Infant and maternal mortality in relation to size of family and rapidity of breeding : A study in human responsibility / [Clarice Margaret Burns].

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INFANT AND MATERNAL MORTALITY

IN RELATION TO SIZE OF FAMILY AND RAPIDITY OF BREEDING.

A study in human responsibility.

By

C. M. BURNS, M.A.

WITH A FOREWORD BY

THE RT. HON. LORD EUSTACE PERCY,
M.A., D.C.L., LL.D.,
RECTOR OF KING'S COLLEGE.

FROM THE DEPARTMENT OF PHYSIOLOGY,
KING'S COLLEGE, UNIVERSITY OF DURHAM.

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I desire to express my thanks to the Research Committee of King's College, University of Durham, who gave me a grant to defray the cost of printing this Report; to the Registrar-General for his kindness in answering queries, and to the Controller of His Majesty's Stationery Office for permission to use material in the Registrar-General's Reports, as indicated where they occur in the text.

FOREWORD.

This Report of a survey in the County of Durham states so clearly its conclusions and the nature of the material studied that it needs no elaborate introduction. I should like however to say in a few words why I welcome its publication.

We have begun tardily to realise that the civilisation of Western Europe may suffer the same biological collapse in the later years of the twentieth century as Roman Italy suffered in the later years of the second. The probability of such a collapse is in fact much greater than any of the probabilities which statesmen have normally to assume as practical certainties for the purposes of national policy. It is certain (even disregarding the casualties of war) that the population of England and Wales between the ages of 20 and 44 inclusive must decline in the decade 1945 to 1955 from about 8,000,000 men and 8,260,000 women to 7,600,000 men and (mark this) 7,620,000 women. It is certain that in the next five years 1956-60, the men and women in this age group who were born in the years 1911-1915 must be replaced by those who were born in 1936-40, and there were no less than 1,266,000 fewer children born in 1936-40 than in 1911-15. It is overwhelmingly probable that, in the following seven years 1961-67, this age-group will suffer a further decline of at least 1,000,000. It is certain that, from 1967 onwards, the number of entrants into this age group must begin to be further affected by the fact that, during all the fifteen years since 1927, the female stock of the nation has been failing to reproduce itself. It is certain that, from 1947 onwards, when this declining stock begins to reach child-bearing age, its fertility will have to increase progressively if the population is to be stabilised at all. It may be calculated with a fair degree of certainty that, if the male population between the ages of 20 and 44 is eventually to be stabilised at even so low a level as 6,000,000 the eventual increase in fertility must be as high as about one-third. And it is surely certain that we cannot afford to choose a lower level than this for the main industrial and, in the last resort, the main military strength of the nation—especially when we consider the other certainty that, at these ages, there will no longer be a surplus of women over men.

But it has become evident that propaganda based on calculations of this kind is ineffective. Statesmen are moved by it only to devise the expedients of the Antonine emperors eighteen centuries ago, with their free schools and family endowments. For ordinary men and women, it is absurdly remote from the springs of human action. Family life is not to be regulated by considerations of public policy. Its maladies are its own and will not submit to treatment merely as symptoms of political disorder. Their cure rests with those who can give direct advice : with the physician, the moral counsellor and the biologist. Direct advice—and positive ; for the expert intent on rousing the social

reformer has too often succeeded only in disheartening the private citizen. To marry and bring up a family is the only adventure in life open to the mass of mankind, and the adventurer deserves better encouragement than public lamentations over the inadequacy of national standards in nutrition, housing and employment.

This Report is an essay in such advice. Like all expert advice, it traverses only a section of the ground, and one that is necessarily rough with technicalities and statistics. But it proves its humanity by the positiveness of its conclusions, and, if some may think it over-positive, that fault is to-day a virtue. The field of its survey is the dreariest that could have been chosen : the deeply disfigured social life of the Durham coalfield in what future generations may well remember as the "workless thirties". It rather understates these disfigurements ; some imagination is needed to read between the lines, for instance, of the facts barely stated on page 6. Yet even here it seems that the family adventure was beset, for the most part, only by dangers which can be clearly defined and prudently avoided ; and if the evidence of private folly and social neglect tempted the investigator sometimes "almost to despair of the future of civilisation", her results show that, amid all this evidence, simple parental wisdom is still justified in its children.

EUSTACE PERCY,

May, 1942.

PREFACE.

In his paper on "Physiology and Preventive Medicine" [1931] Burns said : "The physiologist should be able to add his quota of help in providing an answer to the question "What are the optimal conditions for human life *under present circumstances*? That is, authoritative information should be forthcoming as to . . . . . the best age, season, etc., for procreation, and the ideal number per family." . . . . "If there were any weaknesses in the parents, the weakness would show up more clearly as the family increased in number." From these "seeds", this report has grown and, in it, evidence will be produced to show the best age for a mother to have her first child, and the optimum rate for breeding. The weakness of the large, rapidly bred family will be made apparent.

The compilation of the facts which form the basis of the report was rendered possible by the kind co-operation of the late Dr. McIntyre, County Medical Officer of Health for the Administrative County of Durham, and his successor in office, Dr. Ian McCracken, who gave access to the material and followed the progress of the investigation with sympathetic interest.

Durham County Maternity Unit is unique in that it is one of the largest Units of this kind in the country. It was early in the field, and has kept meticulous records which were freely placed at my disposal. The population is free from the wide variations in income found in the County Boroughs, *i.e.* there are no real slums and practically no rich families.

The discussion of the facts found and of the conclusions drawn have been put at the beginning of the report so that the reader may get a bird's-eye view before actually settling down to a study of the evidence on which they are based.

Tables of figures are irritating, but necessary adjuncts to a report of this nature. The most suitable place to put them is a matter of opinion. Here, they have been inserted at the end of each part so that the more casual reader can avoid them easily, while the earnest student will not, I hope, grudge the trouble of turning to the appropriate table when he meets a reference in the text.

I cannot say that the collection, compilation and co-ordination of the facts involved in this study was a pleasure. It certainly was interesting, but revealed such a state of affairs as almost to make one despair of the future of civilisation. On the other hand, the courtesy, kindness and willingness to help of all who crossed my path was such as to reveal the immense amount of good-will in the personnel of the Maternity Unit of County Durham. In particular, I would like to

record my thanks to the Senior Welfare Medical Officers, Dr. M. E. Howie and Dr. E. S. Williamson, and to Dr. Macrae, Chief Tuberculosis Medical Officer, for access to information, and for help and advice.

I am indebted to Miss Brown, Inspector of Midwives, and her staff, for securing for me the information relating age of mother to birth weight of first child. To the late Dr. L. Mabel Campbell, and to Prof. E. M. Dunlop I owe thanks for help, criticism and advice.

My thanks are due to my husband, Professor Burns, for infinite patience and careful criticism during the whole course of the investigation ; and to the Rector of King's College, The Rt. Hon. Lord Eustace Percy, not only for his foreword to the report but for reading the original draft and for making helpful suggestions thereon.

Finally, I am unable, adequately, to express my indebtedness to Miss Cooper-Hodgson, Superintendent Health Visitor, and her staff, for their collaboration in the work. Not only has it imposed on them much extra work, but only their knowledge of prevailing social conditions, and the generosity with which such knowledge has been placed at my disposal, has enabled the bare bones of the figures to be clothed with any meaning.

C. M. BURNS.

July, 1942.

Contents.

"I have come to the conclusion that genuine thought is not so much a matter of intellect as of courage. Thinking is a moral undertaking." H. FOSTER ANDERSON, *Border-Line Russia*, 1942.

"You have taken up this thought
To play with, for a gentle stimulant,
To give a dignity to idler life
By the dim prospect of emprise to come,
But ever with the softening, sure belief,
That all would end some strange way right at last."

R. BROWNING, *Strafford*.

"Two disquieting features also emerge . . . . Secondly, among the lowest ten per cent, there is poor health and a low educational standard. Only radical reforms in social environment and in the preventive health service can cure this evil." *Outlook for Youth*, "Observer," May 31st, 1942.

"From 50% to 75% of the general death-rate within the group of the population on which the calculations are based, is determined fundamentally by the factors of heredity, and is not capable of essential modification or amelioration by any sort of environmental action."

KARL PEARSON.

"If any dog breeder would suggest that he was going to breed out a black spot in the tan coat of an Irish setter by giving the mother a better kennel or better food, his reputation would slump very fast. Good kennels and good food have their uses, but not here. Careful selective breeding is the only answer, with many a slip thrown in."

G. H. ESTABROOKS, *Man, The Mechanical Misfit*.

"After all, Pearson left from 25% to 50% of the general death-rate subject to environmental control." This report.

DISCUSSION AND CONCLUSIONS.

A study of the information contained in the following chapters renders it possible to give a fairly definite answer to several questions.

What is the size of family with the lowest infant and child death-rates?

The answer to this depends on whether death-rates are measured *as usual* on live births only, or whether still-births are included. When children born *alive* are considered, then the lowest death-rate is found among *first* children, and **families with the lowest death-rates are the one child families.** Out of 1,000 children born alive in County Durham in 1930, the figures for those dying between birth and five years were for firsts 89, for seconds 93, for thirds 99, and for seventh and later children 174. This entirely agrees with the findings of the Registrar-General in his special 1911 investigation, in which he showed that whatever the marriage age of the mother, and however long the marriage had lasted, deaths per 1,000 were always lowest among "only" children.

Are first children less healthy than subsequent children?

Neither his investigation nor the one reported here gives any support to the opinion commonly held that first children are less healthy than later children, but this investigation shows how the idea arose. If the proportion of still-births per 1,000 total births is considered then the following figures are found, for firsts 43, seconds 26, thirds 32, and seventh and later births 64. Moreover the high death-rate before or during birth found in first children continues in the first month after birth, the figures for the death-rate in that period being, for firsts 40, for seconds 34, for thirds 32, and for seventh and later births 72. Thus round about birth, the comparable figures for death-rates are firsts 83, seconds and thirds 60 and seventh and later births 136. But "practical" people only note the stage of family where death occurs round about birth, and hence the emphasis laid on death-rates among **first** children. Every family that has a child has a first child, but few families have seventh or later children, and therefore the excessive death-rates round about birth among these is not observed to be related to the place in the family. Among the first three children in the family, death-rates after the first month tend to offset the high death-rate among first children in the earlier period, rates between one month and five years being respectively 50, 62 and 70, while for seventh and later children the high initial death-rate is followed by the high later rate of 90, (to compare with 50 for first children). When still-births are included, the death-rate up to five years of age for the first three children are 132, 122 and 132 per 1,000, but in seventh and later children the death rate up to the end of the *first month* at 136 per 1,000 is greater than in the early children up to five years, and there is no subsequent drop to offset this. This may mean that, in first children, birth is a relatively dangerous period, and the unfit are weeded out. Those who survive have a relatively low subsequent death-rate. **The late children of large families have however a high death-rate at all stages, *i.e.*, they are the unfit, and they present very special problems.**

There is no difference in total death-rates among first, second and third children which has any social significance though their health problems differ slightly. If the differences between them are not to be explained by the relative dangers of first births, then it is necessary to assume that the birth of even a second child into the average home so lowers the care and amenities generally available, that the post-natal death-rate among such children is higher than among first. No information was secured about death-rates at different stages of family among those classes who can afford domestic servants, and among whom therefore the aforesaid possibility might be ruled out, but over a range of social conditions which gave very considerably differing death-rates at the same stage of family, it was found that even in classes with low infant death-rates, the rise in the post-natal death-rates among second and third children still occurred, although it seemed improbable that such children received less essential care than first children of their own class. It would seem that the more probable explanation of the phenomenon is the greater weeding out of the weaklings by first births.

What other biological factors influence child deaths?

