in 1930-1932 " significantly below the Class III average " (Registrar-General's Decennial Supplement England and Wales 1931 Part 11a Occupational Mortality p 170). Bakers return a normal rate, carpenters a low rate and builders and decorators show nothing abnormal in their rates. So it may be that some of these occupations have contributed to a reduction in certain of the annual rates to the national figure or even below it. In this connection, it is significant that in four of the years with high rates (1931,1935, 1939 and 1941) infant deaths in this class occurred almost exclusively among skilled workers in the coal mines. The figures, however, in any year are small enough for the class as a whole to make it unprofitable still further to divide them for class mortality among the skilled mineworkers only, merely to test their significance against the much larger national returns. The trend of the rates over 15 years is favourable by

comparison and not sensibly divergent, having regard to the peculiarity of local occupations.

For a mining community the rates for Class IV may be regarded as satisfactory, for in only four years namely 1931, 1932, 1935 and 1937 are they higher than the national class rates given by the Registrar-General in his Decennial Supplement, England and Wales 1931 Part IIa Occupational Mortality (Table 14, Col. 8, p 376) namely 66.8 per 1000 legitimate live births. The class average of 50.2 over the fifteen year period (1931-1945) is much below this figure. The rates deviate in many years to a degree which upsets the smoothness of the anticipated regression from class to class. Class IV mortalities deviate more from the general average. In most years the rate increases with social descent with the exception of Class IV, in which, in six years, 1934, 1939, 1941-1943 and 1945 the mortality is lower than the mean value and lower than most of the other social groups. As the bulk of this class includes all coal miners working below ground, except hewers and getters, and other workers above ground it is satisfactory that the rates are so good, for the Registrar-General gives a figure of 82.8 for this component of Class IV. It may be that the explanation of the deviation from social class regression is due to the very low rates assigned to agricultural workers, other ranks in the Army and labourers in building, plumbing and

allied skilled trades and the improved level of economy at which semi-skilled labour has operated in Royal Ordnance Factories since 1941. These factors may well have offset the higher rates attributed to the coal mining section of this class, but even so the rates are better for the last eight years of the period under review.

Although Class V contributes infantile mortality rates only in slightly over one half of the years investigated, the rates are all excessively high, and with the exception of a rate of 62.5 in 1941, have not diminished in recent years. Even allowing for a nil return in six of the fifteen years among Class V workers, the average mortality rate is 83.8 and is higher than the figure of 81.2 given by the Registrar-General for England and Wales in the triennium 1930-1932. General labourers form the bulk of this class and the observations previously made apply signally to this high rate.

While it is evident that occupation and social environment play a significant part in infantile mortality, there is not, locally, that consistent upward trend in the yearly mortality rates with descent in the social scale evidenced in the national returns. No doubt climatic influences are an additional factor in having some effect on all classes. In an urban area, with a

climate less than equable, an abnormal number of dull sunless days, drab surroundings and a rainfall above the average, some of the excess mortality in an occupational group may be ascribed to these. It must be very seldom that we can ascribe the excess to occupation alone, though there is no doubt it is an important factor. From the differences observed, however, and from the less striking differences between social classes III and IV, it cannot truthfully be said that occupation alone plays the predominant part as it does in other areas or in the country as a whole. From the statistics presented it may be said to do so in Social Class V. The data so far submitted do,however, offer an index on the opportunities for survival of the infant. The infant is very sensitive to environmental conditions, much more so than is the adult, but is not hampered by the direct effects of occupation as is the parent. The infant mortality rate is therefore a reliable guide to the social status based on the husband's occupational level. It also reflects direct environmental influences as well. The combination of these has important bearings on the infantile mortality rate and is discussed under social class cause of infant deaths.

Meanwhile, a study of the accompanying graph of infantile mortality rates by social classes (Appendix page 28) discloses

(1) that Class V rates are no better in the

first quinquennium (1931-1935) than in the last (1941-1945),

(2) that in the upper social classes (I and II) an enormous reduction has been effected, namely from 99 to 7.1 per 1000 legitimate live births over the fifteen years,

(3) that class III rates in the last quinquennium are 12 per cent below even the class IV rates in the first five year period 1921-1925, and

(4) that class IV rates in 1941-1945 are 16 per cent better than 10 years previously. Among the skilled and semi-skilled groups the greatest percentage reduction has been effected in the skilled class (III) with a 19.6 per cent reduction over the whole period studied. A comparison with the rates for different social classes in England and Wales in 1930-1932 is represented on the same graph (Appendix page 28), and tabulated on Table 35.

TABLE 35

INFANTILE MORTALITY RATES BY SOCIAL CLASS IN 3 FIVE YEARLY PERIODS.

LEGITIMATE LIVE BIRTHS-1931-1945-BIDDULPH URBAN DISTRICT.

COMPARISON WITH ENGLAND AND WALES 1930-1932

SOCIAL CLASS	1931-1935	1936-1940	1941-1945	MEAN RATES 1931-1945	ENGLAND AND WALES 1930-1932
I and II	99.0	16.09	7.10	40.7	38.8
III	70.0	50.50	50.40	56.9	57.8
IV	62.0	44.16	44.60	50.2	66.8
V	110.0	31.7	109.70	83.8	77.1
ALL CLASSES	71	43	45	31.8	66.8

Over the fifteen years, 1931 to 1945, in this area, the unskilled worker produces the highest infantile mortality rates. The rates for semi-skilled workers are better than those among skilled workers, and apart from high sporadic rates in 1931 and 1934, classes I and II contribute least of any class to the infantile mortality rate. The class III rates have improved slightly more than the class IV ones. Among these classes it is essential that a study of the causes of death should now be undertaken to determine how far they are affected, if at all, by any differences peculiar to the two classes, and to try to discover if the causes of infant deaths can be ascribed to occupational and climatic and environmental hazards and if basic maternal causes can be

correlated with them.

Of the 273 deaths occurring under the age of one year from 1921-1945, 265 were legitimate infants. As the major aetiological factors have already been shown to be prematurity in the first month and respiratory diseases thereafter to the end of the first year, it will be more fruitful to consider fully the distribution of these causes of death by social class and merely indicate the more important features referable to the other causes, rather than detail all the minor causes too, for they would contribute little or nothing to a proper assessment of the problem.

Firstly, the principal causes (or groups of causes) of death are tabulated by social class as distributed by the Registrar-General.

TABLE 36

INFANT MORTALITY RATES BY CAUSE AND SOCIAL CLASS.

PER 1000 LEGITIMATE LIVE BIRTHS-1921-1945 BIDDULPH URBAN DISTRICT.

CAUSE OF DEATH	I and II	III	IV	V	ALL CAUSES
PREMATURITY.	9.7	22.9	25.3	41.4	25
RESPIRATORY DISEASES.	4.8	10.4	12.9	18.2	12
NON-INFECTIVE and OTHER INFECTIVE ILLNESS.	4.8	5.2	6.4	4.5	6
CONG.MALFORMATIONS.	4.8	7.8	3.8	6.8	6
ACUTE INFECTIOUS DISEASES.	2.4	4.7	5.2	13.6	5
GASTRO-INTESTINAL DISEASES.	2.4	5.7	4.5	4.5	4
OTHER CAUSES.	2.4	2.3	1.9	4.5	2

There is a steady rise in the rates from Classes I and II to Class V for all causes shewn, except non-infective and other infective illness (in which I have included convulsions) and congenital malformations. The class mortality for the acute infectious diseases, of which the main one is whooping cough, is almost six times greater in Class V than in Classes I and II and ascends steeply from Class IV to Class V. It shows the greatest rise of all the causes of death. Prematurity is four times greater in Class V than in Classes I and II, and it records a higher rate in Classes I and II than does any other cause of infant death in these classes. This is, in fact, applicable to prematurity in each social class. For the respiratory diseases, the class mortality is four times greater in Class V than in classes I and II and the major components of this group are broncho-pneumonia and bronchitis. Gastro-intestinal mortality in Class V is a little less than double that in classes I and II but the class regression is upset by a high rate in Class III. Congenital malformations show an irregular class mortality, though the rates for all classes are higher than those of the acute infectious and gastro-intestinal diseases. The 'non-infective and other infective illnesses' mortality similarly, is not influenced much by social class, Class

V being actually lower than Classes I and II. A comparison of these data with comparable or nearly comparable causes for England and Wales in 1930-1932 modified from the Registrar-General's Decennial Supplement, England and Wales 1931 - Part 11a Occupational Mortality shows trends of class mortality very similar to those recorded here. (Table 37)

TABLE 37

INFANTILE MORTALITY RATES BY CAUSE AND SOCIAL CLASS

PER 1000 LEGITIMATE LIVE BIRTHS-1930-1932- ENGLAND & WALES.

CAUSE OF DEATH	SOCIAL CLASS				ALL CAUSES
	I and II	III	IV	V	
PREMATURITY.	12.45	16.8	18.6	19.6	17.3
RESPIRATORY DISEASES.	4.45	11.2	14.5	18.8	12.7
INFECTIOUS DISEASES.	1.02	3.25	2.85	3.8	2.55
CONGENITAL MALFORMATIONS.	5.2	5.6	5.7	5.4	5.5
DIARRHOEA AND ENTERITIS.	2.3	4.6	5.4	7.9	5.2

There is the same ascent from Class I and II to Class V for all causes except congenital malformations. Infectious diseases do not show the same excess in Class V, but mortality from respiratory diseases is similar, being four times greater for Class V than Classes I and II. The mortality from prematurity is lower in England and Wales in each class except I and II.

Some relevant figures (1936-1938) for Scotland,

where the infant death rate is high, show

(1) that the infectious diseases mortality of 7.2 was worse than the Class V mortality in England and Wales or the Class IV one in this district,

(2) that the prematurity rate of 16.9 only equalled the Class III rate for England and Wales but was a great improvement on all class rates here except Classes I and II,

(3) that the total respiratory diseases' rate of 17.2 was only slightly better than Class V in the national and local figures, and

(4) that gastro-intestinal rates were far worse at 9.5 than the Class V rates for England and Wales (7.9) or for this district (4.5). (Department of Health for Scotland 1936).

Since prematurity in almost all records is the greatest single cause of death in the first month and is the principal cause of all infant deaths in this area, the social class mortality from this cause is now considered for trends of mortality in each of the five yearly periods hitherto considered. (Table 38)

TABLE 38

INFANTILE MORTALITY RATES FROM PREMATURITY BY SOCIAL CLASS
per 1000 LEGITIMATE LIVE BIRTHS
IN QUINQUENNIAL PERIODS 1921 - 1945 BIDDULPH URBAN DISTRICT

QUINQUENNIAL PERIODS.	SOCIAL CLASS			
	I and II	III	IV	V
1921 - 1925	-	16.5	25.4	27.3
1926 - 1930	-	28.3	41.4	27.0
1931 - 1935	50.0	22.8	29.1	52.5
1936 - 1940	8.6	7.6	29.4	-
1941 - 1945	-	26.1	14.8	53.7

The trends of class mortality are relatively no better in the last quinquennium than in the first; apart from a low rate among skilled workmen and a nil return among the unskilled in 1936 - 1940, there is nothing to suggest that domiciliary midwifery or ante-natal care has improved any in the past twenty five years in working class homes or made a contribution of any importance to better the chance of survival of the premature infant. The industrial depression, with its associated poverty, in the decade 1926- 1935 coincides with some of the highest class rates for prematurity but they are not marked by a steady gradation from high to lowest classes and it is doubtful if the aetiology can be explained at all on this footing. Mortality in the lowest class was in fact relatively good in the period 1926-1930.

Prematurity is intimately bound up with the health of the mother before and during her pregnancy. The actual causes of death in premature infants have already been discussed, for the conditions associated with pregnancy are not the actual causes of death. It is difficult, in a district inquiry, to assess with accuracy the underlying maternal pathological states directly or indirectly referable to the premature onset of labour. Specialised biochemical investigation is seldom available in domiciliary work. The data set out below are extracted from clinical notes recorded by me of observed states of maternal illhealth and pathological conditions associated with prematurity during the past fifteen years. In some cases extracts have been taken from local hospital records to complete the clinical data, and all refer to the deaths of infants prematurely born and weighing 5½ lbs or less at birth. The birth weight was sometimes open to doubt but the age of maturity was seldom in question. The deaths of 52 premature legitimate infants born to 47 mothers were investigated between 1931 and 1945. I found that 20 of the deaths or 38.6 per cent were associated with toxaemia of pregnancy evidenced by such signs as albuminuria, a systolic blood pressure over 130MM. Hg, or eclampsia. Ante-partum haemorrhage with no clinical signs of toxaemia accounted for 12

premature births or 23.1 per cent, eight of which occurred in multiparae. In five cases or 19.2 per cent the prematurity was associated with twin pregnancy, that is ten premature infants dying. Three cases or 5.7 per cent were associated with repeated pregnancies in which there was a severe degree of hypochromic anaemia. One case or 1.9 per cent followed Caesarean section for placenta praevia and in another there was a long history of mitral disease and chronic bronchitis. In the five remaining cases or 9.6 per cent no obvious cause was found, though trauma was given by two mothers as the only explanation. Bundesen, Fishbein and their co-workers consider the complications of pregnancy particularly important in causing the deaths of premature infants especially under the age of two weeks.(Bundesen, H.N. et al 1938). Spence and Miller have inquired, inter alia, into the causes of the onset of premature labour in Newcastle-upon-Tyne during 1939 and have found that among 78 prematurely born infants, 13 or 16.6 per cent were associated with toxaemia of pregnancy and 15 or 17.9 per cent were twin pregnancies. In 34 or 43.5 per cent of their cases no obvious cause could be discovered. (Spence, J.C. and Miller, F.W.J. 1941). McNeil states that the causal factors in prematurity and premature deaths have been extensively studied in American maternity hospitals and that no significant

correlations were obtained between prematurity and general maternal health or even pre-eclamptic toxaemia in pregnancy, but that ante-partum haemorrhage and hydrammios were significant factors, as were such conditions as severe heart disease, prolapse of the cord and external violence. (McNeil, C. 1942). In the report of a sub-committee of the Scientific Advisory Committee on Infant Moratlity in Scotland it is stated " Even if the associations (that is, the pathological maternal states) had been definite, the problem of prematurity would still be unsolved because the causes of the toxaemias, haemorrhages, and premature rupture of the membranes would still be unknown." (Department of Health for Scotland 1946).

Further study of the problem, from the clinical data sifted, revealed that in twenty of my cases there was little possibility of preventing the premature birth, for there had been no prior ante-natal supervision of any kind. Four had well marked symptoms of toxaemia when first seen. Three were twin-births and in three others there was sudden ante-partum haemorrhage. The deaths subsequently, sometimes within a few hours, occurred in circumstances where facilities were wholly lacking. It seemed too, that even with ante-natal care, many infants were lost through the difficulties encountered in controlling the aetiological maternal

factors. Two facts have impressed me in this district. One is that there is insufficent co-operation between the work of the infant welfare centre and the general practitioner. The medical officer at the clinic is responsible only for the ante-natal work and the general practitioner often for both the ante-natal care and the conduct of the labour. Neither is specially trained for the work, the one undertaking only minor therapy in the clinic and the other dealing often with abnormal obstetrics in surroundings far from ideal. The second is that in the surrounding major hospitals, voluntary and municipal, no facilities exist for the special care of the premature infant such as are available at "Sorrento" Maternity Home, City of Birmingham. (Crosse, V.M. 1939). Here, between 1931 and 1938, of babies with a birth weight between 4 and 5 lbs 78 per cent were saved, and of those with a maturity of 34 to 36 weeks 91 per cent were saved.