This investigation entirely confirms the results of the earlier inquiry by the Registrar-General [1911] in showing the great importance to the health of a child of the mother's age and the rate of breeding. The inclusion of still-births in this investigation greatly amplifies the earlier results. After the first child the influence of maternal age and rate of breeding are inseparably connected. Generally speaking, women who are young to bear children, or to have borne a number of children produce small and weakly babies. Still-births are few among these but the infant death-rate is very high. Among first children born in 1930 in the area studied, to women under 20 years of age, the total death-rate up to five years of age was 176 per 1,000. Among first children of women of the same social classes of twenty to twenty-five years it was only 129 per 1,000. Very early marriage is thus to be deprecated. (It may incidentally be pointed out that a considerable part of the excess death-rate among illegitimate children is due to the physical immaturity of the mother.) Nevertheless unnecessary postponement of marriage is also undesirable because of the steady rise of still-births, and neo-natal deaths in children, and the rise in maternal deaths, with increase of mother's age.

Marriage shortly after skeletal maturity has been reached is undoubtedly most favourable to the health of women and children. A social system which generally permits of this should be evolved.

Rate of breeding is however of great importance to both mother and child. Too rapid breeding greatly increases death-rates. In this investigation it was found that sixth children born to mothers of twenty-five to thirty had a death-rate up to five years of 235 per 1000; those to mothers five years older, and therefore on the whole bred more slowly had a comparable death-rate of 176 per 1000. Of the previous children in these families, in the former group 264 per 1000 had failed to be born alive or had died before the birth of the sixth child; in the latter group the figure was 179. Since both these groups belonged to

the same social class and the older mothers had more children alive needing money and care, it is clear that the advantage attaching to the better spacing of children is due to *biological* causes and not to social factors.

The lowest death-rates for considerable groups were found among first, second and third children born to mothers between twenty and thirty-five, and fourth and fifth children to mothers between thirty-five and forty. These may be described as "good biological groups." By the time the fourth or fifth child is born, the health problem is complicated by the fact that gain in health to both child and mother by adequate spacing of births may be offset by those changes produced in the mother by mere increasing age—changes which greatly increase the proportion of still-births and neo-natal deaths.

In these good biological groups however (numbering 8,875 out of a total 15,510) the total death-rate up to five years was 124 per 1000, a figure very similar to that for all children in England and Wales at that time. The whole country contains in the slums of the larger towns many people living under bad conditions, but to offset this it contains an enormously larger proportion than County Durham of the professional and business classes whose children have very low death rates (Table XXI). During the period under consideration unemployment was excessive throughout the area studied. That the children in these good biological groups (nearly 60% of the total) had health records which compared so well with the rest of the country is a tribute to the efficiency with which much has so often been made of so little. The excellence of the results in so many cases is a marvellous testimony to the care and skill of the parents, and to the admirable use of the help and services available.

This must not however be taken to mean that social factors are unimportant to child health.

What is the influence of overcrowding on child deaths?

As has usually been the case, it was found that death-rates were higher in homes where there were more persons per room than in the less overcrowded. Analysis of the figures by size of family showed however that *this was not, as usually believed, due directly to overcrowding*, but to the fact that, in general, the overcrowded house is occupied by a large family, and it is the *size of family* and *not the overcrowding* which is the harmful factor. First children who lived under as overcrowded conditions as seventh children had the death-rate of first children and not that of seventh children.

This is of great importance in any housing policy. It only corroborates the findings of Paton et al [1926] who also failed to find any connection between housing space and child health. This must not be taken to mean that improvement in housing amenities is unnecessary. It may only mean that quantitative overcrowding in an adequately equipped house is relatively unimportant. Densely packed slum areas are of course not found in a county area, and **no conclusion about the influence of housing in such an area can be applied to slum problems.**

What is the influence of the father's occupation on the child's chance of life ?

It is clear that generally the father's occupation will influence the child's health only indirectly by determining the family income or place of residence, and admittedly knowledge of the nature of the father's occupation throws little light on the exact nature of the social factors important to health.

Among all the children born in the area in 1930, there were some 2% who were the children of middle-class people who did not come within the scope of the public health services. The total death-rate up to five years of age among these children was 90 per 1000. The still-birth rate at 44 per 1000 was no less than for other classes, but the death-rate among those born alive was halved at all ages and only totalled 46 per 1000 up to five years. Clearly the rugged northern climate must not be blamed for too much. The birth-rank of the majority of these children was not known, but in the cases where it was known, more than 90% were either first, second or third children. The little evidence relating to the age of the mothers confirmed the conclusion deduced from figures given by the Registrar-General, that in this class marriage and child-birth is relatively postponed. The birth-rate is low and first births therefore form a large proportion of all births ; late marriage determines that a large proportion of women bear their first child when near or over thirty. The high still-birth rate and maternal death-rate in this class is largely explained by these facts. Also it must be pointed out that the low post-natal death-rate in this class is partly due to the rigorous weeding at birth and is not wholly due to the excellent conditions.

The parents of the children covered by the public health services were divided into three classes :—

(*a*) black-coated and independent workers.

(*b*) miners including all employed round the mine and all described as unemployed miners.

(*c*) the rest of the manual workers, including all just described as unemployed.

As might be expected, the children of the black-coated workers had death-rates approximating to those of the middle classes, the total rate to five years being 102 as against 90 per 1000, and the rate from birth to five years being 65 against 46. Most of the middle class children were first, second or third, and if the good biological groups alone of the black-coated group are considered, then the total death-rate is 92 and the rate from birth to five years 62 per 1000. Thus for the same size of family the middle class children showed no advantage over the children of the black-coated workers, but earlier marriage among the latter caused the still-birth rate to be lower and the post-natal death-rate to be higher than in the middle classes. **The most striking "class" differences were however found when the miners and other manual workers were studied.**

From the following table it may be seen that the death-rates among miner's children exceed those of the children of the other manual workers of the area.

Death-rates per 1000 live and still-births.

Groups	Total death-rate up to 5 years, including still-births.	Death-rates between birth and 5 years.
All miners	161	121
All other manual workers	132	93
Best biological groups— miners	137	100
Best biological groups— other manual workers	109	74

This can hardly be due to genetic factors as a good many of the black-coated classes are recruited from mining families.

Is the high death-rate of miners' children due to unemployment?

It has not been possible to check this quantitatively. All that can be said is that many of the industries employing the other workers have been among the hardest hit of the whole country. All these workers, black-coated, miners and other manual workers have in common, climate, and health and educational services. In the latter to a large extent, the same personnel serves all sections of the community. Under the conditions of employment of the last few years the black-coated workers have probably been somewhat better off than the others because of the greater stability of their employment. It is difficult to explain the difference between the other two groups in this way. There are probably two main contributory factors.

In the first place, mining communities tend to suffer from some of the evils of urban life. The atmosphere is laden with smoke, with all that that means of the loss of sunlight and direct nasal, bronchial and pulmonary irritation. They also suffer from the worst evils of rural life. Shops are few and foods expensive. Ambulant patients, who in a town would unhesitatingly go round the corner to a hospital or dispensary will, in the country, put off a visit to the doctor four miles away. It is difficult to estimate the quantitative importance of this, but the records did reveal several cases where children died, in which the time factor was important. This was not due to negligence on the parent's part. The poor hesitate to send several miles for a doctor whom they may be unable to pay. They hesitate to send for the "free" doctor until the grim necessity is obvious. Unfortunately then it is sometimes too late. This is no reflection on the doctors concerned. In towns the nearness of clinic, hospital, etc. minimises this problem. In the country it is all too real. Among isolated communities there is also suspicion of innovation, and perhaps not full use is made of the services available.

A second factor however has to be considered. There is almost no employment for young women in the area. Annually then, a large number of the ablest young women of the area leave it to work elsewhere and many never return. This gives a considerable male excess at the marrying age. Consequently a not inconsiderable number of women who are mentally and physically unfit for the responsibilities of marriage do marry. Quite a few women who are actually certified mentally defective are married and have had large families, while a good many who are of low intelligence but are not certifiably deficient contribute much to the health problems of the area. In a better balanced area, probably many of these would not be saddled with responsibilities for which they are unfit.

In the survey of the factors influencing child health Paton et al [1926] concluded that the main factor was maternal efficiency and that this in its turn depended largely on maternal health. They quoted Karn and Pearson as stating that "mother's health before conception is twice as important for the babies' health as crowding, clothing, cleanliness, feeding or economic conditions".

What then of the health of the women of this area?

From Table LVI it may be seen that the maternal mortality rate per 1000 has been about 10% above that for the rest of the country for many years, while Table I shows that the death-rate of women in the county at the reproductive age is about 30% above that of women in the whole country and where deaths from natural causes only are considered, the death-rate of women is 15% above that of the men in the county, although for the whole country, natural death-rates are about equal in the two sexes at that age.

What are the conditions which in this area bear so heavily on the female?

Only indirect evidence is available. From Table LXVI deduced from the Registrar-General's special report on Occupational Mortality [1931], it may be seen that during the reproductive period, despite the special industrial hazards of the male, **it is more dangerous to be a miner's wife than to be a miner.** Both puerperal and non-puerperal death-rates in these women are high. This is found to occur in other social groups where a high fertility rate is found under poor social conditions. In the investigation described in this report it was found in Durham County for several successive years, that in addition to about 90-100 so-called maternal deaths, there were a further 40-50 deaths among mothers, which would not have taken place had pregnancy and parturition not occurred. The problems presented by these women are not obstetric, but they cannot be overlooked by any health service. This inflation of the non-puerperal death-rates by child-birth under poor conditions probably explains the high female death rate throughout the reproductive period in all primitive countries. It is customary to state that the female is healthier than the male, because the male death-rate is higher than the female. This however is only true for certain countries and conditions. In this country as just pointed out, the natural death-rate which may be regarded as some measure of health is about equal in the two sexes between five and forty-five,

being slightly higher in the female in the earlier stages and in the male at the end of the period. But in countries like India, Japan and Chile with an excessively high death-rate in both sexes, the total for the female is considerably *higher* than for the male up to the end of the *reproductive* period. (Table LXIX.) In European countries such as Hungary, Bulgaria, Poland and Ireland fairly high death-rates in both sexes are accompanied by a female excess during the child-bearing ages. Agricultural countries such as Holland, Denmark and Canada have low death-rates in both sexes, but show a *female* excess during the *reproductive* period. In this they are comparable to the farming population of England and Wales. The high death-rates among women in the primitive communities need call for little comment, since mankind is the only species to attempt to combine in one organism the functions of the milk cow and the draft ox. It is however difficult to explain the high death-rate among women at this particular age in the more highly civilised communities except on the assumption that it is the result of child bearing. It is therefore of interest to note that in a report of the League of Nations, certain peasant populations in Hungary are described as having quite fantastically low maternal mortality rates and Holland, Denmark (Gilliat 1933) and France are classed as the three European countries with the lowest maternal mortality figures *despite their high female death rate during the reproductive period.* The farming community in England and Wales on the other hand are classed as having a puerperal death-rate 80% in excess of the average (Registrar-General, Occupational Mortality 1931). It is difficult to reconcile the low maternal death-rate of Holland, Denmark, France and rural Hungary with an excess female death-rate at " and only at " the reproductive age. The question inevitably arises "*When is a dead mother not a maternal mortality?*" It does seem clear however that rapid breeding under poor social conditions, whether the poor conditions are those of modern civilisations or of primitive peasant societies produces a high death-rate among reproducing women, whether the deaths are or are not directly attributed to child-birth and however they are classified. This high death-rate must be associated with a relatively low standard of health in the women, and this is probably one of the indirect causes of the relatively high infant and child death-rate in the area investigated.

How are maternal death-rates influenced by size of family and maternal age?

Just as first births are associated with a high still-birth rate which increases rapidly with the age of the mother, so are they associated with high maternal death-rates. The death-rate among women bearing their first child after thirty was *four times* that of primiparae between twenty and twenty-five. Even at the age of twenty-five to thirty, a marked increase in death-rate is to be noted as against the earlier period. (Table LI). The lowest maternal death-rates are associated with second and third births, but even at this stage of family, death-rates of women over thirty are fairly high. **The practical result of this is that where marriage or first child-birth is postponed to an age round about thirty, not only is the first birth relatively dangerous, but all subsequent births are associated with a maternal death-rate which is relatively high for**

that stage of family. This in part explains the absence of improvement in the figures for maternal death-rates in the more fortunate classes, who on the whole marry later than the working classes.

Associated with the late births of large families, there is a second peak in maternal death-rates, as in still-birth rates, and this peak was the more important in the area studied, where postponement of marriage is negligible. The total birth rate in the area appeared to correspond to an average completed family of about three. If all the families had really consisted of three children, and these had been born to mothers between twenty and thirty, **then the maternal death-rate under existing conditions would only have been about 3·5 per 1000 instead of 6·3 per 1000.** It might therefore seem that the encouragement of early marriage might do much to solve the problem. It must however be realised that a very considerable proportion of the personnel of our social and educational services and many of those engaged in retail trade are women between twenty and thirty. Either their removal from employment or their continued employment after marriage would raise problems, not necessarily insoluble problems, but of considerable social complexity. Moreover as marriage is a life partnership, many people who continue to develop mentally after physical maturity is reached, are likely to postpone such an important step. The problem cannot therefore simply be solved by a change in marriage habits. Where however any community proposes to produce a population policy these facts should be borne in mind in determining the steps to be taken.

What has so far been accomplished in the saving of life?

Evidence will be adduced in Chapter I to show that the *vast growth of population* accompanying the development of the industrial era was mainly due to the *saving of life.* Bad as were the conditions to our eyes, they were infinitely more suited to the mere maintenance of life than is the case in any peasant civilisation which does not have the advantages of the machine. **The industrial revolution was easily the greatest preserver of life known to history** though life for many only reached a very low level of comfort.

Since 1840, there are adequate records of death-rates which make possible some study of the causes at work in prolonging life. Appendix 11 gives the death-rates for males and females at different ages in England and Wales for the four periods 1841-45, 1871-75, 1901-05 and 1931-35. It also shows the rate of fall between these periods calculated as a percentage of the 1840-45 rate. From these figures it is permissible to make certain deductions. In any community studied, health may be expected to be determined by the general level of wealth, and by its distribution throughout the community. It may be influenced for good by changes producing a higher standard of life throughout the whole community, or by smaller changes influencing only sections of the community. By limiting the hours of labour and controlling some conditions of work for women and children, much legislation has aimed specifically at improving the health of these sections of the community. The supporters of this legislation believed that such improvements would follow, even if the total wealth of the community were, at any

rate temporarily, reduced. At any stage of a civilisation in which the two sexes are normally occupied under different conditions, it might be expected that suitable changes in conditions of work would result in improved health in the workers whom they affected. Changes in housing however (*i.e.*, improvement in general sanitation, etc.) might be expected to influence all ages and both sexes alike.

Study of the details in the fall of the death-rate between 1840 and 1930 leads to interesting observations. It is convenient to consider the three periods, roughly 1842 to 1872, 1872 to 1902, 1902 to 1932.

During the whole period 1842 to 1932, the total death-rate in this country was roughly halved and the death-rate in the first half of "the allotted span". *i.e* from birth to thirty-five years was reduced by approximately 70% From thirty-five years onward the decrease in death-rate was progressively smaller with age, since death can only be postponed and not avoided, but in women, the decrease was appreciable even after age eighty-five years, and was not negligible in men between sixty-five and seventy-five years. This fall was however brought about in a somewhat erratic way as different influences made themselves apparent in the health statistics.

In the period 1842-1872, there was no significant change in the total death-rate of the population, but this apparent stability concealed interesting changes. During these thirty years, the young of both sexes between the ages of five and twenty-five showed a small but quite steady decrease in death-rate. This was particularly true between the ages of five and twenty. After twenty-five, men showed an increased death-rate while among women, the rate was nearly constant up to forty-five years, and thereafter rose, but the rise was not as great as in the case of the men. With so many changes taking place in the social life of the country, it is impossible to attribute these changes in death-rate with any degree of certainty to any one cause. It seems however probable that the change in the attitude to the employment of women and children which ultimately expressed itself in legislation was in one way or another responsible for improving health in children and young people, and in mitigating for women the rigour of those conditions which caused an increased death-rate in men during the period. At the beginning of this period, the death-rate in girls and young women was higher than for boys and young men as is still true in all relatively primitive countries. During this period the improvement was slightly greater among females than among males, and at the end of the period death-rates were closely similar in the young of both sexes. **There was no improvement in the death-rate of either sex under five.**

In the period 1872 to 1902, a very different story unfolds itself. The total death-rate fell by 25 to 30% of the 1840 figure, and some improvement was found *at all ages*. Under one year however the total fall was small and doubtful because the change was so very erratic. From one year to forty-five the improvement varied from 30% to slightly more than 40% of the 1840 figure. After forty-five the rate of improvement fell off, but it remained positive and appreciable. The greatest improvement in both sexes occurred in the *twenty to thirtyfive years* age periods, but from the stage of the tiniest toddler to middle-age

remarkable improvement showed itself. During the period [1872-1902] compulsory attendance at school became established, and it might have been thought that the substitution of supervised for unsupervised conditions for the young would have been of special value in improving the lot of children of this age. The relative steadiness of the improvement for the bulk of the population, irrespective of age and sex, however, strongly suggests that the important factors were those common to all—a general rise in the standard of living (food, clothes, etc.) or general improvement in sanitary conditions.

According to some writers on economics, our existing economic system tends to produce an increase of about 1% in the capital wealth of the country each year, which in a period of thirty years would considerably increase the country's available resources. Since many forces were at work to improve the lot of the poorest it seems probable that a very marked advance was made in general well-being, and particularly in the poorest section which always has highest death-rates. **This was apparently shared by the tiny children of one year or more, but curiously it was not shared by infants under one year, whose death rate declined little or not at all.** It will be shown (chap. VIII.) that the fall in the birth-rate in this period occurred mainly in the better-off classes, in which even the late children of large families have death-rates below the average rate, and the elimination of these children caused the infant death-rate to rise rather than to fall. But it is difficult to understand why the improved social conditions which brought about such a marked improvement after the first year had so little influence on the lot of the infant. It is difficult not to conclude that many of the children were undesired and uncared for. They came unwanted, and they passed unwept.

The years 1902 to 1932 again present a very different picture. The fall in total death-rate was about the same as in 1872 to 1902, but the fall occurred at very different ages in the two periods. While in the earlier period the main improvement lay between one year and thirty-five with satisfactory improvement up to forty-five, in the later thirty years **the most impressive fall in the death-rate was found in the first year of life, the infant mortality rate being halved during the period.** After the first year, the greatest rate of advancement was in the one to five years period and then again at the *thirty-five to fifty-five* years stage. **Between five and twenty-five years of age the rate of progress was only about that brought about in the years 1842 to 1872 and was less than half that achieved in the period 1872 to 1902.** That the concentration of effort on the preservation of infant life should have resulted in great advances at that age would be expected. That the death-rate during school age should only improve at the rate found sixty years earlier when social services were undreamt of would seem surprising. It must of course be remembered that much improvement in health, efficiency and comfort may be found without much influence on the death-rate, *i.e.* there may be much improvement in the level of health without any saving of life, but since the improvement in general well-being during 1872 to 1902 resulted in a drop in the death-rate of the school child and young adult of about 30-40%, it seems strange that the improvement in conditions in the next thirty years

should only have achieved an improvement of half that amount although much more deliberate thought was expended on health, and general social progress also occurred. It might seem at first that part of our social services had surpassed all expectations, but that other parts had had much more limited success. In determining what has been achieved in this century however it is necessary to take into account the other great new social factor which has become operative. **This is the fall in the birth-rate which has now reached all ranks and classes.** Such a fall may be brought about in various ways. (1) People may marry at the usual age but have a carefully spaced, small family (2) They may marry late and have an extremely small, well-spaced family, late in life. (3) There may be fewer marriages or more childless marriages. (4) People may marry early, have a small rapidly-bred family and then no more. (5) They may marry late, and have a small, rapidly-bred family and then no more. Since age of mother and rapidity of breeding have been shown in this paper to be as important as actual size of family in the child's chance of life, it is clear that any fall of birth-rate (which occurs throughout a whole community thereby eliminating purely class differences) will influence the infant and child death-rates according as it lessens the numbers of children born into the bad biological groups. If the same number of large families continue to be born, and the birth-rate falls because small families are becoming smaller, or are not being started at all, the infant death-rate may remain constant or rise. Crude fall in birth-rate gives little valuable information. It is however certain that the fall in the birth-rate in this century has been caused by the substitution of the small family for the large as the commonest size. Now from the Registrar-General's Special Report 1911 it can be deduced that in 1905-10, the infant death-rate in families of one cannot have exceeded 55/1000, and that this figure was approximately also the infant death-rate in 1900-05 among only children. Among families of two or three it was slightly higher but only slightly so. In 1930, in County Durham the death-rate for the first three children was about 60/1000 among all classes and about 45/1000 in the middle classes. For England and Wales it probably lay between these two figures. **So that for these small families the fall in infant death-rate during this century has been very slight.**

The Registrar-General's 1911 special report deals only with families in which both parents were alive in 1911. Where such parents had married in 1870 to 1880 and had had only one child, these "only" children were in 1911 usually between thirty and forty years of age. These "only" children had had a death-rate of 166 per 1000 in the total thirty to forty years. But of all children born between 1870 and 1880 about 150 per 1000 died before one year, 300 per 1000 before five years and 400 to 500 per 1000 in thirty to forty years. Clearly these 'only' children of parents themselves healthy enough to survive thirty or forty years after marriage, had had a death-rate at all ages only a fraction of that of the rest of the community, *i.e. they were the fit specimens*, and despite the poor sanitation of the period and the lack of dietetic knowledge of the time, these " only " children compared favourably with the children of small families today. This was true for all small families.

When every allowance is made for the adverse influence on child health of a parent's death, it can be concluded that the improvement in the health of these small families has been very slight and that a major factor in the reduction of the infant death-rate in this century has been just the substitution of the small for the large family. There has however been a real improvement in infant health.

Since the infant and child death-rate of small families was very much below the average it follows that the death-rates among the late children of large families must have been much above the average.

In Chapter V it will be shown that with a general child death-rate up to five years of about 300/1000 in the years 1870-1900, the rate for small families cannot have exceeded 150/1000 and was probably very much less. Clearly the figure for the late members of large families must have been at least 400 to 500/1000 and may have been more. But this figure had fallen in County Durham in 1930 to 200 to 250/1000 according to social class. This represents a real saving of life. But these children still have relatively high death-rates at all stages, *i.e. they are the relatively unfit* and the maintenance of their health poses a serious problem to the community. Study of the health records of these children shows the very great extent to which they are receiving medical and other, parental, care by proxy, but the extent of their innate unfitness can perhaps best be indicated by the simple fact that their death-rate before, during and in the first month after birth (excluding abortions) exceeds the total death-rate up to five years in the first three children. It seems improbable that either clinics, nursery-schools, family allowances or any other of the usual suggested expedients will be of much use here. It is moreover possible that the relatively low rate of improvement during 1900 to 1930 in the five-to-twenty age groups as compared with the great progress made in 1870 to 1900 is due just to this survival to school age of these delicate children, who must always require the greatest care at all stages.

It is not necessary to regard as a counsel of despair any emphasis laid on the enormous contribution to the welfare of the community that has been made by the reduction in the average size of family. If marriages take place early enough it would be quite easy to produce a fairly large proportion of well-spaced families of four, five or even six children under the best 'biological' conditions. The elimination of the problems at present produced by haphazard and irresponsible breeding would liberate large enough funds to cope adequately with any social problems presented by such moderate sized families.