So the problem of reducing the prematurity death rate, which is very high here in the lower social classes, resolves itself into the dual study of the care of the mother in her pregnancy, on the one hand, and proper nursing of the premature infant organised in premature baby units in modern hospital surroundings, on the other. Until there is a co-ordinated service in which the patient and the

patient's home are linked with the general practitioner, the infant welfare centre, obstetric consultants and hospitals equipped for ante-natal, natal and post-natal work, and these with each other, the prerequisites for the preservation of the life of the premature infant will not be achieved.

It is unfortunate that the statistics of stillbirths are so incomplete in this district, for the problems of maternal care apply equally to them. Of this McNeil gives figures to " show the incompleteness of any study of prematurity that excludes stillbirths", and he states " that the natal and ante-natal factors which cause stillbirths probably account also for a large number of premature post-natal deaths". (McNeil, C. 1942). The vastness of this problem is hinted at by Mackintosh when she observes that " in Chicago, between 1936 and 1940, with a highly organised service of care after birth, it was only found possible to reduce the premature death rate by 10 per cent ". (Mackintosh, J.H. 1945).

The class mortality from infectious and respiratory diseases in this area over twenty five years has been shown to be respectively six times and four times greater for Class V than Classes I and II combined. In England and Wales the class mortality from these causes, as defined by the Registrar-General, shows that

for infectious diseases it is nine times greater in Class V than Class I and for respiratory diseases seven times greater in the poorest classes than among the well-to-do. (Registrar-General 1931)

Since infectious and respiratory diseases together form the second largest cause of infant deaths in this district and occur in greatest frequency after the age of one month, they have been grouped together for the purpose of discussing them in relation to environmental conditions. They include, mainly, whooping cough and measles, bronch-pneumonia and bronchitis. It is not without significance that in many towns and cities where overcrowding is heaviest, infantile mortality is greatest, for existence is often maintained at the poverty level, powers of resistance are minimal and the importance of correct feeding of infants little understood.

It would not be true to say that all or even many of these factors are referable to an urban and partly rural area of this kind. Certainly housing conditions among the poorer classes favour the spread of infectious diseases. These classes form a section of the community where life is often maintained at its lowest level, where diet is generally inadequate or unsuitable for proper nutrition and where faulty methods of infant feeding are most in evidence. They

are also the class which suffers most from the impact of any wave of epidemic disease. Among them are found the largest families, of whom, very often, the spread of infection, and particularly droplet infection, takes its greatest toll.

But not all this district consists of those at or near the poverty level. The majority are of the skilled and semi-skilled artisan class who are housed by the local authority or dwell in private properties built for and owned by themselves and of modern designs common in the last post-war era. There are very few slum dwellings, (only 20 are scheduled for demolition), nothing approaching the tenement system prevailing in Scottish cities and towns and no back-to-back houses. The incidence of overcrowding is low. The last survey under the Housing Act 1935 was undertaken in April 1936. 2123 houses, out of a total of 2530, rated at £11 and under, were surveyed and the number of occupants of these houses was found to be 8303, giving a rate of 3.91 per house. From the standards laid down by the Ministry of Health under this Act only 84 houses, or 4.2 per cent were found to be overcrowded. 56 had an excess of 1 or one half and the remaining 33 were overcrowded to the extent of $1\frac{1}{2}$ to $4\frac{1}{2}$. (Craig, J.1936). In 1937 the number had been reduced to 63, in 1938 to 52, since when no statistics are available. It is

more than probable that it increased during the war years but it has to be remembered that the Ministry's standards are not high and do not necessarily constitute overcrowding in practice. They merely remove the menace of gross overcrowding.

It is with these facts in mind that the class mortality from infectious and respiratory diseases is now discussed.

TABLE 40

INFANTILE MORTALITY RATES FROM INFECTIOUS AND RESPIRATORY DISEASES.

AFTER ONE MONTH 1921 - 1945 BIDDULPH URBAN DISTRICT

	SOCIAL CLASS				
	I and II	III	IV	V	ALL CLASSES
INFECTIOUS and RESPIRATORY DISEASES	3.6	7.55	9.05	15.9	8.5

The rise in social class mortality is marked with descent in the social scale and is more than four times greater in Class V than in Classes I and II. There is little real difference in Classes III and IV.

A quinquennial review of the incidence of these diseases by social class is given in Table 41.

TABLE 41

INFANTILE MORTALITY RATES FROM INFECTIOUS AND RESPIRATORY DISEASES.

QUINQUENNIAL PERIODS 1921 - 1945 BIDDULPH URBAN DISTRICT

QUINQUENNIAL PERIODS	SOCIAL CLASS				
	I and II	III	IV	V	ALL CLASSES
1921 - 25	15.8	28.3	22.6	-	20
1926 - 30	16.3	18.8	16.6	27.02	14
1931 - 35	-	17.6	21.9	28.3	14
1936 - 40	-	7.6	6.5	11.6	6
1941 - 45	-	6.5	13.1	21.5	9

That a reduction has been effected in the upper classes is apparent. No mortality in the past 15 years is a considerable achievement. The steady drop in mortality among Class III infants has been progressive in each of the five quinquennial periods and is now two and a half times better than was the Class I and II mortality in 1926-1930. Class IV has an irregular mortality over the period and is now relatively better than its own class or that of Classes I and II in the second quinquennium. The rates have, however, improved in the last decade. Class V is worst in all quinquennia except the first, but even in this class the figures in the last decennium are an improvement on those of the previous ten yearly period.

While part of these improved rates since 1931 may be attributed to better housing conditions and the low incidence of overcrowding, I have not sufficient information at my disposal fully to discuss the effects of such conditions as occupation of the mother, diet in the home, family income and faulty infant feeding in their relation to deaths from these diseases. Some generalisations on them, drawn from experience of the life and habits of the community, may indicate broadly their relation to fatal infections under one year of age.

There is no doubt that it has been the custom of the district for very many years for married women to be in gainful employment, first in fustian cutting and, in more recent years, in the manufacture of textiles. Their employment in industry often continued until or beyond the 28th week of pregnancy and, in many cases was re-entered within two months of their accouchment. I have calculated, that, of 56 confinements I conducted in 1936, infants were wilfully weaned within two weeks of birth in 8 per cent of the cases, solely because of the mother's early intended return to employment. In 4 per cent feeding was discontinued within one month through the mother subscribing to the force of lay opinion that artificial lactation was the superior method. It is reasonable to assume that if, on average, 12 per cent of infants born are artificially

fed and a proportion of these is denied the whole time care of a mother, the liability to contract and perhaps succumb to infectious and respiratory diseases will not be lessened. Occupation by the mother is widely practised and its effect may be weighed in relation to the Registrar-General's observation that " in a few instances, notably textile workers, there is a tendency for the mother also to work herself in a factory, with consequent effects on infant mortality." (Registrar-General 1931). On the other hand, the employment of the mother augments the family income and should provide more comforts, an increased diet with consequent improvement in the stamina and resistance of herself and her infant. No doubt it does this in many cases, but infectious and pneumonic diseases in infancy take a heavier toll among the artificially fed than among the breast fed. There is no doubt that the progress and health of breast fed infants are, in general, better than in those artificially fed.

No surveys of diets in the home have ever been undertaken in this district, but Orr has demonstrated in the United Kingdom that the adequacy of a diet is directly related to the income level of groups of the population. It reflects the health of the consumer, and he estimated that as many as 30 per cent may be below the optimum, that is, the physiological standard

for health. (Orr, J.B. 1936). It is a commonplace that, within the family, where the income leaves no margin beyond the necessities, the mother often denies herself in order to make a more liberal provision for her family, with, for her, resulting sub-nutrition. With the birth of her child, this state of under-nutrition will not necessarily affect the birth weight, but it will deplete her own reserves. The most serious sequel will be the inability to maintain lactation, leading to the inevitable advent of weaning and recourse to bottle feeding, with its repercussions, at the lowest social level, on the infant's ability to combat infectious and respiratory diseases. This may account for higher mortality rates in Class V in this district and a less rapid fall in the rates in successive quinquennia. It may well be that the system of providing supplies of priority protective foods and vitamin supplements for expectant and nursing mothers during the war years and subsequently, has had a beneficial effect on continued lactation with consequent slight improvement in Classes III, IV and V mortality compared with only ten years ago. The need for continued persuasion that these supplements are for herself alone is voiced by Mackintosh, who states that " figures for the City of Birmingham (1944) show that only 45.7 per cent of the expectant mothers take the vitamin capsules provided by the Ministry of Food."

(Mackintosh, J.H. 1945). Many more undoubtedly avail themselves of these supplements from private sources. I have observed during the war years in this district that rationing of essential foods and inability to obtain in quantity foods of poorer protective value, have prevented under-nutrition manifesting itself so obviously by social gradients as it did before the war.

Family income is linked directly with the nutritional value of a diet and it has been demonstrated by Orr that under-nourishment is more marked in lower cost diets, or " that the degree of adequacy for health increases as income rises". (Orr, J.B. 1936) Rates of pay in this area, have only been equitable in the mining industry (Classes III and IV) in the past five years. Irregular wages were the rule in all class IV mine workers in the first twenty years covered by this inquiry whereas those among hewers and getters were higher and less affected by output. They should be adequate for good nutrition, but ignorance and disinterestedness often dissipate earnings to the detriment of the dietary. There is less margin among Class V workers and their lower income reveals itself in unwise spending on such foods as condensed milk, bread, potatoes and sugar without commensurate increase in the purchase of protective foods. Dietary deficiencies, in pre-war days, were, however, all too common amongst all classes

of workers. Indirectly dependent then, on the family income, are the vitality and stamina of the expectant mother and her ability later to maintain efficient lactation. Dietary deficiences in pregnancy will thus expose the infant to the twin risks of artificial feeding in the care of an ailing mother and lowered resistance to epidemic diseases and chest infections.

A reduction in the infantile mortality rates in the different social classes from infectious and respiratory diseases, in this district, not being dependent on overcrowding, will not be attained by a direct attack on the existing housing conditions, for it is not even one of the major causes of social class mortality. In order of importance the aetiological factors underlying these diseases may be summarised thus :

1. too early weaning by reason of occupation of the mother in local industry,
2. ignorance of the value of protective foods to maintain lactation,
3. too low income in the lowest social class with consequent excess expenditure on cheap non-protective foods,
4. lowered resistance to droplet infection among infants, resulting from these maternal and monetary influences,
5. larger families among the poor and increased

danger from cross infection during epidemics, for example, measles and whooping cough.

In spite of these palpably unfavourable influences and because many infants are still breast fed in reasonable home surroundings and parents now obtain and are more receptive to guidance and instruction, favourable reduction in mortality has taken place in this district in the past ten years. This is greatest with social ascent. Concentration of effort is required in the lower social classes, especially Class V. This class has proved hitherto to be more prone to take the weight of epidemic diseases, evidenced in this area by the high rate in the 1931-1935 quinquennium. The increased rate (1931-1935) among infants of Class IV workers coincided with an epidemic of measles in 1933; and in the 1941-1945 quinquennium with measles and whooping cough outbreaks in 1942, 1943 and 1944 Class IV again suffered an increase in mortality. The added hazards of artificial feeding and unwise spending no doubt increased the fatality rates.

No isolated method of attack can deal effectively with this problem for it is closely bound up with the physical and mental stamina of the parents, the size of the family, ignorance of personal and communal hygiene, insufficient food on low incomes and poor home conditions. But much has been done in twenty five years to educate

the parent on her responsibilities to her infant in the matter of her own diet and its effect on lactation, and although the mortality rates among the lowest social class do show some reduction, it seems to have benefited least from this instruction.

More enlightenment, then, of lay opinion, better town planning with all amenities, and rehousing for old as well as condemned properties would reduce still further the infantile mortality rate from infectious and respiratory diseases. Advances in modern therapy can never do it unaided, though it cannot be denied that since the introduction of sulphanilamide therapy, there is clinical evidence that their correct administration has benefited the respiratory complications of infectious disease among infants. The more ready use of hospital facilities in later years has also contributed to a reduction. This country district has made more frequent use of hospitals for many illnesses in the past decade than was the custom in the previous fifteen year period. It is an interesting speculation to contemplate the further benefits which may be derived from the administration of penicillin in suitable cases when its manufacture permits it to be put to practical use by the general practitioner in his domiciliary work.

SUMMARY.

The section deals with the effects of occupation and social conditions on the infantile mortality rate. Statistics are submitted of occupations, legitimate live births and infantile mortality rates by social class of the father.

The more important facts revealed by the analysis of them are as follow:

A. Infantile Mortality Rates.

(1) The rates are low in Social Class I and II.

(11) Higher rates among skilled mine workers keep the Class III rates high.

(111) There has been irregular reduction in Class IV mortality.

(1V) There is no apparent improvement in Class V mortality.

B. All causes.

(1) The rates rise with social descent.

(11) This rise is greatest from infectious diseases.

(111) The prematurity rates are higher in all classes and relatively high in Class I and II.

(1V) Deaths from congenital malformations are not affected by social class.

C. Prematurity.

(1) Rates in most years are high and there is an irregular class mortality.

(11) The relation of maternal morbid states to deaths from prematurity is discussed clinically.

(111) The importance of improved ante-natal care is emphasised.

D. Infectious and respiratory diseases.

Housing conditions are reviewed.

(1) The rise in mortality is marked with social descent.

(11) There are signs of a downward trend in the rates in all classes in the last decennium.

In the absence of factual data, a general discussion is undertaken on

1. the employment of married women in local industry,
2. the lack of knowledge of the nutritive values of diets,
3. the causes of failure to maintain lactation,
4. diet in relation to income, and
5. the importance which the provision of priority protective foods to expectant and nursing mothers may have on the future reduction of infantile mortality.

PART V. - GENERAL REVIEW.

17. GENERAL SUMMARY.

In Great Britain the average size of the family began to decline about the year 1870. This did not result in an immediate absolute fall in the total population, but the rate of increase from census to census declined from just over ten per cent to four and a half per cent. At the same time the balance of the population was upset, resulting in a relative increase in the advanced age groups (60 to 80) as compared with those in the vital productive age groups (20 to 40). This seemed to foreshadow the ultimate decline in the total population. His Majesty's Government, impressed by this serious problem, appointed a Royal Commission on Population to examine the facts, investigate the causes and consequences, and consider what measures were necessary to influence the future trend of population.

Among the known factors which influence the rise or fall of the population is the Infantile Mortality Rate. In the course of the present century this had shewn substantial improvement, but compared with other countries our progress was still relatively unfavourable. As a general practitioner and part-time Medical Officer

of Health this aspect of the problem had long attracted my interest. I decided, therefore, to make it the object of special inquiry among the community of the Urban District of Biddulph in which I had practised for fifteen years.

Biddulph is a typical urban district of North Staffordshire comprising a population of approximately 10,000, in which the staple industry is coal-mining. The period covered by the inquiry is the twenty five years, 1921 - 1945.

Terms are defined in accordance with the most generally accepted connotation so that this contribution may be related to the published work of others in this field.

The infantile mortality rate in the Biddulph Urban District during the period 1921 - 1945 has been investigated through the official published statistics of the local Medical Officer of Health, County Medical Officer of Health and the Registrar-General. The cognate social factors have been studied in a field inquiry enhanced by my intimate personal knowledge as a general medical practitioner in the area since 1931.

The findings have been reviewed and discussed relative to the experience of other workers as published in the literature in this country and abroad.

The crude infantile mortality rate is divisible

into two components, the neo-natal and post-natal mortality rates.

The crude infantile mortality rate in the Biddulph Urban District showed wide unstable annual fluctuations until 1936. Since then a favourable, more stable downward trend has developed. In 1921 the rate was 94 as compared with 38 in 1945. The corresponding rates for England and Wales were respectively 83 and 46.

Comparison is also made with the rates in the County of Stafford and other similar urban districts.