The fall in death-rates in the first period of this century however shows a further peculiarity which must be considered in relation to the fall in the birth-rate. The greatest fall in death-rate or 'saving of life' occurred in the earliest age group. The next best period was in the age group thirty-five to fifty-five years with the twenty-five to thirty-five and fifty-five to sixty-five groups showing up quite well. Some light on this may be thrown by Table LXIV and Appendix 11 in which are shown death-rates for married and single women and for men in 1911 and 1931. From these it may be seen that a fall in death-rate occurred in all these groups during the period considered, but the proportionate fall varied with age and sex. Single women progressed

least at all ages, but even they showed a 20% fall in death-rate in the thirty-five to fifty-five age group as against a fall of only 6% in the twenty to twenty-five age group. It is clear that general social changes were markedly more productive of improvement in the later age groups in both men and women, married and single. The only exception to this is found in the great decrease in death-rate in young married women. But this decrease is in fact merely the inevitable result of the fall in the birth-rate. The great decrease in the number of children born per 1000 married women results in an exactly proportional decrease in the number of married women dying in child-birth, since the maternal deaths per 1000 births remained constant over the period. Moreover the Durham investigation has shown that where the birth-rate is high there are a large number of deaths among child-bearing women which are not classed as maternal deaths, but which would not have taken place if the women had not borne children. The reduction in the birth-rate eliminates these too, and the greater fall in the death-rate of married women over single women can be almost wholly explained by this fact. **This fall represents no solution of the problems of mammalian reproduction. It merely indicates that we are walking away from them.**

Men and single women usually have to earn their living in 'gainful occupations' and neither share the biological advantages which accrue to married women from the fall in the birth-rate but men showed a much greater improvement in death-rates in the period considered than did single women. Married men would share with married women the social advantages of having fewer children to support, and part of the great improvement in men's health must be thus indirectly attributed to the fall in the birth-rate. It is very noticeable that the fall in men's death-rate is maximal at just those ages at which a very large family presses most heavily on the parents. But as the fall in men's death-rates at these ages is greater even than in married women, it is obvious that for men some further social advantage must be accruing which does not equally affect women. Just what the nature of this advantage may be is not clear. It is however clear that the reduction in the size of family not only transformed the whole health problem for children but caused a great improvement in the lot of married women and fairly certainly in married men. **This reduction in size of family has in fact dominated the whole health position in this century.**

The vast saving of life that has been secured by the more or less intelligent use of the wealth that has been made available by the 'machine' is so impressive that the possibility is sometimes overlooked that certain ills may not be eradicated by mere social progress, yet there are diseases which appear to be equally common in all classes, and difficulties which have so far resisted all attempts to deal with them. In the period 1905 to 1936, the death-rate of infants in the first month of life only fell from 40 to 30 per 1000, while the death-rate from the end of the first month to the end of the first year fell from 87 to 29 per 1000. The still-birth rate remained virtually constant, and up to 1936 the maternal death-rate was relatively stable. Since then there has been a significant fall in the maternal death-rate due to sepsis, as a result of modern treatment of this condition. It has been shown in this paper that the lack of improvement in these cases either during

this century throughout all classes, or in the wealthier as compared with the poorer classes at any given time is due to the fact that changes in reproductive habits are causing births to take place more frequently at maternal ages associated with most risk, and advances in science have failed to cope with this. Housing, diet, general social conditions, etc. are largely irrelevant to the problems here.

It would seem inevitable that a certain nucleus of problems will remain even when the best use is made of existing social facilities, and that two different sets of problems have to be appreciated. In the first place it is necessary to know just what are the social conditions essential to health, and how these are to be made generally available. It is illogical for instance to claim that maternal deaths are as common among the upper classes where births are always attended by trained midwives as among the poor, and then to propose to try to reduce the maternal death-rate among the poor by the use of more trained midwives. If these fail when working with superior amenities it is not reasonable to expect them to succeed with less suitable facilities. In the second place it is necessary to consider how individuals with special weaknesses (for some such will exist however carefully a community is bred) can be fitted to make the best of life and give the best service to the community.

What remains to be achieved in the area under consideration?

The figures for County Durham seem to indicate that to secure the best possible level of child health three conditions are necessary.

(1) Reproduction must take place at the age and rate to give the best physiological conditions.

(2) The necessary social conditions must be available to all.

(3) Considerable advance must be made in the present knowledge of the physiological processes in mammalian reproduction.

The middle classes in Durham appear to compare satisfactorily with similar classes in the rest of the country with a child death-rate up to five years of age (including still-births) of 90 per 1000 live and still-births. The black-coated classes with a child death-rate to five years of 102 per 1000 are 10% worse, but the best biological groups of this class, *i.e.* first, second and third children born to mothers between twenty and thirty-five and fourth and fifth children born to mothers between 35 and 40, with a death-rate of 92 per 1000 are as healthy as the more fortunate classes. *The difference here is largely one of reproductive habits.*

Manual workers other than miners with a child death-rate up to five years of 132 per 1000 are **50**% worse than the middle classes but the best biological groups with a death-rate of only 109 per 1000 show an excess over the middle classes of only 20%. The total excess of 50% therefore consists of 30% to be removed by a change in reproductive habits and 20% which must be attacked by improvement in social conditions. Miners' children had a total death-rate up to five years of age of 161 per 1000, *i.e.* an excess death-rate over the middle classes of **80**%. Even the best biological groups had a death-rate of 137 per 1000, *i.e.* an excess of 50% in the death-rate must be attributed to bad *social* conditions.

The social changes of the last forty years have done much to bridge the gap between the classes, and it would seem that a furtherance of these changes might do the rest. If new methods are tried such as family allowances, such allowances should be planned to encourage as far as possible reproduction on the best physiological lines. **It is important to remember that among seventh and later children, the deaths before the end of the first month (including still-births) are greater than the deaths (including still-births) up to five years of age in the first three children. It is improbable that these early deaths in the later children would be seriously affected by any system of family allowances.**

Given healthy reproduction however, so many existing problems would fade away, that time and money now spent on them would be available for coping with the social problems remaining.

There would still however remain the problems common to all classes. From the League of Nations Statistical Year Book it may be learnt that of every 1000 children born *alive* in India, 500 die before reaching the age of twenty ; in Bulgaria the figure is 300 ; in England and Wales 120 and in the highly civilised but agricultural countries of Holland and New Zealand, the figure is as low as 70. Among the middle classes of England and Wales where only 40 to 50 per 1000 children born alive die before reaching five, it may safely be concluded that the figures up to twenty would be about at least as good as for Holland and New Zealand. Yet of the total of 70 per 1000 dying before twenty, from 20 to 30 per 1000 die in the *first month* of life. In our country, of each 1000 children born, 40 die before or during birth, *i.e. Of the children conceived under the best known conditions, about* 110 *per* 1000 *fail to reach maturity and of these* 60 *to* 70 *per* 1000 *are dead before the end of the first month of post-natal life.* (To these there probably ought to be added at least 20 natural abortions per 1000 births. The inadequacy of the existing information about abortions will be discussed in Part I.)

There is thus left a nucleus of problems that can only be tackled by a study of the fundamentals of the physiology of mammalian reproduction. The numerical importance of this may be estimated by the fact that in 1936, in England and Wales there were 2966 maternal deaths, 25,046 still-births and 18,159 deaths among children under one month. Natural abortions may be conservatively estimated at 20,000. In the same year there were 28,268 deaths from tuberculosis and 66,354 from cancer.

It would seem that only by a broad attack on these fundamental problems can any real advance be made, not only in decreasing maternal death-rates so-called, but in limiting the adverse influence of pregnancy and parturition on other pathological conditions which now cause much maternal morbidity and many deaths indirectly due to child-birth.

"There is probably no subject of such importance to the individual as that of the health of the nation of which he is, inescapably, a living part. And in Britain, one of the few remaining democratic countries, the subject has an urgency of a special kind, because the citizen is himself arbiter of the steps taken by both the central and the peripheral organisations to establish and maintain the Common Health. As parliamentary voter he decides upon the governing principles, and as municipal voter he holds the scales between enlightened parsimony and reckless expenditure . . . . . "

"Health is hammering at the door of economics."

From a foreword by Lord Horder to "Britain's Health"
'a Pelican Special'.

"Man is born, develops, and dies in accordance with certain laws which have never been studied as a whole, or from the standpoint of their mutual interplay. Some of them have been investigated in greater or less detail, and certain results have emerged from isolated observations and from theories, the latter often based on mere sketch-work. Such is, in the main, the sum total of our concrete knowledge of man. No attempt has been made to determine the age at which human faculties are at their highest and the age at which they begin to fail, or their relative worth at different stages of life, their inter-actions, or the influences to which they are subject. Little more attention has been given to the gradual development of the moral and intellectual ego, to the influence exerted upon it at different ages by the physical being, and to the manner in which the latter asserts itself. This whole fruitful field has, so to speak, remained fallow." (Quetelet, "Essai de physique sociale").

"The life of the average working-class woman is that of an obstetrical steeple-chase."

(Dr. Edith Summerskill, House of Commons. Feb. 1939.)

PART I.

SOME BIOLOGICAL FACTORS INFLUENCING INFANT AND CHILD MORTALITY.

CHAPTER 1.

THE PROBLEM.

One of the outstanding features of the social life of the last eighty years or so has been the active interest displayed in the health of the community. This arose out of a changing conception of mutual social responsibilities, but its practical expression was only made possible by a series of fundamental scientific discoveries, which, for the first time enabled man deliberately to take steps which might reasonably be expected to improve the health of large numbers of people.

Health in the individual has always been roughly measured by his physical capacity to do those things he wanted or needed to do in the circumstances under which he found himself. This capacity does not however lend itself to measurement, and it is true, though unfortunate, that there is as yet no measure or even group of measurements which can reasonably be regarded as indicating a definite grade of health. For the individual, freedom from certain common and clearly-defined physical defects has been broadly taken to indicate good health. For the community, a low death rate, *i.e.* a high capacity to remain alive, has been considered the chief desideratum. This assumes that the number of people who die is an accurate measure of the number of people who are unhealthy, and over brief periods during which there is no great social change, the death-rate is probably in direct proportion to the incidence of certain types of fairly readily fatal disease, and is a rough measure of the general health of the community which largely determines the degree of incidence of such disease. Health is however a balance between hereditary make-up and environment, and over long periods, great improvement in environment may enable very poor biological stock to remain alive at various levels of apparent health, but any stress, such as the spread of an epidemic or food stringency in time of war, may reveal the latent weaknesses. Moreover, a slight improvement in the general physical conditions of a people brought about by better housing and a slightly more ample diet, together with greatly increased protection from infectious disease such as can be achieved by sanitary measures may permit a great decline in the death-rate (*i.e.* a great improvement in apparent health) together with a great increase in minor and non-fatal diseases which may become an intolerable burden on the community.

For instance, the evidence cited by Clapham [1926] would seem to show that the rapid increase in population which occurred during the eighteenth and nineteenth centuries was not due to the increase in birth-rate but to the saving of young life. Since one of the effects of such saving was to increase the proportion of women of child-bearing age, there was a slight secondary rise in the crude birth-rate. The cause of the declining death-rate in this period was not understood then, and is ill-understood now. The decline occurred long before any systematic and large scale attempt was made to improve health. It may probably be attributed to the general improvement in the standard of living, where this is allowed to cover increase in knowledge, increase

in spread of knowledge, and improvement in transport permitting readier flow of goods, services and people as well as mere increase in productivity per person. This declining death-rate did however cause a great increase in population, and this spilled squalor over the green fields of our country, not because the nineteenth century poor were worse housed than their predecessors, but because there were so many of them, and a wholly insanitary cottage which seemed picturesque and charming nestling in the corner of an orchard, when multiplied by thousands and oriented in straight rows became a nightmare.

The industrial revolution is the largest single factor determining the health problems of today. It revolutionised the life of the individual and of the community. It made possible life on a low level for vast numbers who would otherwise have died. It did not degrade the poor except in so far as it kept alive those whom a more 'natural' environment would have weeded out before or immediately after birth. (Orr and Gilks [1931] state that in primitive African agricultural communities as many as 50% of the children born alive die before the end of their first year). But it failed to provide the very special conditions necessary to maintain the feebler members of the community whom it just preserved alive, in anything approximating good health. Every community appears to include in its numbers a few superbly fit specimens who can triumph over almost any environment, but the vast majority can, however, only survive to attain their highest 'human' possibilities in environments carefully controlled to suit their needs. This is essentially the problem which is still with us.

The death-rate is however not the same throughout a community, but is directly related to age, being highest at each end of life. That the old and worn should be more liable to die than the young and virile would seem obvious. That the newly-born should display such a precarious hold on life, even after allowance has been made for the dangers involved in birth itself, is less readily explained. On this subject two schools of thought have arisen :—those who hold, usually vehemently, that the high death-rate in the very young is due to faulty environment, and can be reduced by social measures to the complete advantage of the community, and those who hold that a high infant death-rate performs a useful social function in removing the less desirable elements from the community, at an early stage. In the words of Pearl [1922] "The death-rate of the earliest period of life is selective—eliminating the weak and leaving the strong". Few of the supporters of the latter thesis would deny that in some measure even the strong may be the victims of ignorance, prejudice and poverty, but they hold that, in the main, measures taken to decrease infant mortality tend to result not in improved community health, but in an enfeebling of the whole stock. This view is perhaps most common among the biologically-minded, and *should not be confused with class prejudice*. From the biological point of view, the steps taken by anxious parents to rear their delicate children may be just as fundamentally dysgenic as any expenditure of public money to that end.

Whether it is advantageous or not, the fact that the high death-rate of infancy is primarily a weeding-out, would seem to be supported by the changes in death-rate with age. Even under the worst social

circumstances, the newly-born infant is relatively protected, but his death-rate decreases precisely as his protection from the dangers of his environment decreases. School age, with its great increase in personal contacts and therefore great increase in exposure to infections is not accompanied by an increase in death-rate, but by a decrease, but the passage from school to the relatively rigorous conditions of industry is accompanied by a definite increase therein (Table I). This might be attributed to bad industrial environment, but the position is not simple. Entrance into paid employment at round about fourteen or fifteen coincides roughly with adolescence, and the question arises whether the increased death-rate at this stage must be attributed to the physiological strains of adolescence, or to the adverse conditions in industry. From the age of fifteen onwards it is necessary both as regards physiological changes and social conditions to consider the sexes separately. (Table I., page 75).

Table I shows the death-rate of both sexes for the years 1921 and 1931, column D representing the total death-rate, while D-A represents the natural death-rate, *i.e.* the total death-rate less the rate due to accident and suicide (*i.e.* A), this being calculated from the figures given by the Registrar-General.

Among males, there is a jump in the accident rate (*i.e.* A), on the entry of the youth into employment at about fifteen, which accounts for part of the increased death-rate at this stage, but while the accident rate remains fairly constant from fifteen to forty-five years, the natural death rate increases, with a *steadily increasing increment.* After forty-five years there is a great increase in deaths due to natural and accidental causes and it seems difficult not to conclude that here both death-rates reflect the increasing unfitness of the man for the duties forced on him by our society. The steady increase in the death-rate from natural causes in the male after entering industrial, commercial or professional life, *despite stability of environment,* would seem to make clear that this increase is determined by *biological* changes of a retrogressive kind.

In the female, the changes in the death-rate are slightly more complicated, and environmental changes more varied, so that interpretation of the figures is more difficult. At no stage does the accident death-rate contribute considerably to the total death-rate in the more highly disciplined and protected sex. In infancy where the responsibility for accidents presumably lies mainly with someone else, the accident rate is closely similar for both sexes. In industry, the conditions to which the male is exposed, makes his accident death-rate always many times that of the female of the same age but during the school age, the slight but constant excess of the male rate over the female would seem to indicate mere lack of discipline.

When the *natural* death-rate only is considered, it is seen that the bulge on the female graph coinciding with the entrance into employment and also with the biological changes of adolescence is slightly greater than for the male (0·9/1000 as against 0·7/1000 for England and Wales), so that for the country as a whole the natural death-rate of females at this age is slightly higher than for the male. Table I only gives the figures for 1921 and 1931, but figures were also calculated from the reports of the Registrar-General for 1930 and 1932, the assumption

being made that the age distribution of the population for these years did not differ significantly from that given by the 1931 census. The same excess of female over male rates for the age period 15-25 years is noted, so it appears to be a real difference. This is supported by the figures given by the Registrar-General in his Annual Report for 1931, where he surveys the relative total death-rates of male and female at different ages from 1840 to 1930. From his figures it is clear that from 1840 to 1920 the *total* death-rate among girls between 10 and 15 exceeded that of boys. From 1920 to 1930 it was very similar in both sexes. Between the ages of 15 and 20, the *total* female death-rate exceeded that of the male from 1840 to 1895, and thereafter varied round it, despite the disparity known to exist at this age in the *accident* risks of the two sexes. From 20 to 45 years of age, the relative *total* death-rates were of the order to be expected with approximately equal *natural* death-rates in the two sexes, and the known excess of accident rates in the male. Thus the figures shown in Table I for 1921 and 1931 may be taken as expressing a fairly permanent state of affairs, which indicates special health problems in the adolescent female. Is this due to the greater physiological re-adjustments necessary in the female? Is it due to the possibility that the conditions of employment for the female are more adverse than for the male?

Some light on the subject may be thrown by the other figures in Table I. There it may be seen that in the administrative County of Durham which is characterised by a remarkable lack of industrial employment, and a considerable lack of paid employment of any kind, for the female, the bulge on the graph of natural death-rate of the female at the period 15-25 years is even more marked than for the country as a whole (1·5/1000 in the female as against 1·2/1000 in the male). In this county, while for all three years 1930, 1931, 1932, the natural death-rate for both sexes between five and fifteen years is about equal, from fifteen onwards that of the female shows an excess of 15% or so over that of the male, and this difference in this direction remains till the age of forty-five is reached. This fact has many implications which will be dealt with later in other connections. The marriage age for women in this area is low, 60% of all first legitimate children, 33% of all seconds, and 16% of all thirds being born to women under twenty-five, while the average marriage age of the women of the country as a whole is between twenty and twenty-five, but is approaching the latter figure (Registrar-General) Had paid industrial as against unpaid domestic conditions determined the rapid rise in the death-rate at adolescence, it might have been expected that this area would have shown these changes in a less rather than in a more marked degree than other areas. Actually also the figures given by the Registrar-General in 1933 for the death-rates of married and single women at this age do not support the thesis that the peculiarities of the female graph at this stage can be explained by the effect of gainful as against home employment.

Table II shows that for the three periods 1910-12, 1920-22, and 1930-32, the death-rate among married women between the ages of fifteen and twenty-five (total death-rate) is greater than among single women. The death-rate due to accident in married and single women for 1930-32 is given in the Registrar-General's special report on

Occupational Mortality [1931]. From this it is apparent that the difference in death-rate between married and single women is not due to differences in the incidence of accidents. It is not of course possible to know how many married women are gainfully occupied, or how many single women are not, but the figures in Table II seem to render it probable that the very rapid rise in the natural death-rate of women from fifteen onwards is due to biological difficulties of ever increasing degree, rather than to the adoption of paid employment.

EXPECTATION OF LIFE.

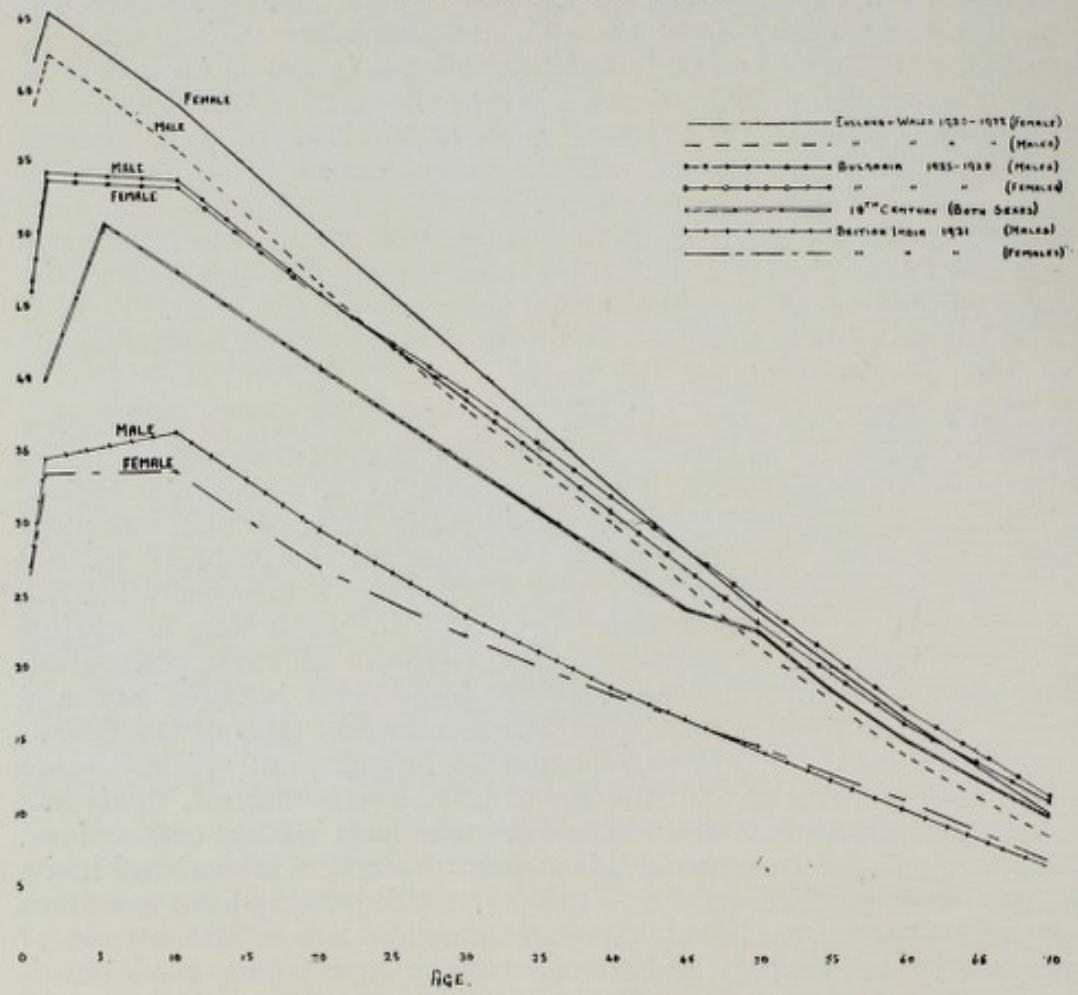

Fig. 1. The curves represent the expectation of life at various ages :—upper two curves for females and males in England and Wales (1930-32) ; next two curves, males and females in Bulgaria (1925-28). This is followed by a curve (double-line) of both sexes in England and Wales in the 18th century and the final two curves give particulars of males and females in British India in 1931.

In the female, middle age is accompanied by well marked glandular and other physical changes, and a decided further increase in the death-rate. In the male, much less marked physiological changes are associated with an even greater increase in death-rate. It has frequently been noted that almost all the alleged success of recent years in prolonging life has been due to decrease in the death-rate in early life. At later stages too, death-rates are lower, but to a much less marked degree. This is made clear by a study of the curves on Fig. 1 drawn from figures from the League of Nations Statistical Year Book 1938-39,

and by Appendix 10 showing the expectation of life of an Englishman in 1930-32, a Bulgarian in 1925-28 and an Indian in 1931. (The most recent figures for the latter two countries). The curve for an Englishman in the eighteenth century, taken from Pearl [*ibid*] is included for comparison. (Appendix 10, page 239).