The neo-natal and post-natal components have been analysed. This analysis confirms the general experience that the neo-natal component (including stillbirths) is the major factor, which up till now has proved less capable of remedy and so retards decline in the crude infantile mortality rate.

The crude infantile mortality rate and the neo-natal and post-natal components have been further analysed and discussed in relation to the following influences, sex of the infant, multiple births, illegitimacy, serial order of birth and economic and social factors, with particular reference to experience during the war years 1939 - 1944.

Infantile mortality has been studied in relation to the certified cause of death. It is shewn that

prematurity is the most important single factor in the causation of death during the neo-natal period and that acute pulmonary and gastro-intestinal infections are dominant in the post-natal period.

It is recognized that there are minimum rates beyond which improvement cannot reasonably be expected. Stocks regards these as follows :

infantile mortality rate	25
neo-natal mortality rate	18
post-natal mortality rate	7.

These figures were indeed achieved in the Biddulph Urban District in the year 1930. They proved of little significance, however, for the subsequent annual rates showed no relation to these isolated minimal values, but they indicate a low level at which they may well be stabilised in years to come.

18. CONCLUSIONS.

The infantile mortality rate has shewn a definite downward trend in this country and in most other countries throughout the world during the past twenty five years.

The present rate in this country, however, compares unfavourably with some other countries and this suggests that it is possible for us to achieve still lower rates.

The downward trend in the national rate is observed in the statistics of the Biddulph Urban District, although the local rates are subject to wider annual fluctuations.

The separation of the crude infantile mortality rate into two components, neo-natal and post-natal, is based on sound practical observation of the aetiological factors responsible for infant deaths, and represents no mere arbitrary division.

The study of neo-natal mortality is incomplete and the findings fallacious unless they include that not inconsiderable portion of potential life lost by stillbirths.

Prematurity is the most important single certified causal factor in neo-natal mortality. The difficulties in controlling its onset and the lack of measures to assure better care of the premature infant

retard the favourable trend in the crude mortality rates.

Respiratory and gastro-intestinal diseases account for most of the deaths in the post-natal period. The notable reduction in mortality from broncho-pneumonia is the greatest contributory factor in the decline of the post-natal rate.

The exhibition of sulphanilamide compounds and anti-biotic drugs may assist towards further reduction of the post-natal component rate.

The factors which determine the incidence of premature births are still incompletely understood and call for further research.

All rates are influenced in some degree by social, economic and environmental factors. It would seem that the post-natal component is unfavourably affected by adverse social circumstances, the neo-natal component by a lack of integration of the several health services responsible for the care of the pregnant woman and subsequently of her infant.

The extant methods of certification of infantile deaths and particularly of stillbirths are not wholly satisfactory but are capable of further improvement. The incorporation of fuller scientific data would, over the years, stimulate research into some of the causal factors and so assist in the further reduction of the

infantile mortality rate.

The inquiry discloses a creditable record of progress. It does not permit of complacency for the rates of infantile mortality can and should be improved.

19. RECOMMENDATIONS.

A study as recorded in this thesis, while not resulting in any new discovery, may stimulate certain constructive ideas.

As a result of my inquiry and reinforced by my long intensive daily work as a general practitioner in a typical urban industrial community I am persuaded that the infantile mortality rate can be reduced still further and approach the irreducible minimum of twenty five postulated by Stocks. However, it is a long rather than a short term view.

I feel justified in submitting for consideration the following recommendations, which may be conveniently classified and discussed under the following headings :

1. The doctor,
2. The hospital and nursing services,
3. The health and social services,
4. The community,
5. Research.

1. The Doctor.

The medical curriculum for undergraduates in medicine is already seriously overloaded and becomes increasingly so with modern advances. It cannot reasonably be extended but a new emphasis is possible.

On the clinical side better practical

instruction is required in ante-natal and post-natal care of the mother and infant feeding, especially of the premature baby. The new departments of Child Health must direct special attention to Infant Health.

Under certain circumstances it may be necessary to advise a woman against the risks of further pregnancy. The doctor of the future must be equipped not merely to give this advice but to give practical instruction in the best methods of scientific birth control and family planning.

The old ideas of Public Health and Sanitary Science have now been developed in the new concept of Social Medicine. This involves greater emphasis during training on housing, nutrition, family income, the right use of leisure and occupation as important social factors. Every graduate in medicine should not be permitted to engage in practice until he has completed a period of further training in a hospital or as an assistant to a general practitioner of good professional standing. If need be this could be achieved by government subsidy. Facilities should be placed more fully at the disposal of the general practitioner for post-graduate study and should be directed towards those subjects in which his special interests lie.

2. The Hospital and Nursing Services.

Hospitals, and particularly maternity hospitals, have existed hitherto as centres for the reception of the emergency or the acutely ill. Too little attention has been given to the use of maternity hospitals for the care of the pregnant woman harassed by domestic anxieties and requiring, as well as the treatment of complications, periods of physical and mental rest, observation and ante-natal instruction to ensure satisfactory labour and an uneventful convalescence. The availability of maternity and children's hospitals merely for obstetrical and infant emergencies falls short of the conception of them as units in a complete health service. Rather should they be planned of sufficient size to admit a large percentage of normal cases desiring hospital care. Co-ordination of hospital accommodation, hospital consultant, maternity and infant welfare personnel and general practitioner into a unified service can be successful and economical and thereby ensure the most complete care of all types of maternity cases and the supervision of normal, ailing and premature infants.

There is a shortage and bad distribution of maternity and health visiting nurses under existing services. Improved working conditions to attract the

best types of trainees are fundamental to the success of any future co-ordinated nursing service. The statutory enactments for extended education may facilitate the recruitment of them. Increase in their numbers and division of the area of their responsibilities, at present far too large, would permit of more frequent refresher courses and an extended training on such little known subjects as diet, rest, housewifery and mothercraft as well as providing opportunities for intensive study of infant care and the nursing of the premature baby. There exists to-day little continuity between the functions of the midwife and those of the health visitor and no co-operation at all between them during the puerperium.

3. The Health and Social Services.

The Ministry of Health, through major local authorities, has on occasions during the recent war encouraged the enlistment of personnel of voluntary nursing and social welfare organisations to provide home help for families temporarily incapacitated by illness. This provision of home help services is no new conception. It has, however, never been put to wide practical use, but is considered of sufficient importance for incorporation in the recent National Health Service Act. Properly organised, under powers granted to local authorities, and in due time, home

helps should form a unit, inter alia, for assisting the mother to conserve her physical resources during her pregnancy, a factor of importance to her own health and to the maturity and survival of her infant. Integrated with this and for the same purpose, the wider provision of creches for the pre-school children and the provision of school meals for the 5 to 15 age group will minimise that sense of despair and futility so commonly exhibited in the overworked multiparous woman, a state which cannot fail to have adverse effects on her physical and mental stamina and so predispose to ante-natal morbid states and premature delivery.

4. The Community.

The need for the education of the public in the elements of Social Medicine has been recognised, and this has largely taken the form of health propaganda by lectures, leaflets, posters and clinic demonstrations.

The value of the wireless and the documentary film has asyet not been fully explored. All of these depend on the intelligence and co-operation of the individual. Besides, the approach has been too largely directed to the woman. Men also require the training.

It would appear that the instruction must be given at a time when it is not voluntary for the person to receive it. The proposed raising of the school age to sixteen years - an age which closely

approaches the age of marriage - seems to offer a favourable opportunity. All boys and girls before leaving school should receive instruction in elementary anatomy and physiology, including sex instruction. The primary object of such training should not be directed against such problems as sexual delinquency, venereal disease and illegitimacy but should have for its objective the proper preparation for healthy married life.

In the training of the woman, domestic science is not enough; it must be housecraft. At present mothercraft classes are available. Similar classes should exist for men.

There must be a re-awakening of the social conscience whereby it is recognized that the home is even more important in the education of children than formal instruction in schools.

5. Research

The need for further research into such maternal pathological states as the toxaemias of pregnancy and ante-partum haemorrhage has for long been recognized. Even although the causes of death from prematurity are fully known and a high standard of infant care achieved, without further intensive research into the pathology of the expectant mother,

a large percentage of immature infants will still be lost.

For many years all maternal deaths have been subject to close investigation by the Local Health Authority. I wish to submit that similar investigation should be made into the circumstances associated with all infant deaths and particularly stillbirths. A basis for this study, referable to neo-natal mortality, would be the incorporation of a stated maternal cause, if present, on the issuing death certificate. The introduction of this, if necessary by regulation, would secure a certain uniform standard of certification and make available for analysis much essential information, not previously recorded, on the relation of neo-natal mortality to maternal ill-health. In time, research could be directed into those channels in need of most urgent investigation.

The permitted method of certification of stillbirths in England and Wales requires radical alteration if records of any value are to be made available for research and study.

Continued research directed to improvements in housing amenities, sanitation, water supplies and

communal and personal hygiene has as its object the maintenance of life and health at its highest level at all ages. The need for this is particularly important to ensure survival of the infant in the first year of life.

B I B L I O G R A P H Y.

Abrahamson, H. (1941) Journ. Paediatr. Vol. XIX. 545.

Baird, D. (1945) Journ. Obstet. and Gynaec. Brit. Emp. Vol. LII. Aug. No. 4 339.

_____ (1945) Ibid., 359.

_____ (1945) Ibid., Vol. LII. June No. 3 227.

Beck, A.J. (1941) Amer. Journ. Obstet. and Gynec. Vol. XLII : 355.

Benians, T.H.C. (1943) British Medical Journal, **1**, 623.

Brit. Med. Journ. (1946) **Epidemiological Notes, 2 : 214.**

Bundesen, H.N. (1938) Journ. Amer. Med. Assoc. 111 : July 134-141.

Fishbein, W.I.
Dahms, D.A.
_____ Potter, E.M. Ibid., 138.
Volke, W.

Campbell, J. (1929) Reports on Public Health and Medical Subjects. No. 55. Ministry of Health. 1.

_____ (1929) Ibid., 61.

Carruthers, W.D. (1944) M.O.H. Ann. Report Staffs. Co. Coun. 25.

Craig, J. (1929-1939) M.O.H. Ann. Reports, Biddulph U.D.C.

_____ (1929) 1929 : 2

_____ (1933) Ibid., 1933 : 3

_____ (1938) Ibid., 1938 : 2

_____ (1936) Ibid., 1936 : 3

_____ (1930) Ibid., 1930 : 3

_____ (1936) Housing Report, Biddulph U.D.C. 1936, April.

Craig, J. and Ferguson, J. (1938-1945) M.O.H. Ann. Reports, Biddulph U.D.C. 1928-1945 1 : 2.

Ibid., 1.

Crosse, V. Mary.	(1945)	The Premature Baby London, p.146. J. and A. Churchhill Ltd.
————	(1945)	Ibid., 140.
————	(1945)	Journ.Obstet. and Gynaec. Brit. Emp. Vol.LIII.Feb.No.1 72.
————	(1939)	Public Health, No.11, Vol.LII Aug. 332.
Currie, J.R.	(1938)	Hygiene : 97. E. and S. Livingstone, Edinburgh.
————	(1938)	Ibid., : 26.
De Lee, J.B.	(1938)	1938 Year Book, Obstet. and Gynec. 2nd Ed. Obstetrics, The Newborn, 251 The Year Book Publishers, Chicago.
Department of Health for Scotland.	(1946)	Inf.Mort.Scotland, 1946, H.M.Stationery Office, Edinburgh. p. 4.
————	(1946)	Ibid., p.20 Table 12.
————	(1946)	Ibid., p.26.
Eastman, N.J.	(1944)	Amer.Journ.Obstet.and Gynec. Vol. 47 April No.4. 445-461.
Ebbs,J.H.,Tisdall,F.F., and Scott, W.A.	(1941)	Journ.Nutrition, 22. 515.
Edge, P.G.	(1944)	Trans.Roy.Soc.Trop.Med.and Hyg. 38 : 117.
Ferguson, J.	(1944-1945)	M.O.H. Ann.Reports,Biddulph U.D.C.
————	(1945)	Ibid., 1945 : 1 : 8
————	(1944)	Ibid., 1944 : 1
————	(1945)	Ibid., 1945 : 1 : 9
————	(1945)	Ibid., 1945 :11.

Gale, A.H. (1945) Month.Bull,Min. of Health and Emer.Pub.Health Lab.Serv. May 1945 Vol.4:97

_____ Ibid., Oct 1945 Vol.4:212 -214

Henderson, J.L. (1945) Journ.Obstet.and Gynaec.Brit. Emp. Vol. LII. 29

Holland, E. (1944) Rep.Nat.Matern.Serv. Roy.Coll.Obstet.and Gynaec. H.W.Rawson & Co.Ltd., Manchester. May 6 - 7.

_____ (1944) Ibid., 34.

Jameson,W.W. and Parkinson,G.S. (1939) Synop.Hygiene : 210 : 6th Ed. J. & A. Churchill Ltd London.

Lund, J.C. (1942) Amer. J. Obstet. and Gynec. 43 : 365.

Mackintosh, J.H. (1945) Practitioner : Vol. 154 : No. 924 : 339.

_____ (1945) Ibid., 338.

MacGregor, A.R. (1943) Edin. Med. J. 50 : June 332 : 343.

Martin, W.J. (1945) Brit.Med.J. 1 : 364.

_____ (1945) Ibid., 1 : 365.

McKinlay, P.L. (1929) Min. of Health Rep.No.55 Statistical Notes : 30

_____ (1929) Ibid., : 52

McNeil, C. (1942) Glas.Med.J.Vol.xix : No. 4 : 90 - 91

_____ (1943) Brit.Med.J. 1 : 715.

_____ (1942) Glas.Med.J. Vol.xix No.4 : 87.

_____ (1942) Ibid., : 90.

Orr, J.B. (1936) Food Health and Income :31-34

_____ (1936) Ibid., 49 Macmillan & Co.Ltd.London

Potter, E.M. and Adair, F.L.	(1943)	Amer.J.Obstet.andGynec. 45 : 1055 Jun.
_____	(1943)	Ibid., 1061
Potter, E.L. and Crunden, A.B.	(1941)	Amer.J.Obstet, and Gynec. 42 : 870 - 874. Nov.
Registrar-General	(1946)	Quart.Return.389 : 1. H.M.Stationery Office, London.
_____	(1931)	Decen.Supp.E. and W. PartIIa Occup.Mort. 163
_____	(1931)	Ibid., 164
_____	(1931)	Ibid., 220 :226
_____	(1937)	Annual Review : E.and W. : Table 24.
_____	(1938)	Statis.Review : Part 2 : Civil.
_____	(1931)	Decen.Supp.E.and W. : Part lla Occup.Mort.383-384.
_____	(1931)	Ibid., 376:Table 14.
_____	(1931)	Ibid., Table 4A
_____	(1931)	Ibid., 163-169.
_____	(1931)	Ibid., 170.
_____	(1931)	Ibid., 376:14:Col.8
Roberts, Ll.	(1941)	Aids.Pub.Health,4th Ed. 9. Baillière,Tindall & Cox, London.
Ronsheim, J.	(1938)	Amer.J.Obstet. and Gynec. 36 : 419 - 426.
Simon, Ld.	(1945)	Statement, Roy,Comm.Pop : 2 H.M.Stationery Office, London.

Spence, J.C. and Miller, F.J.W. (1941) Rep. Invest. Causes Inf. Mort. Newcastle-upon-Tyne. 1939 Christie & Malcolm, Newcastle-upon-Tyne.

Stocks, P. (1944) Month. Bull. Min. of Health and Emer. Pub. Health Lab. Serv. Jan. 1944 Vol. 3 : 7

_____ (1944) Ibid. 8

Utheim-Toverud, K. (1939) Acta Paediatr. 24, 115

Woodbury, R.M. (1926) Inf. Mort. and Causes Ch. 2 p 45 et seq. Williams & Williams, Baltimore. Md.