The expectation of life at birth in England in 1931 was about fifteen years longer than in Bulgaria and thirty years longer than in British India. (No figures are available for the rest of India). After the age of 20-30 years the Bulgarian man has a slightly greater expectation of life than the Englishman. After the age of 40-50 years, even the eighteenth century Englishman had a higher expectation of life than the Englishman of today. While the expectation of life in England is lower for the male than for the female at all ages, this is not true in Bulgaria or in British India. In Bulgaria it is less for the female up to twenty or thirty years of age and thereafter becomes slightly more. After fifty, it is slightly higher for both sexes in Bulgaria than in England. Here we see the sturdy peasant ancients, beloved by writers—actually the hardy survivors of a rigorously weeded community. In British India, the female has a lower expectation of life than the male up to fifty and then the two almost coincide. Although the expectation at later ages approaches the European figures, it never reaches them, indicating either racial feebleness or acutely bad conditions. Clearly the protection of the female which is such a marked feature of our modern western civilisation does not exist in India, nor seriously in Bulgaria. It is evident that the sex difference in survival is enormously conditioned by the state of civilisation.

Figure I also shows that in the eighteenth century in England the expectation of life in the early stages lay between that of Bulgaria and India today. It is obvious however that advance in time from the eighteenth to the twentieth century in England or in standard of living from Bulgaria to England today influences expectation of life mainly in the early stages. In referring to the changes in the expectation of life, Pearl quotes Pearson's edict "In the course of those centuries, man must have grown remarkably fitter to his environment, or else he must have fitted his environment immeasurably better to himself." This control over environment has however obviously only been at all satisfactory in relation to the needs of the young. The weeding-out among the very young has been decreased, but only in a minor degree has the environment in later ages been adapted to a man's needs. This is underlined by the figures in Table I. Between 1921 and 1931, the death-rate in England and Wales between 0-5 years fell by about 30%, between 15-45 years by about 10% and from 65 years onwards by about 6%. In County Durham, the comparable figures are 50%, 2%—10%, and less than 1%.

It seems probable that no great improvement at the later stages will be possible until more is known of the fundamental physiological changes accompanying senility, which apparently begin round about the age of fifteen to twenty. From the social point of view it is evident that a study of these changes is essential if the structure of society is to be such as to give the fullest opportunity for the development of the powers of the individual, and to make the greatest use of such powers for the common good.

Yet it is remarkably true that the underlying biological capacities and limitations of the human species are entirely ignored by all those who set out either in politics or business to control the social and economic activities of man, or in education to fit the young for their later responsibilities. Perhaps the most outstanding example of this lies in the rigidity of the conditions of employment in the professions and industry, where uniform standards are imposed on all workers from the adolescent entrant to those retiring in old age. The result of this is, of course, the extremely rapid rise in the death-rate in middle-aged men—an increase greatly in excess of that found in women at that period, even when the natural death-rate alone is considered. In domestic life, the cessation of child-bearing and the increasing independence of children causes the middle-aged woman to be gradually freed from her most oppressive duties ; as her energies slowly diminish so do the demands made on her, and the adaptation to old age proceeds smoothly and successfully. The physiological change with its attendant difficulties is thus more than compensated for by the gradual social transition. In the man however, the absence of any marked physiological break in the life curve has led to the absence of any attempt at fitting employment to biological capacity. Industry is in fact based on the 'all or none' theory. In effect, a man of sixty-three is expected to compete with a man of twenty, and then at sixty-five to cease to function altogether. The result is obvious in our vital statistics. If our social and economic life is to be made more rational, many pet economic prejudices must be re-examined in the light of known biological facts. At the present juncture when population problems and physical fitness campaigns are much to the fore, it would not seem inopportune to re-consider the relative importance to community health of heredity and environment.

Humanitarian sentiments have hitherto completely prevented any serious consideration of these problems, because most people seem to have assumed that to admit that certain individuals are inherently weaker than others, must inevitably lead to a policy of laissez-faire—' We may not kill, but need not strive officiously to keep alive." The alternative possibility of deliberately and rationally continuing the process, so far accidentally achieved, of fitting the environment to the individual does not seem to have been entertained at all. Pearl (*ibid*) reports the results of four investigations on the influence of biological and environmental influences, as follows : i. Pearson studied the records of the duration of life for certain families belonging to the Landed Gentry, the Peerage and Quakers, and calculated the coefficient of correlation for the life span of certain pairs of relatives. He concluded that "from 50% to 75% of the general death-rate within the group of the population on which the calculations are based, is determined fundamentally by factors of heredity, and is not capable of essential modification or amelioration by any sort of environmental action, however well-intentioned, however costly or however well advertised." ii. Ploetz in Prussia, iii. Snow in England and iv. Crum in Holland studied the influence in later years, of varying death-rates in the earlier years of the life of groups of children. With only one exception, in the four large towns in Holland, they found that a high death-rate in infancy was followed by a relatively low rate in

subsequent years and vice versa. Snow comments, "Natural selection in the form of a selective death-rate is strongly operative in man in the early years of life. We assert with great confidence that a high mortality in infancy (the first two years of life) is followed by a corresponding low mortality in childhood, and conversely."

The conclusions drawn from these investigations seem to have been considerably disliked by many people who have interpreted them as indicating that the whole 'infant welfare' movement is either futile or undesirable. But it is not clear that they must bear this interpretation. If it is possible for man "to have fitted his environment immeasurably better to himself" in the course of the last twenty centuries it is not evident why he should abandon the process at the precise moment when modern science would seem to have strengthened immensely the weapons available to him in his struggle. If he can keep infants alive there would appear to be no reason why he should fail to keep alive children, adolescents, young adults, or even the middle-aged and old to a greater or less extent, if he is willing to make the necessary social adjustments. After all, Pearson left from 25% to 50% of the general death-rate subject to environmental control. The results quoted above are no argument against the exercise of parental care, or against the development of that parental care by proxy now given by state and voluntary organisations. What they do negative is parental or state care in spurts. It is useless to have a highly organised service for infants for the first year of life and then complete neglect to school age ; a careful school health service and an entirely unaided adolescence. But difficult as it has been to control the environment to secure the welfare of the dependent, uneconomic young, the problem in the case of the adult is vastly greater. Hence the failure to make much headway. We have not the necessary fundamental scientific knowledge, and it is doubtful whether we yet possess the skill to guide the delicate and complicated social machine far along an experimental track, without danger of serious error.

But it is quite obvious that the process of deliberately controlling the environment to the advantage of the physically feebler young carries with it grave disadvantages. No one would desire to eliminate from the community a tuberculous Stevenson, a lame Byron or a deaf Beethoven, but the presence in any population of a large proportion of the diseased or crippled must set up acute strains in the social structure. Any community which deliberately sets out to maintain alive as long as possible all who are born, must seek safety by determining as far as possible that as few unfit are born, as can be achieved by the fullest application of the available knowledge. Only thus can it escape destruction.

CHAPTER II.

THE MATERIAL STUDIED.

The study, of which the results are embodied in this report, deals with one small, but socially extremely important part of the problem relating biological fitness to human responsibilities. It considers the relation of the age of a woman to her fitness for motherhood, such fitness being measured by the chances of survival of mother and child. Since however it would be ludicrous to compare physiologically a woman of thirty-five bearing her first child with one of the same age producing her tenth, the number of children born and, as far as possible, the rate of breeding have been taken into account. For this purpose, the records of the Health Visitors of the maternity and child welfare area of the administrative County of Durham for the years 1930-1937 have been used.

This County has been one of the pioneers in the promotion of schemes for the improvement of child welfare, and during a considerable period has amassed a large amount of information in relation to its child population. The area has, however, certain peculiarities which must be considered in interpreting the figures found. To begin with, it is a 'county' area, and the county boroughs of the geographical county with their special problems of slums and dense aggregates of population generally, are excluded from consideration. Even the smaller boroughs, with one numerically insignificant exception, are not included in the area which is the unit for maternity and child welfare work. This means, among other things, that the commercial and professional classes, as distinct from industrial workers, are not represented in anything like the proportion in which they occur in the whole country. At the other end of the social scale, the socially derelict who congregate in the slums of large towns are likewise under-represented.

Table I however indicates that the area has other peculiarities, the significance of which is profound, although their essential nature is far from obvious. In the first place it may be seen that the death-rate at all ages up to 45, is in excess of that for England and Wales, even where only natural death-rate is considered, although in 1921, this difference was negligible for men between the ages of 15 and 45. Secondly the natural death-rate among women between fifteen and forty-five is about 15% higher than that of men of this age, although in the whole country it is about 3% lower. Thus it is clear that there is here either relatively poor stock or bad environment. The sex differences suggest that the adverse factor is environment, and that for some reason, the bad environment bears more heavily on the female. After the age of forty-five, the natural death-rate among the men of the county both in 1921 and 1931 falls below that of England and Wales, suggesting that the earlier weeding out has left a hardy residuum, better able to withstand the strains of old age, but among women of the same age, the death-rate still remains higher than in the whole country, although the difference decreases from above 30% in the 15-45 group to 6% in the 45-65 group. This must indicate that the special adverse conditions peculiar to the women continue even in the later age groups. The

nature of these adverse factors is not clear, but their existence is important as influencing the possible interpretation of the results of this investigation, and the possible application of such results to other areas and populations.

For purposes of comparison with the county area, Table I also gives the death-rate for the different age-groups in the County Boroughs of the geographical county. (These figures also were deduced from the reports of the Registrar-General). They indicate that in 1921 the figures for the younger age groups for the County Boroughs closely approximate to those of the administrative county, but that the improvement effected in the years 1921-1931 is much less than in the latter, so that on the whole, the natural death-rate in 1931 is higher for both sexes and at all ages (except in old age—over 65) in the County Boroughs than in the administrative county. The outstanding exception to this is in women from 15 to 45, among whom the death-rate is equal in both areas. The excess of deaths in the geographical county over those of the whole country might be attributed to climatic conditions—the cold and rugged north—but as will be seen later there is evidence to negative this.

Comparison of the figures for the years 1921 and 1931 throws some light on the influence of poverty on death-rates as 1921 marked roughly the end of a period of unparalleled industrial prosperity in the North of England, while 1931 marked the depths of a prolonged depression. Yet during the ten years, both in the administrative county of Durham and in the County Boroughs there was an improvement in health, as measured by a drop in the death-rate of the young and middle-aged. There is no convincing evidence that the slower drop in the boroughs is associated with a higher level of unemployment, as the county area included some of the most depressed areas of the whole country.

These figures serve to demonstrate the complexity of the whole problem, and the difficulty of establishing with any degree of certainty direct causal relationships.

The nature of the information sought in this investigation and the material examined.

The nature of the information sought falls into certain broad categories.

1. The influence of the age and parity of a woman on
   - (*a*) Her own chance of survival in child-birth.
   - (*b*) Her own chance of survival for five years after child-birth.
   - (*c*) The child's chance to survive till five years of age.
   - (*d*) The probability of the child's death occurring before or during birth, in the first month of post-natal life, from 1 month to 1 year, or from 1 to 5 years.

2. The influence of a high death-rate at any stage on later death-rates among the same group of children.

3. The influence of the rate of reproduction on the chance of survival of mother and child.

4. The possible effect of certain social factors such as father's occupation, housing and legitimacy on the conclusions drawn from consideration of the biological factors.

The material examined.

The first records examined were those relating to births taking place in the year 1930. A study of these gave information concerning the child's chance of survival to five years, as influenced by both biological and social factors. For information of value in relation to the deaths of mothers, either in child-birth or from other causes, it was necessary to supplement the information secured from the records of the children born in 1930 by study of records covering 1930-1937. Details concerning these later records will be given in Chap. XIII., Part III of the report which deals with maternal mortality.

It was actually found that complete five year records were available for the children living in the area, and reaching the age of five during 1935. Some of these had moved into the area during the period 1930-1935. Some children born in the area in 1930 left it during that period. The influence of these removals on the total figures was slight and will be dealt with later.

Altogether, details concerning 17,049 children born in 1930 were studied. Of these, 474 belonged to families in comfortable circumstances who were either not visited at all, or were only visited once. All deaths occurring among these 474 children were of course recorded, but other information was scanty. In a further 75 cases, neither the age nor the parity of the mother was recorded. Some of these 75 cases were women only temporarily resident in the area, but many were inmates of institutions not visited by the Health Visitors. Of the remaining 16,500, age and parity of the mother was recorded in 15,510, and parity alone in 990 cases. Details as to previous pregnancies were noted and the history of the 16,500 children was followed over the first five years of their lives.