Woolf, B and Waterhouse, J. (1945) J. Hyg. Camb. 44 : 2 : 68.

A P P E N D I X

to

INFANTILE MORTALITY in a MINING AREA

containing

M A P S

D I A G R A M S

G R A P H S

T A B L E S

- o - o - o - o - o -

C O N T E N T S

C O N T E N T S

- - - - - - - - - - - -

APPENDIX 1.

INFANTILE MORTALITY 1921 - 1945

TABLES showing Rates for Different Countries.†

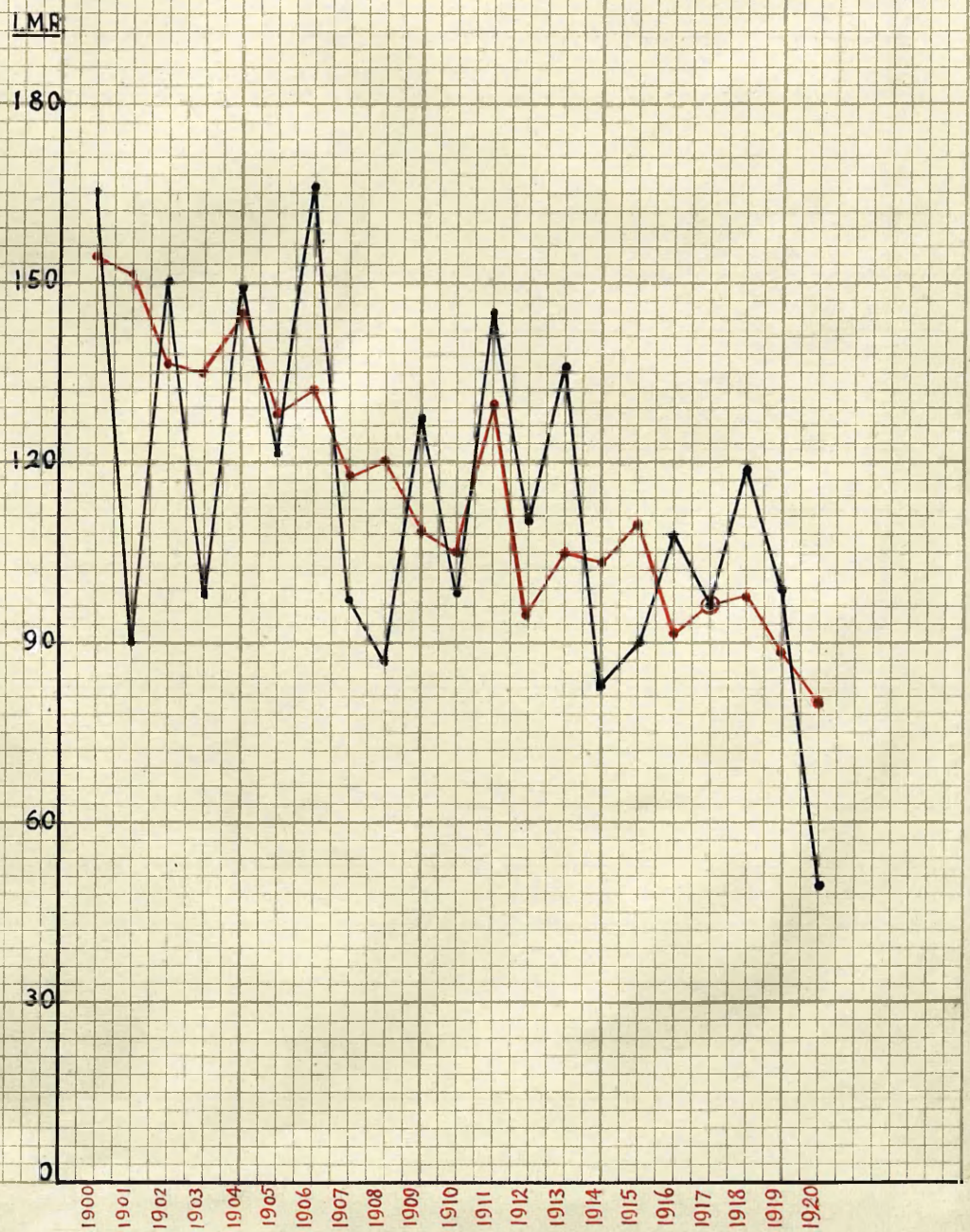
UNDER one year of age per 1000 LIVE BIRTHS

COUNTRY	AVERAGE 1921-1925	AVERAGE 1926-1930	AVERAGE 1931-1936	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945
BIDDULPH U.D.	69	67	73	33	44	43	37	57	66	58	28	53	38
UNITED KINGDOM	78	70	65	62	61	55	54	61	64	54	52	46	47
ENGLAND and WALES	76	68	62	59	58	53	51	57	60	51	49	46	46
SCOTLAND	92	85	81	82	80	70	69	78	83	69	65	65	62
NORTH IRELAND	82	79	78	77	77	75	70	86	77	76	78	77	75
NEW ZEALAND		41	39	41	39	50	42	39	40	37	39		
NORWAY	52	49	45	42	42	37	37						
HOLLAND	64	56	45	39	38	37	34	39	43	40	40		
SWEDEN	60	58	50	43	45	42	39	39	37	29	29		
SWITZERLAND	65	54	48	47	47	43	43	46	41	38	40	42	
UNITED STATES of AMERICA	74	68	59	57	54	51	48	47	45	40	40		
FRANCE	95	89	73	67	65	65	63	91	73	71	75		
CANADA	98	93	75	66	76	63	61	56	60	54	54		
GERMANY	122	94	74	66	64	60	60	63	63	68			
ITALY	127	119	105	100	109	106	97	103	115	108			
JAPAN	159	137	120	117	106	114							
INDIA - BRITISH PROVINCE	182	178	170	161	162	167	156	160	158	163			

† Statistical Year Book of League of Nations : Geneva 1945: Seventeenth Issue 1942 - 44: Table 9 pps 44: 45.

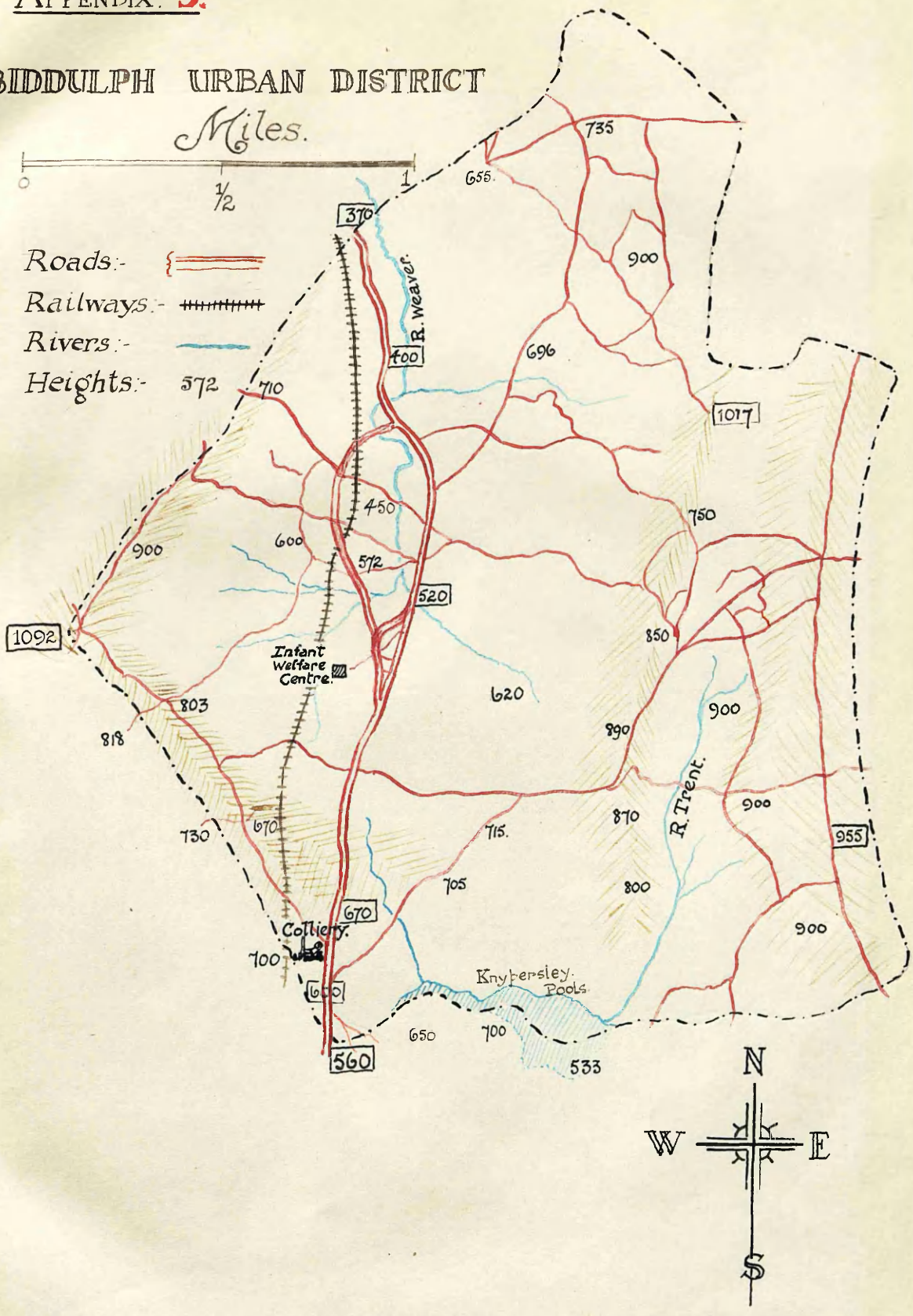
APPENDIX 2.

ANNUAL CRUDE INFANTILE MORTALITY RATES
1900 — 1920
BIDDULPH URBAN DISTRICT
ENGLAND and WALES



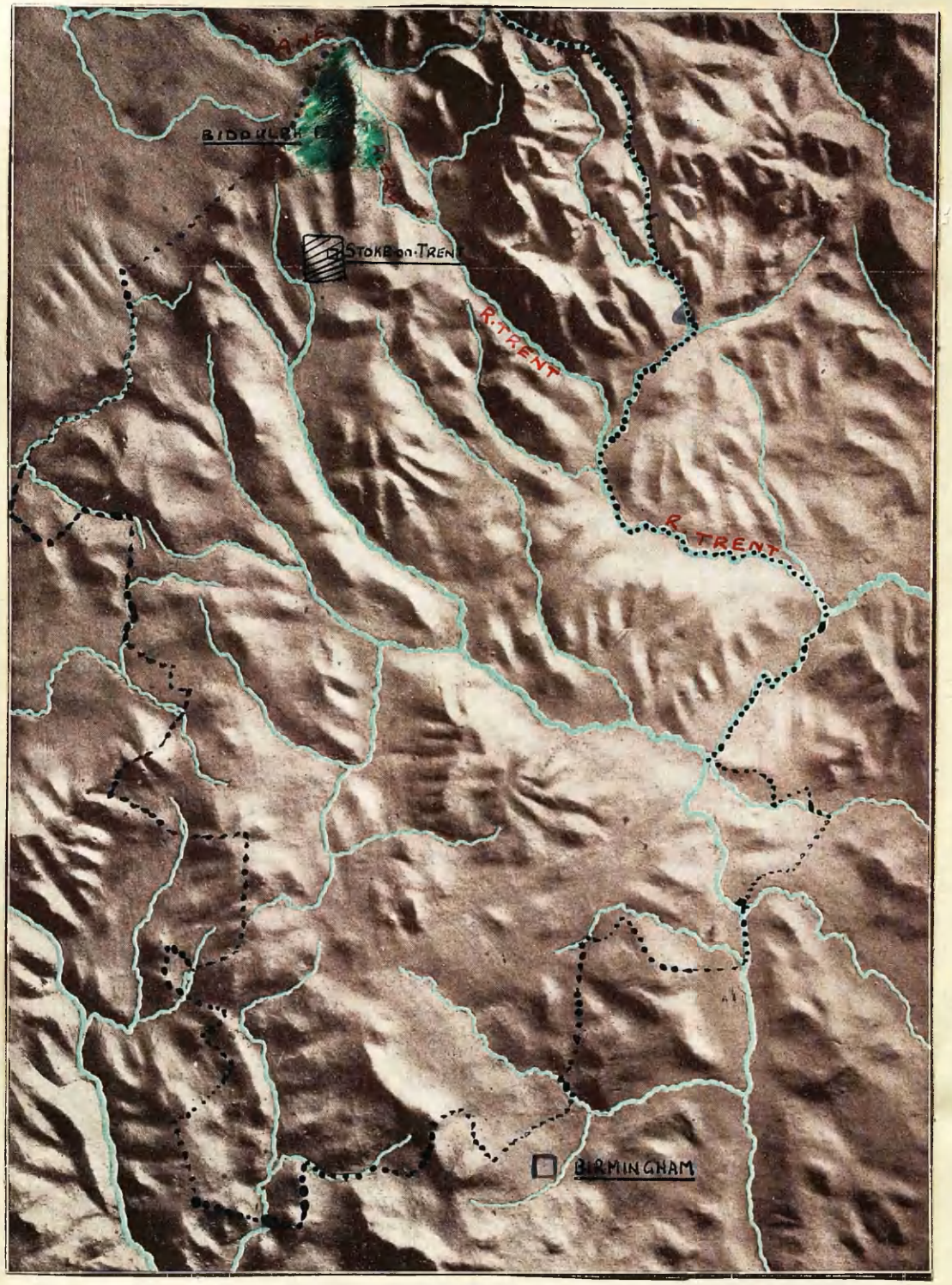
APPENDIX. 3.

BIDDULPH URBAN DISTRICT



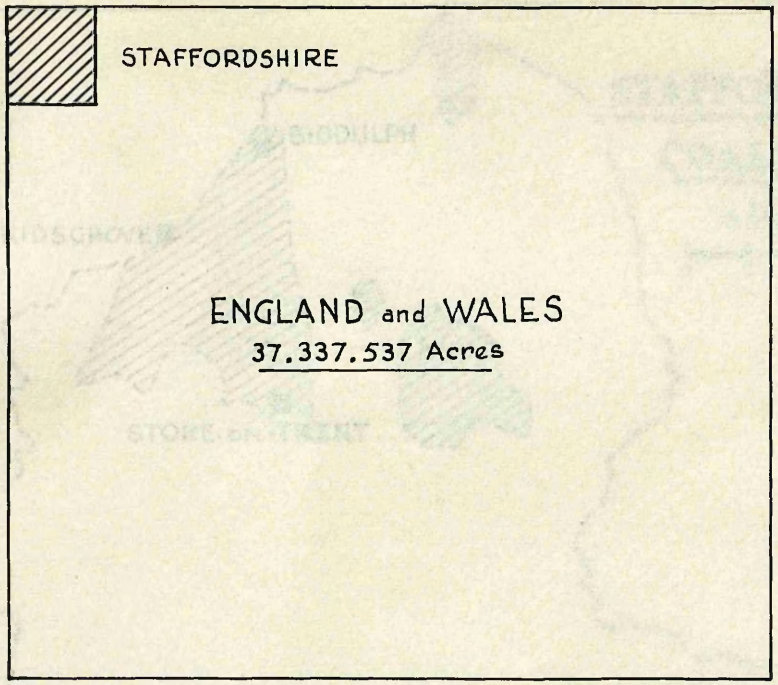
APPENDIX. 4.

STAFFORDSHIRE. RELIEF.