Since these records are compiled in the course of the ordinary work of a Health Visitor, and are designed primarily to enable the health authorities to give the necessary advice and help, but are not designed at all to form the basis of a scientific enquiry, it seemed desirable as far as possible to check the validity of the figures secured. This was done by (*a*) comparing the figures deduced from the Health Visitors' records with the relevant figures given by the County Medical Officer of Health in his annual reports and (*b*) scrutinizing the records themselves to find out whether the information contained in them was consistent. The details of this check are given in Appendix 1, (page 218).

From this examination it was concluded that while occasional obvious errors were found, it seemed clear that there were no inaccuracies in the records likely to vitiate the conclusions drawn from them.

In the figures which follow, all rates are calculated per 1000 *total births*, and not on the usual live births. SB is still birth, IM is infantile mortality (deaths under 1 year), CM is child mortality (deaths between 1 and 5 years) and TM is total mortality up to five years (*i.e.* SB + IM + CM).

Table III shows the varying death-rates in the different groups. The figures for the 15,510 of known age and parity closely approximate to those of the whole group. Those for the unvisited group are much lower, and for the small group of 75 much higher. In the latter, the smallness of the group makes the figures of no significance. The 990 of unknown age but of known parity have figures slightly below the average, which is simply explained by the fact that certain social groups have markedly lower death-rates than others, and that it is in these groups pre-dominantly that the mother's age is either not asked or not given. (Table III., page 76).

CHAPTER III.
RESULTS.

(i.) The influence of the Parity of the Mother on the Child's chance of survival to five years of age.

Table IV. (page 76) and Fig. 2 show the distribution of the 16,500 births of known parity and the variation of the mortality rates with the place in the family. In this table the infant mortality rate is expressed as the sum of NN (the neo-natal rate or death-rate in the first post-natal month) and IM[1], the death-rate between 1 and 12 months.

THE DISTRIBUTION OF BIRTHS OF KNOWN PARITY AND VARIATION OF THE MORTALITY RATES WITH THE PLACE IN THE FAMILY.

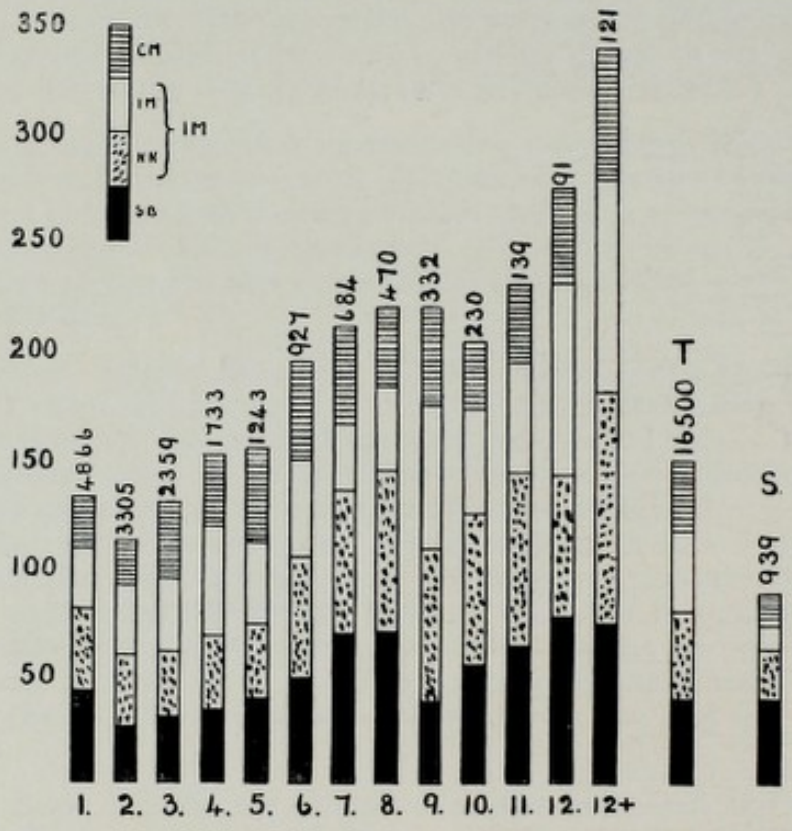

Fig. 2. The penultimate column, T, shows the distribution of death-rates for the whole 16,500 pregnancies ; and the last column, S, for the "unvisited" middle class.

Abscissae :—place in family. Ordinates :—death-rate per 1000 pregnancies. The figures above each column are the actual numbers of births at each stage of family.

The birth-rate for the maternity and child welfare unit in 1930 was 20·6 per 1000, and it may be noted that the proportion of births actually found here differs from that deduced by Campbell [1929] for this birth-rate, in that the small families are relatively fewer, and the large families more numerous than she estimated. The death-rates agree generally with what she found, *i.e.* these rates increase with the place in the family. She included deaths on the day of birth with

still-births and found for this death-rate the drop between first and second births, which here appears only in the still-births. It is noteworthy that in these figures, after the third birth, not only does the death-rate under 1 year increase with place in family, as found by Campbell, but the death-rate between 1 year and 5 years also increases. If first and second children are compared it is seen that the increase in child-death-rate among second children tends to offset the decrease in the still-birth rate between firsts and seconds, so that very little difference is in fact found between the total death-rates up to five years, in the first two children. The total death-rates of first and third children are even closer, but thereafter there is a steady rise until about the eighth birth, beyond which little further rise occurs.

The increase in still-births and deaths on the first day from about the sixth birth onwards which was noted by Campbell is here shown to occur in the still-births.

The total mortality up to five years of age even in the larger family groups, except in the small number with more than 13 in the family, never approaches the figures of 384 and 429/1000 found by Campbell for the death-rate up to *one* year, and it would seem probable that the height of her figures was due to a gross under-estimation of the numbers of the larger families. (This under-estimation was noted in one case in her report).

For the purpose of determining the statistical significance of differences observed, the method used was that described by the Registrar-General in his special report [1931] on Occupational Mortality (p. 17). If the number in a group was n, and the death-rate q per unit, then the number of deaths in the group was nq and the 'standard error' adopted was the square root of nq, *i.e.* the square root of the deaths actually found in the group. A difference of twice the standard error was considered significant, and a difference of 1½ to 2 times the standard error as probably significant. A difference of less than 1½ times the standard error was considered as having no significance.

(ii.) The influence of the mother's age on the child's chance of survival.

Table V. (page 77) shows the proportion of births and the mortality rates among the children as they vary with the mother's age.

Campbell (*ibid*) found no consistent difference up to 35 years and thereafter a tendency for the rates to rise. She included the group 15-20 years with the 20-25 years as the former group was so small. Moreover her estimates of the numbers of women in each group were necessarily only approximate. Only very striking differences could therefore be noted.

In the figures of this study, the infant mortality rate for the children in the under 20 group is very high, and this is equally true for rural and urban areas, the respective figures being 120·5/1000 and 124·5/1000. There is a marked drop in the total mortality rate between the under 20 group and the whole 20-30 group. This drop occurs in the *infant mortality* rate only. Still-birth and child mortality rates tend to rise. After a maternal age of thirty, still-births and infant death-rates increase, but the increase is proportionately greatest among the still-

births, while the child mortality rate varies very irregularly with maternal age.

Thus total mortality increases generally with place in family and age of mother. Since, in general, the children in smaller families are born to younger mothers, it might seem that the increased mortality with increasing maternal age is only the result of a higher degree of parity. Alternatively, it might be argued that the apparent increase with place in family really only reflects the advancing age of the mother. The changes do not however occur quite similarly. Child-mortality rate increases more steadily with parity than with age, while in the age groups there is no sign of the drop in still-birth rates which is so noticeable between first and second children.

The two factors were therefore studied separately, and revealed a somewhat complicated relationship.

(iii.) The influence of the mother's age on the child's chance of survival at each stage in the family.

Figure 3 (page 33) shows the change in mortality rates with age of mother when the birth orders are considered separately.

First pregnancies. These form nearly 30% of the total, and the cases in which age and parity are known number 4,581. The numbers in each group are indicated at the top of each column.

The most important changes with maternal age are :—

1. The very high total death-rate up to five years of age in children born to mothers under 20, or over 35 (176/1000 and 178/1000 respectively).
2. The steady increase in the still-birth rate from the low figure of 26/1000 in the under 20 group to the high figure of 69/1000 in the over 30 group.
3. The very high infant mortality rate composed of a high neo-natal rate and a high rate between 1 and 12 months, in the under 20 group.
4. The extremely high still-birth and neo-natal death-rate in the over 35 group.
5. The reduction in post-natal death-rates, particularly after the neo-natal period, *between* 20 *and* 35, so that the steady increase in the still-birth rate is compensated for, and the total death-rate *remains approximately constant*, about the relatively low rate of 130/1000.

Second and third pregnancies. Second pregnancies in mothers of known age number 3,076, and third pregnancies 2,200.

The following facts are to be noted :—

1. Among the small group of 50 'second' children born to mothers under 20, there is a low still-birth rate, with an extremely high infant death-rate, which, like the infant death-rate in first children of the under 20 group, is high both in the neo-natal period and in the 1 month to 1 year stage.

THE INFLUENCE OF MATERNAL AGE ON THE CHILD'S CHANCE OF SURVIVAL AT EACH STAGE OF THE FAMILY.

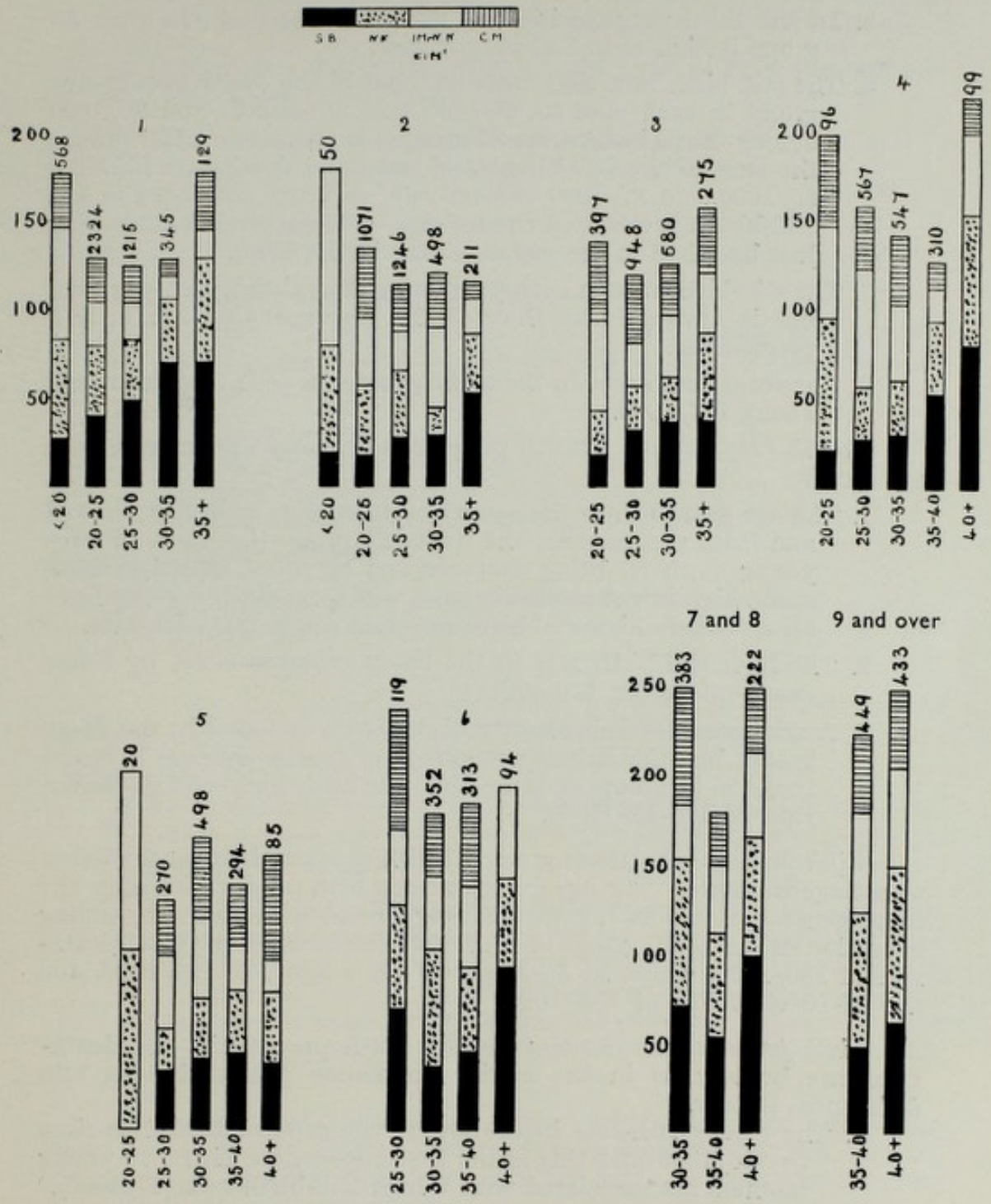

Fig. 3. Abscissae :—Maternal ages. Ordinates :—Death-rates per 100 pregnancies. The figures above each column give the numbers in each group. The columns are in groups numbered to correspond with the place in family from first to sixth children. The final two groups are seventh and eighth children and ninth and later children respectively.