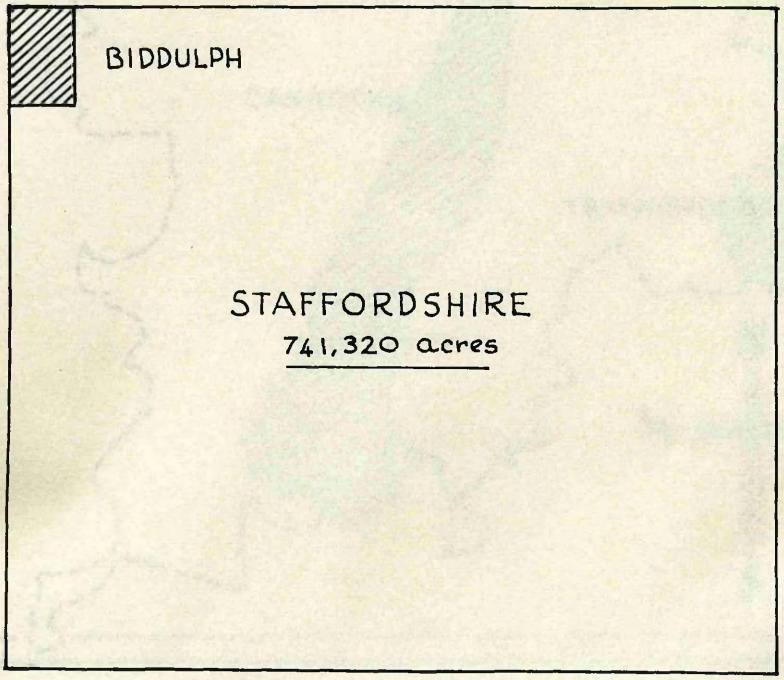


APPENDIX 5.

ACREAGES

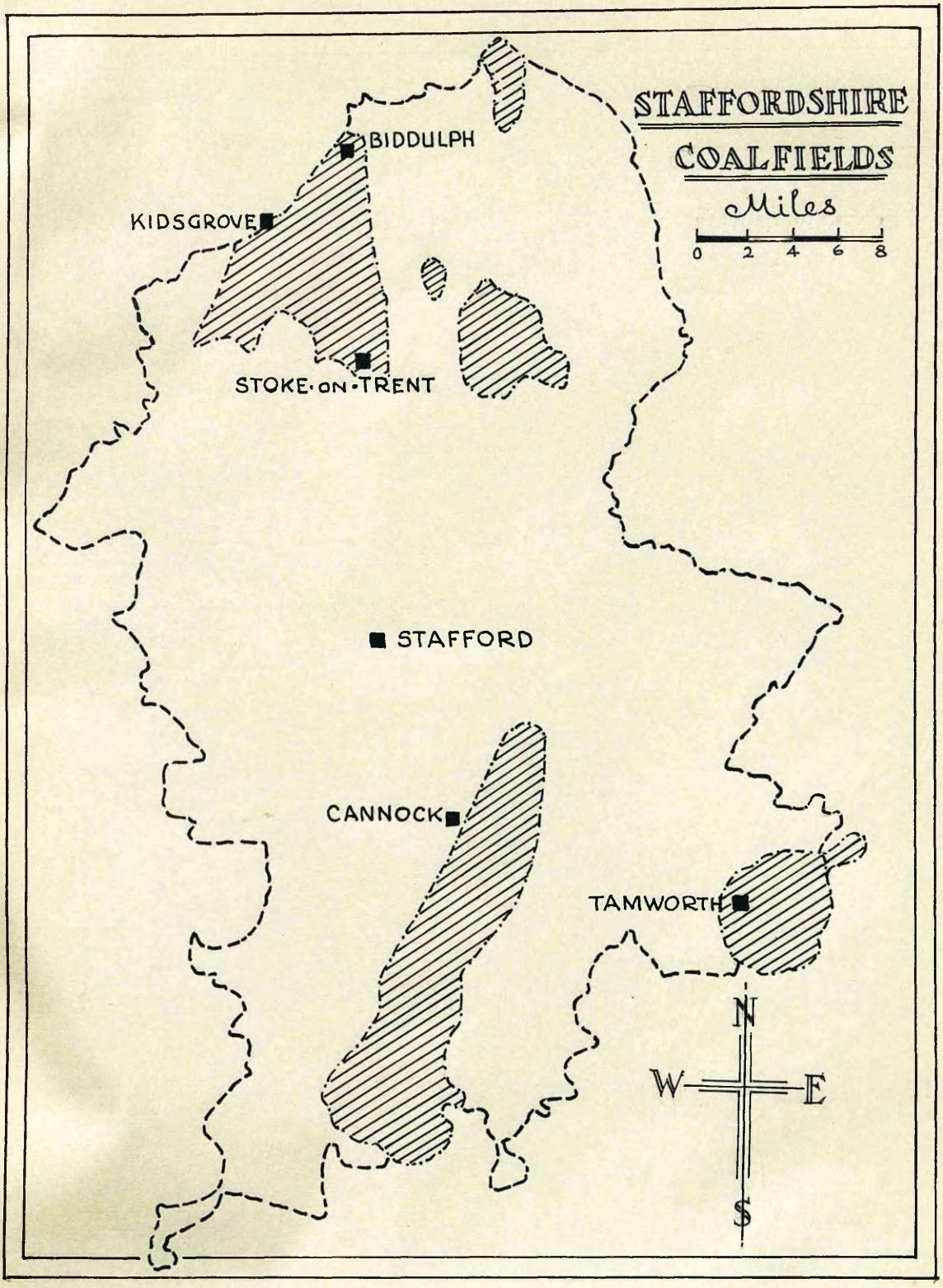


AREA of STAFFORDSHIRE (741,320 acres) Compared with that of ENGLAND & WALES

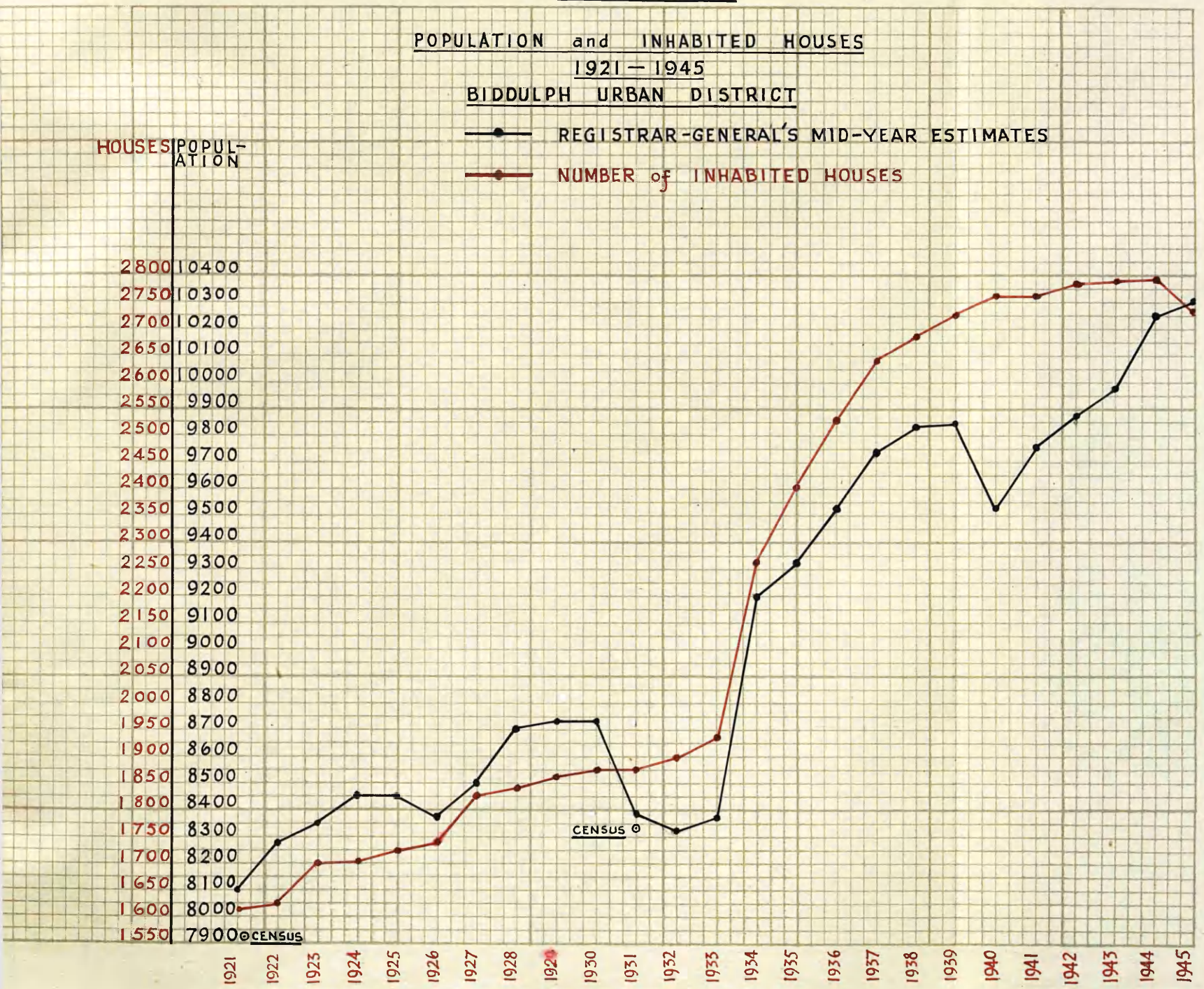


AREA of BIDDULPH (6,674 acres) compared with that of STAFFORDSHIRE

APPENDIX 6.


STAFFORDSHIRE
COALFIELDS
Miles
0 2 4 6 8
BIDDULPH
KIDSGROVE
STOKE-on-TRENT
STAFFORD
CANNOCK
TAMWORTH
N
W
E
S

APPENDIX 7.


POPULATION and INHABITED HOUSES
1921 — 1945
BIDDULPH URBAN DISTRICT
REGISTRAR-GENERAL'S MID-YEAR ESTIMATES
NUMBER of INHABITED HOUSES
HOUSES
POPULATION
2800 10400
2750 10300
2700 10200
2650 10100
2600 10000
2550 9900
2500 9800
2450 9700
2400 9600
2350 9500
2300 9400
2250 9300
2200 9200
2150 9100
2100 9000
2050 8900
2000 8800
1950 8700
1900 8600
1850 8500
1800 8400
1750 8300
1700 8200
1650 8100
1600 8000
1550 7900
CENSUS
CENSUS
1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945

APPENDIX 8.

MEDICAL SERVICES - BIDDULPH URBAN DISTRICT

1.

PUBLIC HEALTH ADMINISTRATION

COUNTY MEDICAL OFFICER of HEALTH

- Local Sanitary Authority (Biddulph U.D.C.)
  - Health Committee
    - One District Medical Officer of Health (part-time)
      - One Sanitary Inspector -full time 1941
- Infectious Diseases Joint Hospital Committee
  - One Infectious Diseases Hospital (not within the area)
- Public Assistance Committee
  - One Medical Officer
    - Two Public Assistance Officers
      - One Public Assistance Institution (not within the area) -Eight Maternity Beds
- Special Health Services
  - Maternity and Child Welfare
    - One Infant Welfare Centre
      - One Medical Officer and School Medical Officer
        - Two Health Visitors
  - Midwives' Acts 1918-1936
    - Two County Council Midwives (domiciliary)
  - Tuberculosis Joint Committee
    - One Medical Officer
      - One Health Visitor
        - Three Sanatoria

2.

OTHER MEDICAL SERVICES

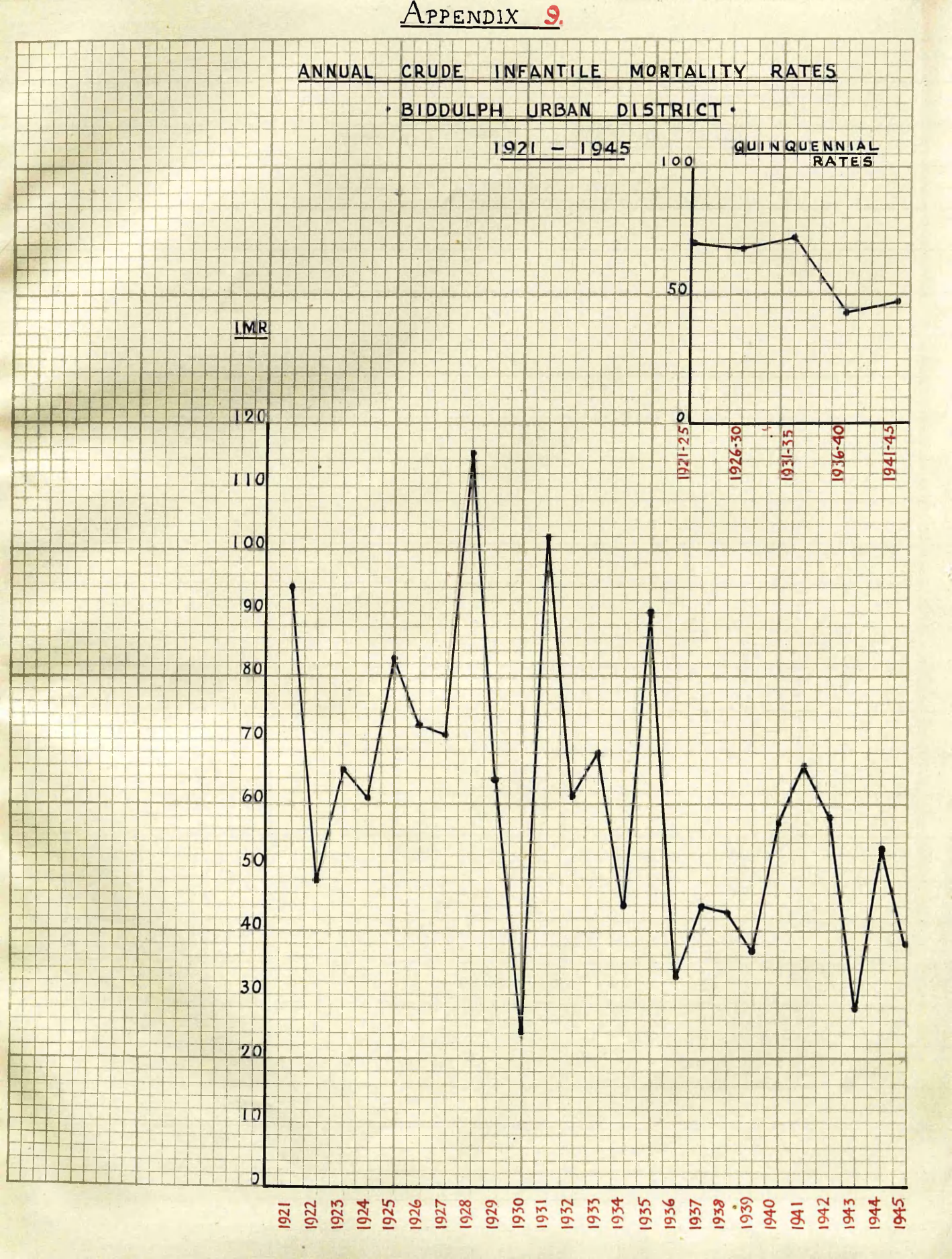
- Three General Practitioners
- Two Non-County District Midwives in Private Practice
- One District Nurse (Rural Area only)
- Six Hospitals (none within the area)
  - Two General Hospitals
    - Eleven Maternity Beds
  - Two Cottage Hospitals
    - Three Public, Three Private } Maternity Beds
  - One Maternity Annexe
    - Twenty Private Beds
- One Ambulance

APPENDIX 9.

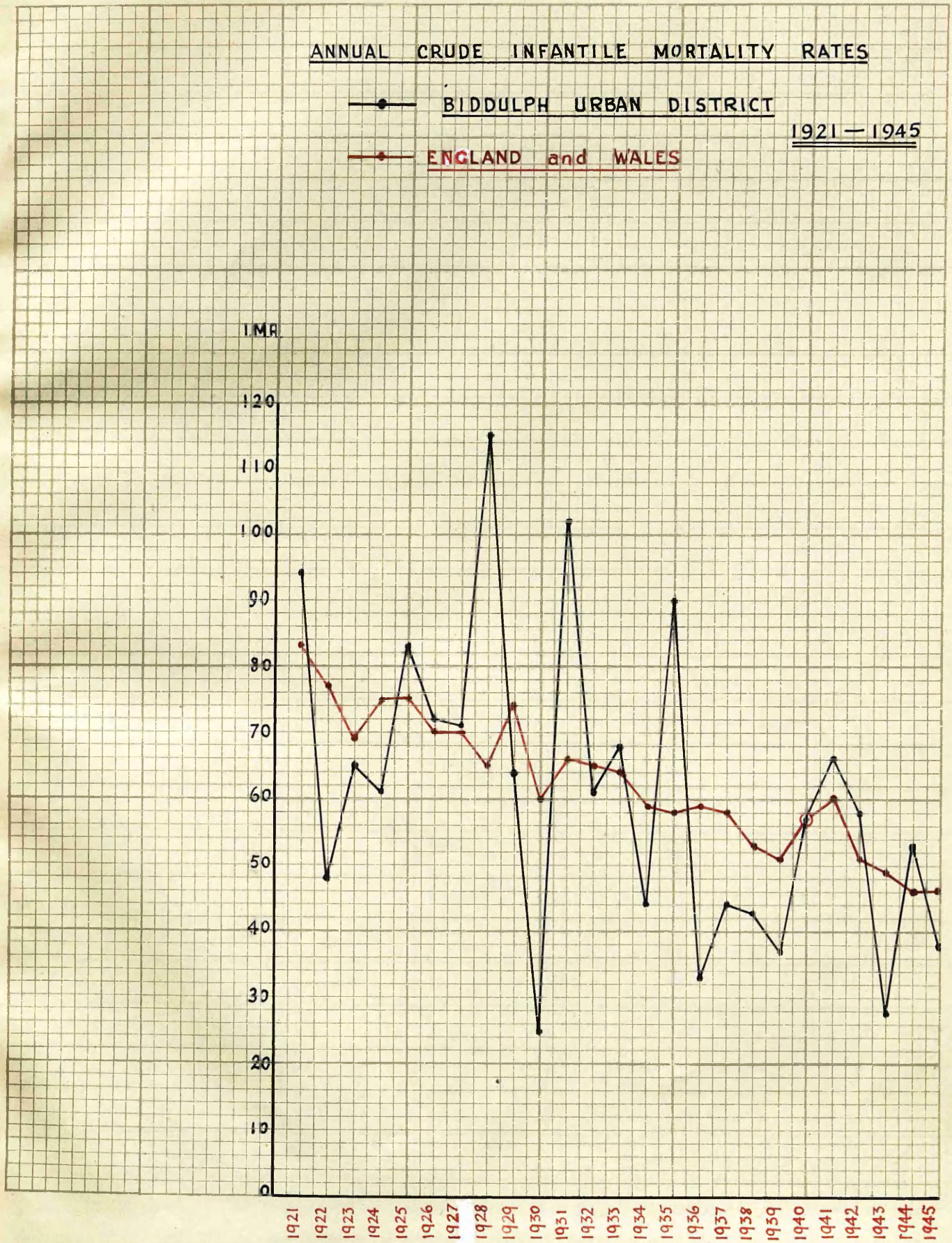
ANNUAL CRUDE INFANTILE MORTALITY RATES

BIDDULPH URBAN DISTRICT

1921 – 1945



APPENDIX 10.


ANNUAL CRUDE INFANTILE MORTALITY RATES
BIDDULPH URBAN DISTRICT
1921 — 1945
ENGLAND and WALES
I.M.R.
120
110
100
90
80
70
60
50
40
30
20
10
0
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945

APPENDIX 11.

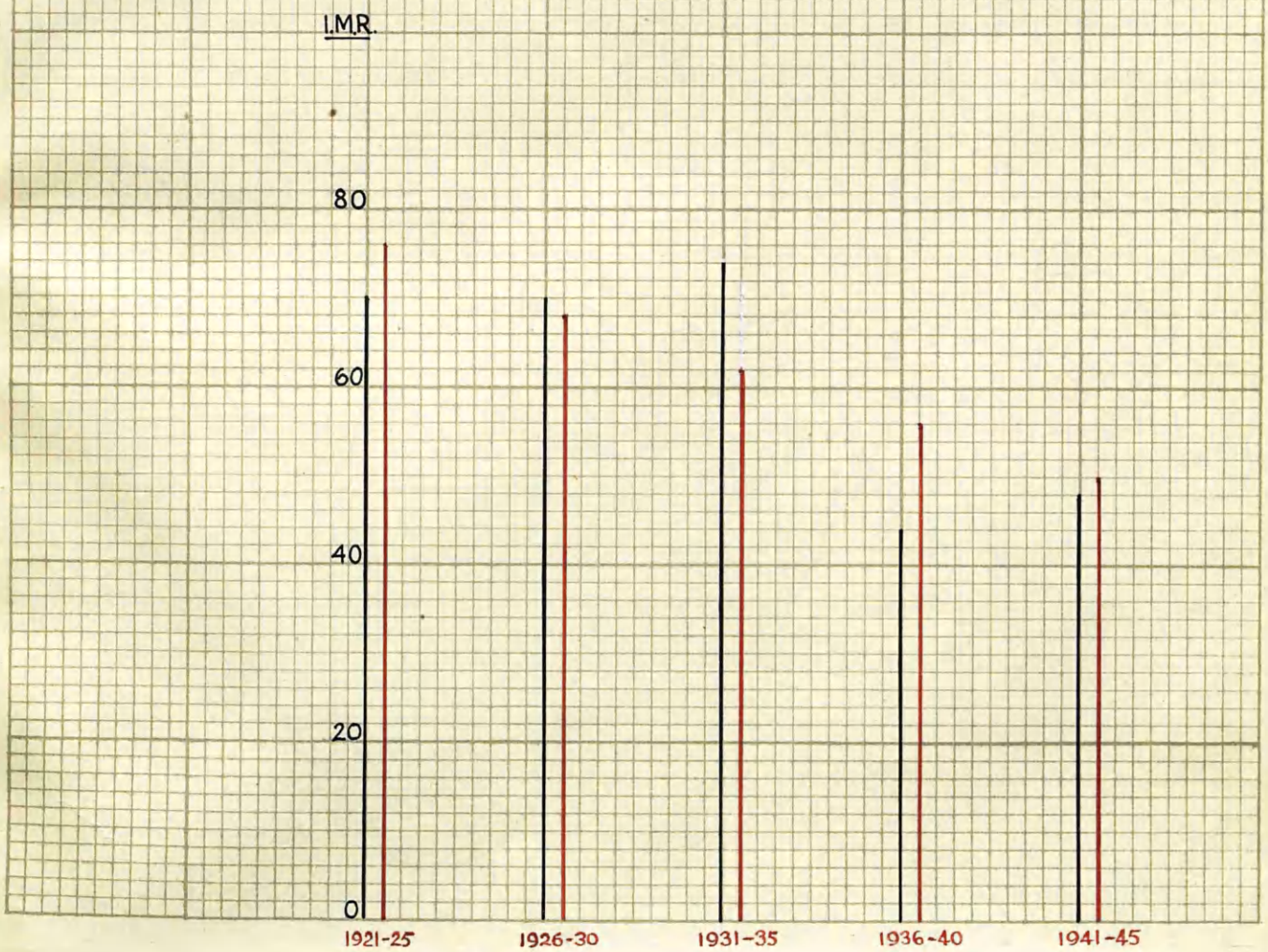
INFANTILE MORTALITY RATES

QUINQUENNIAL PERIODS

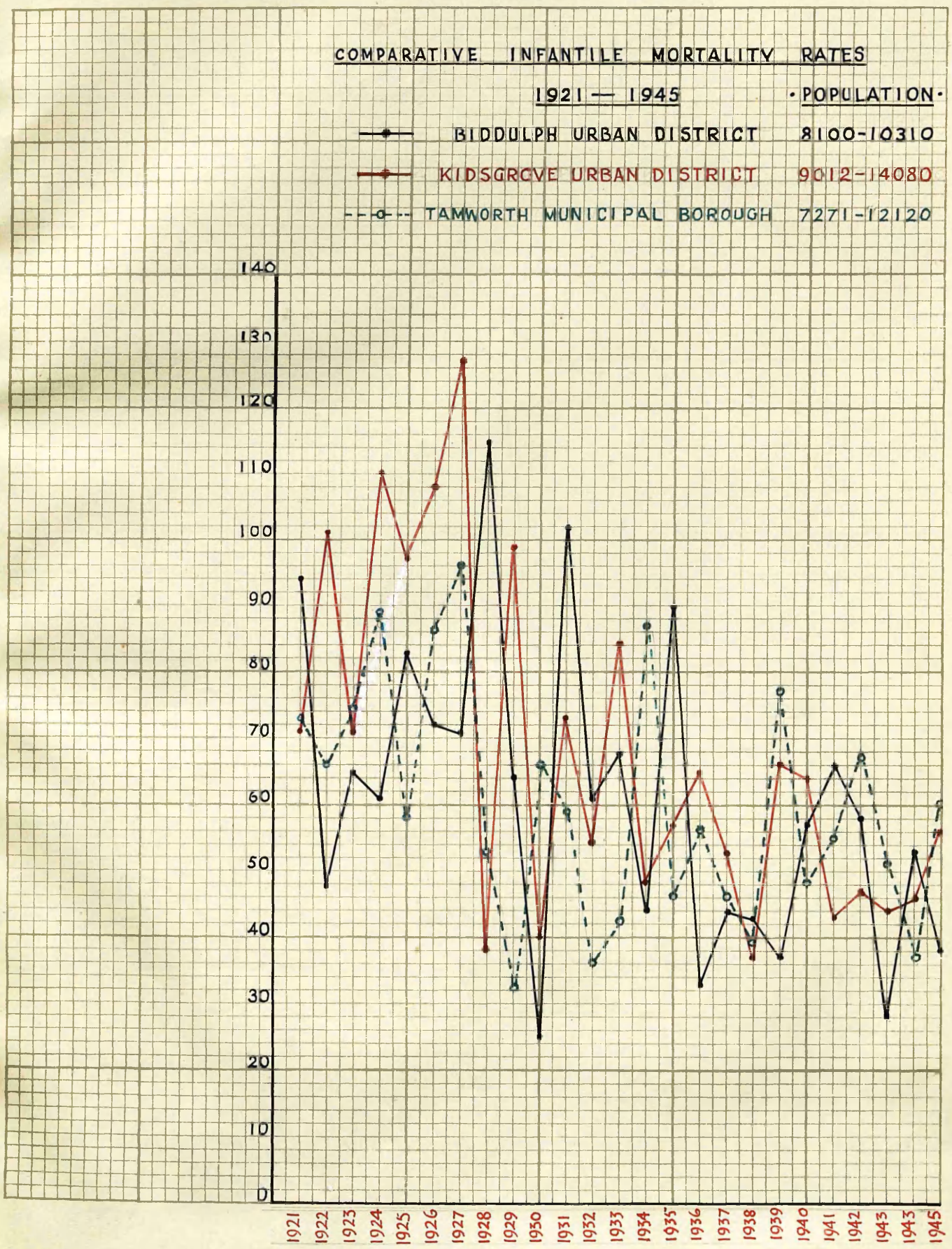
1921 — 1945

BIDDULPH URBAN DISTRICT

ENGLAND and WALES



APPENDIX 12.

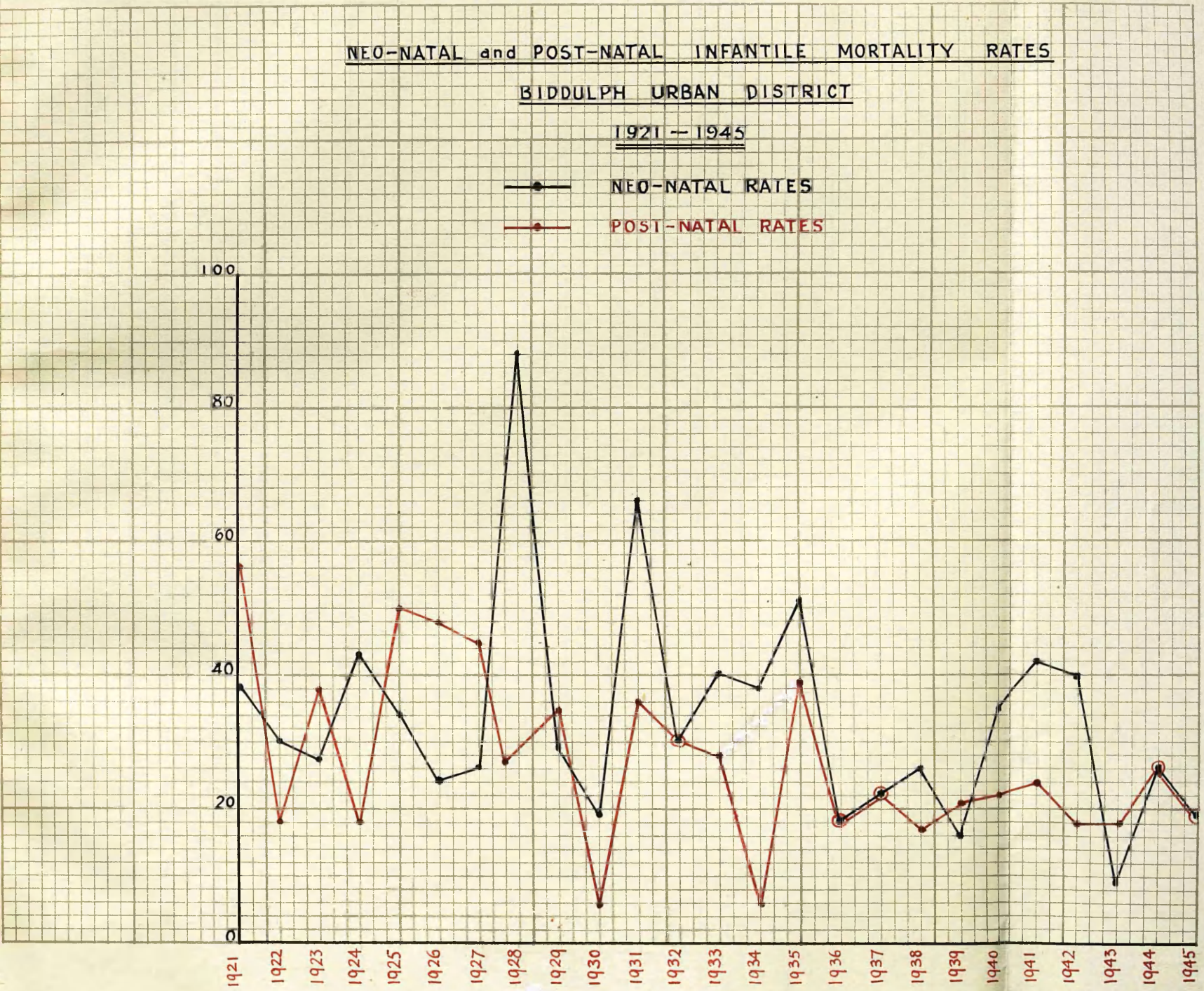

COMPARATIVE INFANTILE MORTALITY RATES
1921 — 1945
·POPULATION·
BIDDULPH URBAN DISTRICT 8100-10310
KIDSGROVE URBAN DISTRICT 9012-14080
TAMWORTH MUNICIPAL BOROUGH 7271-12120
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1943
1945

APPENDIX 13.

NEO-NATAL and POST-NATAL INFANTILE MORTALITY RATES

BIDDULPH URBAN DISTRICT

1921 -- 1945



APPENDIX 14.

MORTALITY in the FIRST YEAR of LIFE in BIDDULPH arranged according to AGE at DEATH 1921 - 1925

AGE at DEATH	1921 DEATHS M.	F.	Total	1921 DEATHS per 1,000 LIVE BIRTHS		1922 DEATHS M.	F.	Total	1922 DEATHS per 1,000 LIVE BIRTHS		1923 DEATHS M.	F.	Total	1923 DEATHS per 1,000 LIVE BIRTHS		1924 DEATHS M.	F.	Total	1924 DEATHS per 1,000 LIVE BIRTHS		1925 DEATHS M.	F.	Total	1925 DEATHS per 1,000 LIVE BIRTHS	
Under ONE DAY	2	1	3	13		1	-	1	6		2	-	2	11		-	2	2	12		2	-	2	9	
1 to 7 DAYS	4	1	5	21	38	-	-		-	30	-	1	1	5	27	1	3	4	25	43					34
1 to 4 WEEKS	1	-	1	4		2	2	4	24		2	-	2	11		-	1	1	6		2	2	4	20	
4 WEEKS to 3 MTHS	4	2	6	26		-		-	-		1	-	1	5		-		-	-		1	1	2	9	
3 to 6 MONTHS	3	1	4	17	56	-		-	-	18	2	-	2	11	38	1		1	6	18	-	-	-		49
6 to 9 MONTHS	1	1	2	9		1		1	6		-	1	1	5		1		1	6		2	2	4	20	
9 to 12 MONTHS	-	1	1	4		1	1	2	12		1	2	3	17		1		1	6		1	3	4	20	
TOTALS under ONE YEAR	15	7	22		94	5	3	8		48	8	4	12		65	4	6	10		61	8	9	17		83
TOTAL LIVE BIRTHS	233					166					185					163					205				

APPENDIX 15.

MORTALITY in the FIRST YEAR of LIFE in BIDDULPH arranged according to AGE at DEATH 1926-1930

AGE at DEATH	1926				1927				1928				1929				1930			
	DEATHS			DEATHS per 1,000 LIVE BIRTHS	DEATHS			DEATHS per 1,000 LIVE BIRTHS	DEATHS			DEATHS per 1,000 LIVE BIRTHS	DEATHS			DEATHS per 1,000 LIVE BIRTHS	DEATHS			DEATHS per 1,000 LIVE BIRTHS
	M.	F.	Total		M.	F.	Total		M.	F.	Total		M.	F.	Total		M.	F.	Total	
Under ONE DAY	-	-	-	-	-	-	-	-	-	2	2	14	1	2	3	17	-	-	-	-
1 to 7 DAYS	1	-	1	6 → 24	1	1	2	13 → 26	4	4	8	54 → 88	1	-	1	6 → 29	1	-	1	6 → 19
1 to 4 WEEKS	2	1	3	18	2	-	2	13	3	-	3	20	-	1	1	6	1	1	2	13
4 WEEKS to 3 MTHS	1	-	1	6	1	-	1	6	-	-	-	-	1	-	1	6	-	-	-	-
3 to 6 MONTHS	1	2	3	18 → 48	1	1	2	13 → 45	1	-	1	7 → 27	-	-	-	- → 35	-	1	1	6 → 6
6 to 9 MONTHS	1	-	1	6	2	-	2	13	-	-	-	-	2	-	2	12	-	-	-	-
9 to 12 MONTHS	1	2	3	18	1	1	2	13	2	1	3	20	1	2	3	17	-	-	-	-
TOTALS under ONE YEAR	7	5	12	72	8	3	11	71	10	7	17	115	6	5	11	64	2	2	4	25
TOTAL LIVE BIRTHS	167				155				148				171				159			

APPENDIX 16.

MORTALITY in the FIRST YEAR of LIFE in BIDDULPH arranged according to AGE at DEATH 1931 - 1935

AGE at DEATH	1931				1932				1933				1934				1935			
	DEATHS			DEATHS per 1,000 LIVE BIRTHS	DEATHS			DEATHS per 1,000 LIVE BIRTHS	DEATHS			DEATHS per 1,000 LIVE BIRTHS	DEATHS			DEATHS per 1,000 LIVE BIRTHS	DEATHS			DEATHS per 1,000 LIVE BIRTHS
	M.	F.	Total		M.	F.	Total		M.	F.	Total		M.	F.	Total		M.	F.	Total	
Under ONE DAY	3	1	4	24	1	1	2	12	-	-	-	-	1	1	2	13	2	4	6	34
1 to 7 DAYS	3	1	4	24 } 66	2	-	2	12 } 30.5	3	-	3	20 40	3	-	3	19 } 38	1	-	1	5 } 51
1 to 4 WEEKS	3	-	3	18	1	-	1	6	3	-	3	20	-	1	1	6	2	-	2	12
4 WEEKS to 3 MTHS	2	2	4	24	-	1	1	6	1	1	2	14	-	-	-		1	1	2	12
3 to 6 MONTHS	-	-	-	} 36	-	-	-		-	-	-	- } 28	-	-	-		2	1	3	17
6 to 9 MONTHS	-	1	1	6	2	1	3	19 } 30.5	-	1	1	7	1	-	1	6 } 6	-	1	1	5 } 39
9 to 12 MONTHS	-	1	1	6	-	1	1	5.5	-	1	1	7	-	-	-		-	1	1	5
TOTALS under ONE YEAR	11	6	17	102	6	4	10	61	7	3	10	68	5	2	7	44	8	8	16	90
TOTAL LIVE BIRTHS	167				165				147				158				177			

APPENDIX 17.

MORTALITY in the FIRST YEAR of LIFE in BIDDULPH arranged according to AGE at DEATH 1936-1940

AGE at DEATH	1936 DEATHS M.	F.	Total	1936 DEATHS per 1,000 LIVE BIRTHS	1937 DEATHS M.	F.	Total	1937 DEATHS per 1,000 LIVE BIRTHS	1938 DEATHS M.	F.	Total	1938 DEATHS per 1,000 LIVE BIRTHS	1939 DEATHS M.	F.	Total	1939 DEATHS per 1,000 LIVE BIRTHS	1940 DEATHS M.	F.	Total	1940 DEATHS per 1,000 LIVE BIRTHS
Under ONE DAY	1	1	2	11	1	1	2	11	-	1	1	5	1	-	1	5	1	-	1	6
1 to 7 DAYS	1	-	1	5.5	-	1	1	5.5	3	-	3	16	-	-	-	-	4	-	4	23
1 to 4 WEEKS	-	-	-	-	1	-	1	5.5	-	1	1	5	2	-	2	11	1	-	1	6
4 WEEKS to 3 MTHS	-	1	1	5.5	1	-	1	5.5	-	-	-	-	-	-	-	-	1	1	2	11
3 to 6 MONTHS	-	1	1	5.5	1	1	2	11	-	2	2	11	-	-	-	-	2	-	2	11
6 to 9 MONTHS	-	-	-	-	-	-	-	-	-	1	1	5	-	3	3	16	-	-	-	-
9 to 12 MONTHS	1	-	1	5.5	-	1	1	5.5	-	-	-	-	-	1	1	5	-	-	-	-
TOTALS Under ONE YEAR	3	3	6	33	4	4	8	44	3	5	8	43	3	4	7	37	9	1	10	57
TOTAL LIVE BIRTHS	180				182				186				176				174			

Under ONE DAY + 1 to 7 DAYS + 1 to 4 WEEKS: 1936 = 16.5; 1937 = 22; 1938 = 26; 1939 = 16; 1940 = 35

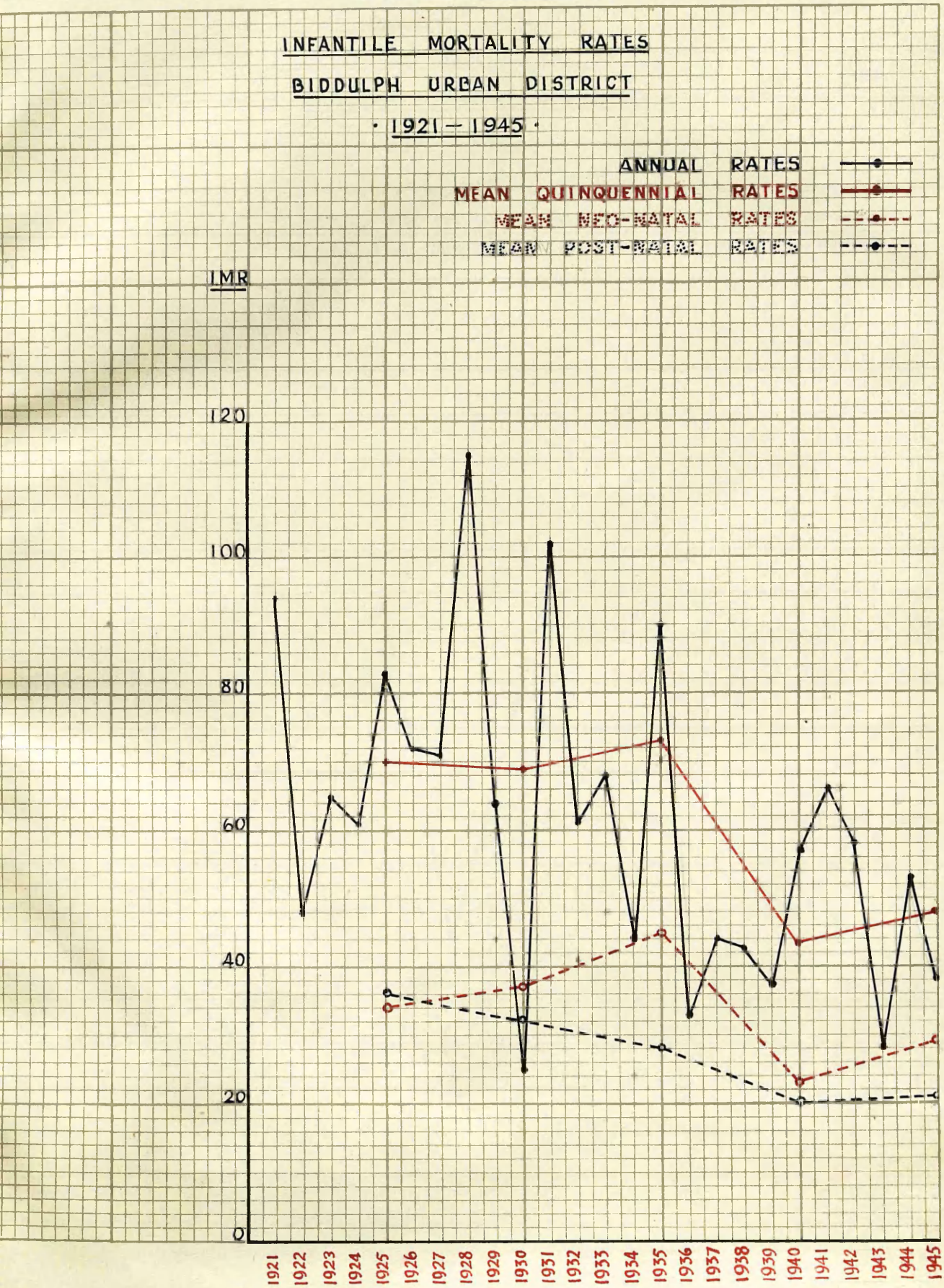
4 WEEKS to 3 MTHS + 3 to 6 MONTHS + 6 to 9 MONTHS + 9 to 12 MONTHS: 1936 = 16.5; 1937 = 22; 1938 = 17; 1939 = 21; 1940 = 22

APPENDIX 18.

MORTALITY in the FIRST YEAR of LIFE in BIDDULPH arranged according to AGE at DEATH 1941 - 1945

AGE at DEATH	1941 DEATHS M	F	Total	1941 DEATHS per 1,000 LIVE BIRTHS		1942 DEATHS M	F	Total	1942 DEATHS per 1,000 LIVE BIRTHS		1943 DEATHS M	F	Total	1943 DEATHS per 1,000 LIVE BIRTHS		1944 DEATHS M	F	Total	1944 DEATHS per 1,000 LIVE BIRTHS		1945 DEATHS M	F	Total	1945 DEATHS per 1,000 LIVE BIRTHS	
Under ONE DAY	3	-	3	14		2	3	5	22		1	-	1	4.7		-	3	3	16.5		2	1	3	16	
1 to 7 DAYS	2	4	6	28	42	1	2	3	14	40	-	1	1	4.7	9.4	1	1	2	10	26.5	1	-	1	3	19
1 to 4 WEEKS	-	-	-	-		-	1	1	4		-	-	-	-		-	-	-	-		-	-	-	-	
4 WEEKS to 3 MTHS	2	1	3	14		2	-	2	9		1	-	1	4.6		-	-	-	-		-	1	1	3	
3 to 6 MONTHS	1	-	1	5	24	-	-	-	-	18	-	-	-	-	18.6	3	-	3	16.5	26.5	1	-	1	3	19
6 to 9 MONTHS	1	-	1	5		2	-	2	9		-	3	3	14		1	-	1	5		-	2	2	13	
9 to 12 MONTHS	-	-	-	-		-	-	-	-		-	-	-	-		-	1	1	5		-	-	-	-	
TOTALS under ONE YEAR	9	5	14		66	7	6	13		58	2	4	6		28	5	5	10		53	4	4	8		38
TOTAL LIVE BIRTHS	212					225					209					188					190				

APPENDIX 19.


INFANTILE MORTALITY RATES
BIDDULPH URBAN DISTRICT
· 1921 – 1945 ·
ANNUAL RATES
MEAN QUINQUENNIAL RATES
MEAN NEO-NATAL RATES
MEAN POST-NATAL RATES
IMR
120
100
80
60
40
20
0
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945

APPENDIX 20.

INFANTILE MORTALITY RATES

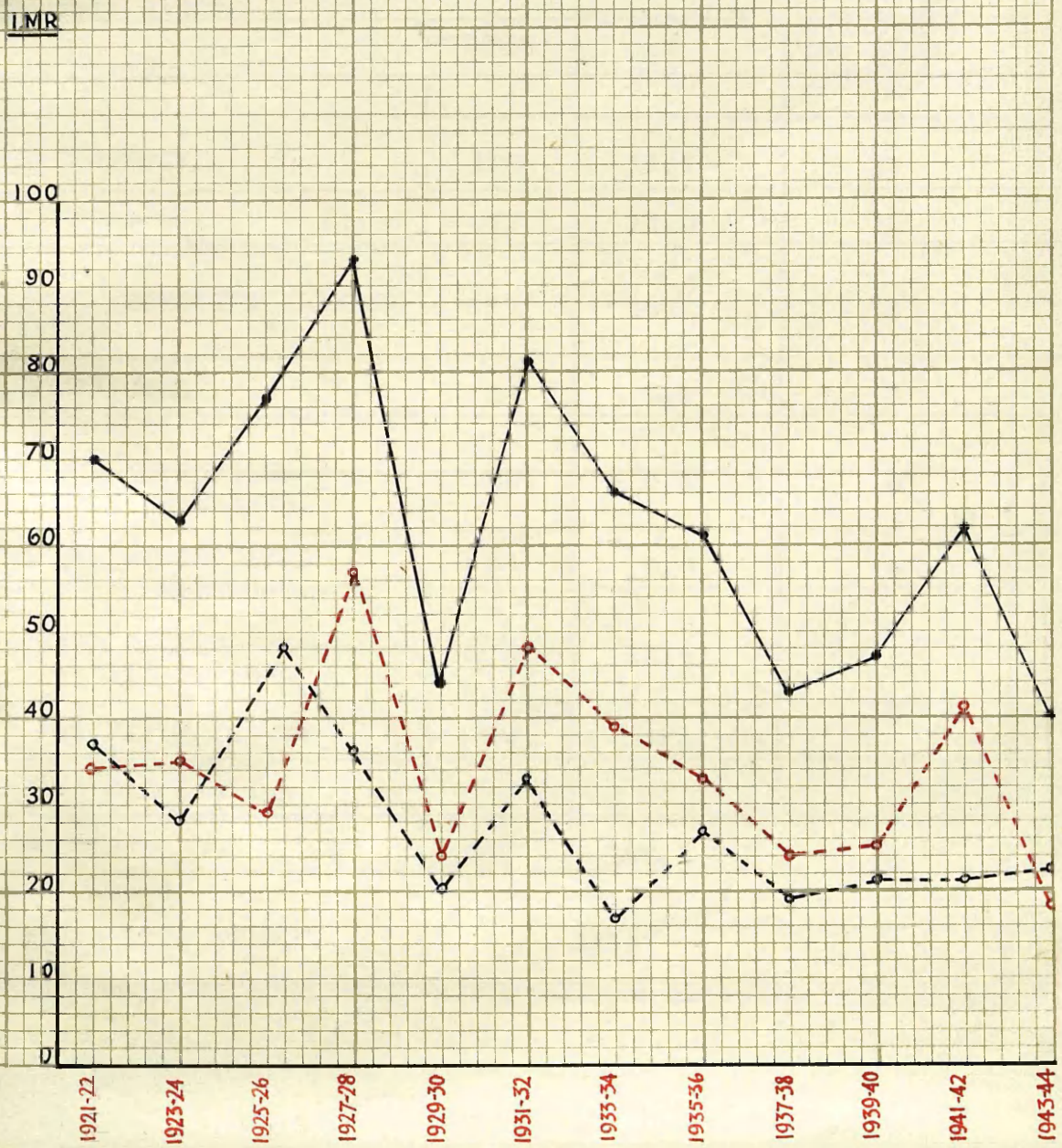
· BIDDULPH URBAN DISTRICT ·

1921 – 1945

MEAN TWO-YEARLY RATES

MEAN TWO-YEARLY NEO-NATAL RATES

MEAN TWO-YEARLY POST-NATAL RATES



APPENDIX 21.

PRINCIPAL CAUSES of DEATH

and

INFANTILE MORTALITY RATES

BIDDULPH URBAN DISTRICT

1921 - 1945

PRINCIPAL CAUSES AT DEATH.	NUMBER	PERCENTAGE of TOTAL	INFANTILE MORTALITY per 1000 LIVE BIRTHS.
1. PREMATURITY.	108	39.9	25
2. RESPIRATORY DISEASES.	52	19.0	12
3. (NON-INFECTIVE ILLNESS (OTHER Do.	27	10.2	6
4. CONGENITAL MALFORMATION & DEBILITY.	26	9.9	6
5. ACUTE INFECTIOUS DISEASES.	25	9.1	5
6. GASTRO-INTESTINAL DISEASES.	23	8.0	4
7 OTHER CAUSES (a) Ill-defined	8)	2.6)	
	)12	)4.0	2
(b) Birth Injury Accidental Suffocation	4)	1.4	
TOTALS	273	100.0	60
TOTAL LIVE BIRTHS.	4538		

APPENDIX 22.

INFANTILE MORTALITY

BIDDULPH URBAN DISTRICT

1921 - 1945

NEO-NATAL DEATHS

by AGE and CERTIFIED CAUSE of DEATH

CAUSE OF DEATH.	Under 1 day.	1 to 7 days.	1 to 2 weeks.	2 to 3 weeks.	3 to 4 weeks.	Total under 4 weeks.	
PREMATURITY.	43	40	10	8	-	101	
CONGENITAL MALFORMATION and DEVELOPMENTAL DEFECTS.	3	3	3	3	2	14	
PULMONARY ATELECTASIS.	2	6	-	-	-	8	
CONVULSIONS.	-	5	2	-	1	8	
INFECTIONS							
1. Bronchitis.	-	1	-	-	1	2)	
2. Pneumonia.	-	-	2	-	1	3)	8
3. Gastro-Enteritis.	-	-	1	1	-	2)	
4. Pemphigus.	-	-	-	-	1	1)	
BIRTH INJURY.	1	1	-	-	-	2	
JAUNDICE.	-	1	-	1	-	2	
CONGENITAL DEBILITY.	1	1	-	-	-	2	
ASPHYXIA NEONATORUM.	1	-	-	-	-	1	
ILL DEFINED CAUSES.	-	-	2	-	-	2	
TOTALS	51	58	20	13	6	148	

APPENDIX 23.

INFANTILE MORTALITY.

BIDDULPH URBAN DISTRICT

1921 - 1945

POST-NATAL DEATHS

by AGE and CERTIFIED CAUSE of DEATH.

CAUSE OF DEATH.	MONTHS											
	4 weeks to 1 month.	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	10 to 11	11 to 12	TOTALS 1 to 12 months.
Broncho-Pneumonia.	1	4	2	1	3	3	2	4	5	5	8	38
Gastro-Enteritis.	2	3	2	-	-	1	1	3	1	-	-	13
Convulsions.	3	1	1	5	-	-	3	-	-	-	-	13
Whooping Cough.	2	-	-	1	1	2	3	-	-	1	1	11
Bronchitis.	3	2	1	-	-	-	-	-	-	1	2	9
X Prematurity	4	2	-	-	1	-	-	-	-	-	-	7
Measles.	-	-	1	-	-	-	1	-	1	-	1	4
Congenital Heart Disease.	-	-	-	-	1	-	-	1	1	1	-	4
Meningitis. - non-Tubercular.	-	-	-	-	1	-	1	1	-	-	-	3
Tuberculosis: 1.Meningitis.	-	-	-	-	-	1	1	1	1	-	-	4
2.Peritonitis.	1	1	1	-	-	-	-	-	-	-	-	3
Congenital Pyloric Stenosis.												
Influenza.	-	-	1	-	-	-	1	-	-	-	-	2
X Congenital Debility	-	-	2	-	-	-	-	-	-	-	-	2
Intussusception.	-	-	-	1	-	1	-	-	-	-	-	2
Pink Disease.	-	-	-	-	1	-	1	-	-	-	-	2
Suffocation by Accident.	-	-	1	1	-	-	-	-	-	-	-	2
X Congenital Malformation &c.	1	-	-	-	-	-	-	-	-	-	-	1
Ill defined & other causes.	1	-	2	-	1	-	-	1	-	-	-	5
TOTALS	18	13	14	9	9	8	14	11	9	8	12	125

X Neo-natal causes.

APPENDIX 24.

MORTALITY ONE TO FOUR WEEKS-BIDDULPH URBAN DISTRICT-BY CERTIFIED CAUSE OF DEATH.

QUINQUENNIAL PERIODS 1921 - 1945

CAUSE OF DEATH.	1921-1925 Deaths	1921-1925 I.M.R.	1926-1930 Deaths	1926-1930 I.M.R	1931-1935 Deaths	1931-1935 I.M.R	1936-1940 Deaths	1936-1940 I.M.R.	1941-1945 Deaths	1941-1945 I.M.R.	TOTALS Deaths	TOTALS I.M.R
PREMATURITY	17	16.96	24	30.00	23	28.24	14	15.58	23	22.47	101	22.25
CONGENITAL MALFORMATION	3	2.99			5	6.14	5	5.56	1	0.97	14	3.08
PULMONARY ATELECTASIS			1	1.25	4	4.91	1	1.11	2	1.94	8	1.76
CONVULSIONS	7	6.98	1	1.25							8	1.76
INFECTIONS	3	2.97	2	2.50	1	1.22	2	2.22			8	1.76
BIRTH INJURY					1	1.22			1	0.97	2	0.44
JAUNDICE					1	1.22			1	0.97	2	0.44
CONGENITAL DEBILITY	1	0.99			1	1.22					2	0.66
OTHERS	2	1.98			1	1.22					3	0.66
ALL CAUSES	33	32.87	28	35.00	37	45.00	22	24.47	28	27.32	148	32.61
TOTAL LIVE BIRTHS.	1002		800		814		898		1024		4538	

APPENDIX 25.

MORTALITY ONE TO TWELVE MONTHS-BIDDULPH URBAN DISTRICT-BY CERTIFIED CAUSE OF DEATH.

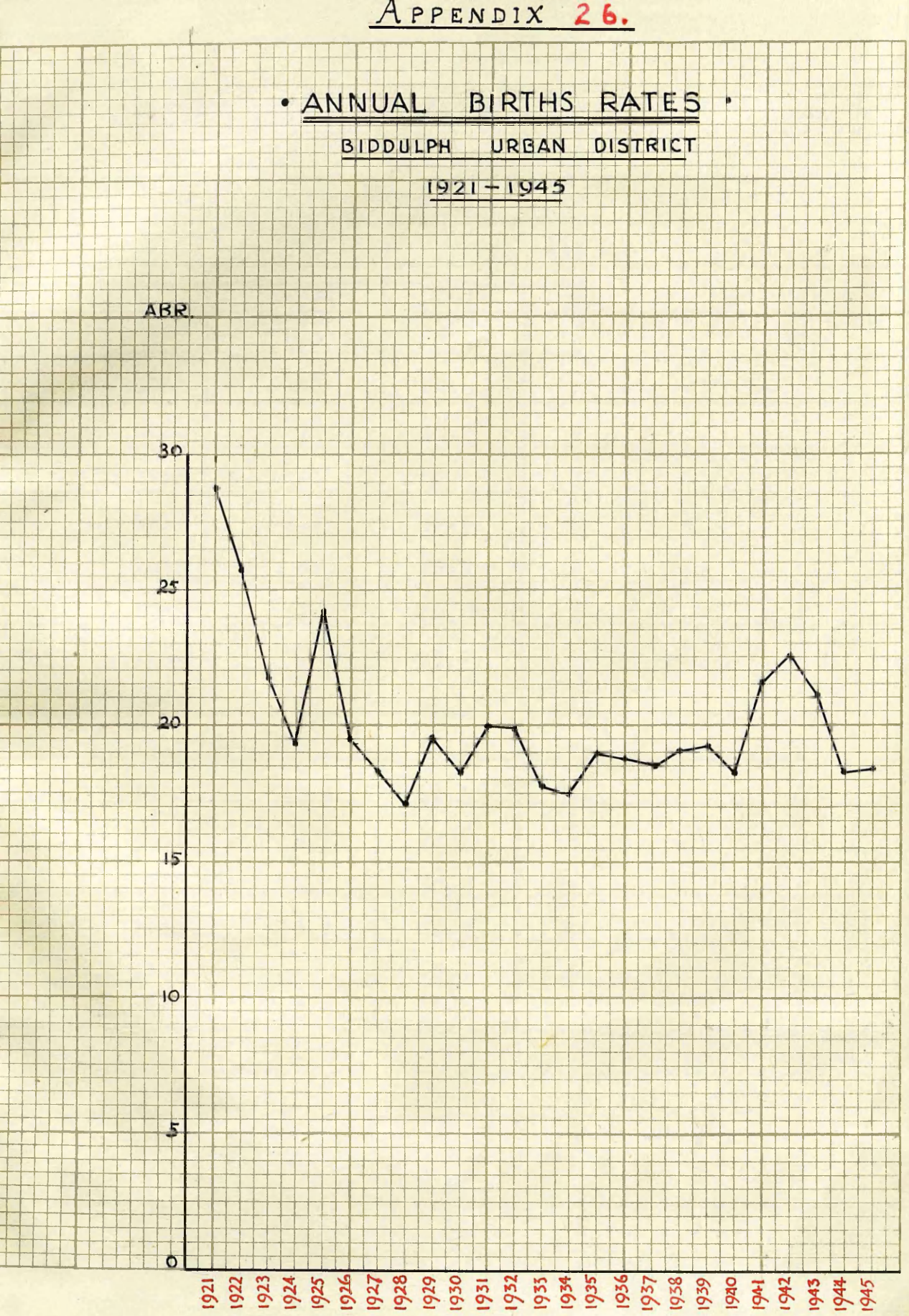
CAUSE OF DEATH.	QUINQUENNIAL PERIODS 1921 - 1945											
	1921-1925		1926-1930		1931-1935		1936-1940		1941-1945		TOTALS	
	Deaths	I.M.R.	Deaths	I.M.R.	Deaths	I.M.R.	Deaths	I.M.R.	Deaths	I.M.R.	Deaths	I.M.R
BRONCHO PNEUMONIA	13	12.97	9	11.25	9	11.56	3	3.34	4	3.90	38	8.37
GASTRO-ENTERITIS	2	1.99	4	5.00	1	1.22	3	3.34	3	2.93	13	2.86
CONVULSIONS	10	9.98	1	1.25	1	1.22	-	-	1	0.97	13	2.86
WHOOPING COUGH	3	2.97	1	1.25	3	3.68	-	-	4	3.90	11	2.42
PREMATURITY AND CONG. MALFORMATION	3	2.97	3	3.75	3	3.68			1	0.97	10	2.27
BRONCHITIS	4	3.99	1	1.25	1	1.22	2	2.22	1	0.97	9	1.98
MEASLES			2	2.50	1	1.22	1	1.11			4	0.88
TUBERCULOSIS			1	1.25	1	1.22	1	1.11	1	0.97	4	0.88
CONG. HEART DISEASE			1	1.25			2	2.22	1	0.97	4	0.88
MENINGITIS							1	1.11	2	1.94	3	0.66
INFLUENZA			2	2.50							2	0.44
OTHERS	1	0.99	1	1.25	3	3.68	5	5.56	4	3.90	14	3.08
ALL CAUSES	36	55.92	26	32.50	23	28.25	18	20.04	22	21.49	125	27.54
TOTAL LIVE BIRTHS	1002		800		814		896		1024		4538	

APPENDIX 26.

ANNUAL BIRTHS RATES

BIDDULPH URBAN DISTRICT

1921 - 1945



APPENDIX 27.

INFANTILE MORTALITY RATES 1931-1945 per 1000 LEGITIMATE LIVE BIRTHS.

BY SOCIAL CLASS OF FATHER

BIDDULPH URBAN DISTRICT

ALL CAUSES

YEAR	SOCIAL CLASS I and II	SOCIAL CLASS III	SOCIAL CLASS IV	SOCIAL CLASS V	ALL CAUSES.
1931	133	92.6	70.4	250	102
1932	77	57.5	90.1	-	61
1933	-	55	64.0	176	68
1934	111	49.7	38.8	125.6	44
1935	66	98.1	81.8	-	80
1936	-	40.0	46.0	-	33
1937	-	25.3	72.4	100.0	44
1938	37	53.3	44.1	-	43
1939	-	73.1	17.8	-	37
1940	43.4	64.1	54.5	58.8	57
1941	-	95.7	57.0	62.5	66
1942	-	50.0	39.25	214.2	58
1943	35.7	20.4	30.7	90.1	28
1944	-	34.4	58.8	181.8	53
1945	-	51.9	27.4	-	38

APPENDIX 28.

INFANTILE MORTALITY by SOCIAL CLASS · 1931-1945

QUINQUENNIAL PERIODS . . . .

. . . . BIDDULPH URBAN DISTRICT

RATES per 1,000 LEGITIMATE LIVE BIRTHS