2. In both second and third pregnancies there is a fairly high total death-rate in the 20-25 group, followed by a lower one in the 25-30 group.
3. In the third pregnancies, but not in the second, the over 35 group is high as in first pregnancies.
4. The still-birth rate rises from 20/1000 in the under twenty-five group in each case to 52/1000 among seconds and 36/1000 among thirds in the over 35 group. In these two latter groups the sum of the still-births and neo-natal deaths are however 85/1000 and 87/1000 respectively, and the difference in the still-births is clearly a chance one—a few more infants having just breathed in the one case than in the other.
5. The still-birth rate in each pregnancy class rises with age group, but is always lower than at the corresponding age in first pregnancies.
6. The total death-rate in the 25-35 groups in each case lies round about 117/1000.

Fourth pregnancies. Fourth pregnancies among women of known age number 1,619.

1. The age groups show the same characteristics as in first, second and third pregnancies, the under 25 group (*i.e.* those of very young mothers) being characterised by a low still-birth rate, and a high infant mortality rate, while the over 40 group have an extremely high still-birth rate and neo-natal death-rate.
2. The high still-birth rate in the 35-40 group is offset by a low death-rate after 1 month.
3. A minimum total death rate of *125/1000* is found in the *35-40* group, but the largest proportion of fourth children is found in the 25-35 group, and they show the fairly high total mortality rate of 140-158/1000.

Fifth pregnancies. There are 1,167 fifth pregnancies among women whose age is known. The age groups among fifth pregnancies show the same general trends as the earlier pregnancies with the outstanding exception of the 25-30 group which has the extremely low total death-rate of 130/1000, while the 30-35 group has a figure of 160/1000, and the 35-40 class one of 136/1000.

Sixth pregnancies. Among the 881 sixth pregnancies the death-rates are broadly as in the earlier pregnancy classes, but certain differences appear.

1. The total death-rate in the lowest age group (25-30) has risen to 235/1000 and this is the first case where births to young mothers are associated with a high still-birth rate (67/1000).
2. The still-birth rate first falls and then rises with age, but at its best is still relatively high—37/1000.
3. The total death-rate in the best group (30-35) has risen to 176/1000. Clearly there is here a very marked upward bend in the death-rate curve, particularly as noted by Campbell (*ibid*) in the still-birth curve.

Seventh and eighth pregnancies. The 1,091 seventh and eighth pregnancies are considered together. The most noticeable features are

1. High death-rates at all stages (*i.e.* High S.B., NN, IM[1] and CM) which indicates a low chance of survival at each stage.

2. A drop and then a rise with maternal age in the still-birth and neo-natal death rate.

3. The minimum total death-rate is in the 35-40 group and is 180/1000, rising in the others to 250/1000.

All later pregnancies. There are 882 later pregnancies in women of known age. These are considered in the two groups under and over 40.

The following facts may be noted :—

1. The total death-rate for the under forty group is 222/1000 and for the over forty group 248/1000. Most of this difference lies in the still-birth rate.

2. The total figures show no increase on those for seventh and eighth pregnancies, and the still-birth rates are actually lower. A probable explanation of this somewhat unexpected fact will be found when the question of abortions is discussed.

Summary.

1. At all stages of the family, still-births are associated with the greater age of the mother. *This is most marked in first pregnancies.*

2. Where the mother is very young for any size of family up to about 5, the children have a low still-birth rate and an extremely high infant death-rate.

3. Total death-rate up to five years increases markedly after the fifth pregnancy, and here a high still-birth rate begins to appear in the children of young mothers.

4. At each size of family there is a maternal age which gives children with the greatest chance of survival. *First, second and third children born to mothers between* 20 *and* 35 *and fourth to fifth children of mothers between* 35 *and* 40 *have a total death-rate up to five years of age which compares very favourably with that of the country as a whole* (*about* 130/1000) *despite the poverty of the area.*

5. The high total death-rate in the children born to *very* young mothers at all stages of the family suggests that not only the age of initial child-birth, but the rate of subsequent breeding is of great importance.

6. In the large families, the influence of increasing age and parity of the mother is probably cumulative, and gives the very high total death-rate found both in this investigation and by Campbell (*ibid*). In these families still-birth rate, infant and child death-rates are all increased.

(iv.) Is the high death-rate among the children of very young mothers a biological or social phenomenon ?

Shortly after the last war the Registrar-General published an analysis of figures relating to the chance of survival of legitimate children born to parents married at varying ages (from figures collected in 1911). He noted an excessive mortality rate among children born to mothers married before 20. He concluded that this was a *social* phenomenon related to the poor mothercraft of women of this age. His results will be discussed at much greater length in connection with the information derived in this investigation from the previous children in the families studied, information with which his results are more comparable, but the extreme frequency with which the predominantly social factor of illegitimacy occurred among children of mothers under 20 led to the analysis of the influence of this factor on the child's chance of life—to the question in fact whether illegitimacy was largely responsible for the high death-rate found in the under 20 group. Table VI shows that for first children of mothers under 20, among both legitimate and illegitimate children alike, the death-rate falls as the mother's age rises. The total death-rate among illegitimate children in this age group (191/1000) is actually slightly higher than that for all children (176/1000) but this is due to the fact that 26 out of the 29 children of mothers under 17 were illegitimate and the death-rate among the children of these very young mothers is excessive (270/1000).

That this high death-rate is a biological rather than a purely social phenomenon seems to be supported by the following facts—

1. The still-birth rate in children of the under 20 group (first children) is 26/1000, and for the illegitimates of the group 28/1000. This is extremely low for first children. If the high total mortality were due to deliberate or accidental neglect, to attempted abortion, etc., it would have been expected that the still-birth rate would be high.

2. While it may be agreed that the social circumstances of the very young unmarried mother may not be markedly worse than those of the very young wife, so that the high mortality rate in the children of both might be explained by poverty and ignorance of mothercraft, yet it would seem certain that the social circumstances of the married woman of 20-25, would be generally better than that of the unmarried mother of the same age. Actually a large proportion of the illegitimate children of very young mothers are either born and reared in institutions, or are simply tacked on to the families of their grandmothers, and receive the care of someone much experienced in child-rearing. The older unmarried mother usually belongs to a family of which the members are already too old for her child to be naturally absorbed into their number. Yet the difference in mortality rate of all children between the two age groups under 20 and 20-25 is 176/1000 and 129/1000, while among illegitimates it is 191/1000 and 144/1000. As will be seen in the discussion on the influence of social factors generally, the death-rate among the legitimate children of miners, where mothers bear their first child at 20-25, is 145/1000, which compares very closely with the 144/1000 among the illegitimates in the same biological group. (This must not be taken to indicate that illegitimacy is commoner among

the mining section for which there is no evidence, but merely that this group of *illegitimate* children compares favourably with the *legitimate* children of the largest single social class in the County).

3. Table II shows that the death-rate among *young* married women is higher than that of *young* single women. This would seem to be probably associated with the strain of child-birth. (Page 75).

From Table VI it would seem that the reduction in total mortality among first children with increasing maternal age ends at about the age of 19-20 years, *i.e* at about the time at which the mother is approaching skeletal maturity. It seems possible that the drain on the salts of the maternal skeleton which has been found to occur in pregnancy and lactation in animals, [Sherman and MacLeod, 1925] and in women, even under excellent dietary conditions (Macy et al 1930) may prove excessive in the case of young mothers in whom skeletal growth is still occurring, thus diminishing the chances of health in mother and offspring. The relatively low still-birth rate in the group suggests however that this skeletal immaturity may be favourable rather than otherwise to parturition. The steady rise of the still-birth rate with age, which is most marked in first births, suggests that the fully developed body may respond less and less satisfactorily to the changes needed for parturition. Theiler [1934] in reviewing bone lesions in domesticated animals points out that since sexual maturity occurs considerably before skeletal maturity is reached, and since in the lower animals sexual maturity is usually followed fairly quickly by the reproductive cycle, the immature female is usually subjected to the dual strain involved in the growth of her own skeleton, and that of her offspring. Though the postponement of the reproductive cycle in the human would seem to be on the whole advantageous to the offspring, it raises its own particular problems. (Table VI., page 78).

Table VII summarises the position in relation to the effect of advancing maternal age in different birth orders. In this area few women bear their earlier children after they are 35. This inevitably decreases the significance of the differences noted, but the figures indicate a rise in total mortality in first children in the 35 + group: (from 127/1000 in the 30-35 group to 178/1000 in the 35 + group.) The rise at 35 + does not occur in 2nd, 3rd and 4th children because the rise in still-births is so slight, but after 40, total death-rate rises to 208/1000. In fifth and sixth children no change in total death rate occurs beyond 30 years of age, while among seventh and eighth children, there is a drop between the 30-35 and the 35-40 group followed by a rise. It is probable that among seventh and later children parity is of more importance than age, and that at all maternal ages the survival chance of the offspring is low.

(v.) The influence of the age of intitial child-birth and of the rate of breeding on the child's chance of survival.

In order to determine the significance of the drop in total death-rate which fig. 3 indicates as occurring after the early births in each parity group (*i.e.* after births to women who have started to reproduce very early or have reproduced very rapidly) the following observations and

analyses have been made. From Table VIII it may be seen that for each birth order there is a quinquennium in which most births take place. This modal quinquennium occurs later and later as birth order increases. If the first to sixth births are considered (thereby excluding the groups in which parity is clearly dominant), then the births may be divided into four groups :—

(*a*) All those occurring before the modal group.
(*b*) The 'modal' group.
(*c*) The next quinquennial group.
(*d*) Those occurring after (*c*).

From Table IX. (page 79) it may be noted that—

1. The total mortality rates for the 14,433 children among first to sixth births is 11/1000 below that of the 16,500 of known parity. This difference lies mainly in the infant death rate.
2. The total mortality for group (*a*), those born to young mothers, is 19/1000 above that of the two succeeding groups.
3. The infant mortality and child mortality rates in group (*a*) are together 30/1000 above those of group (*b*), but a rise in the still-birth rate among the latter offsets some of this decrease.
4. Groups (*b*) and (*c*) have closely similar total death-rates, but an increase in the still-birth rate with age is compensated for by a decline in the later rates.
5. In group (*d*) the children of relatively old women, the total mortality rises again, mainly due to the increase in still-births.
6. The still-birth rate in the children of young women (*a*) is roughly 33% below the average while in those of old women (*d*) it is roughly 60% above the average.

Group a' is also shown on Table IX. This group is (*a*) minus the 2nd children born to mothers between 20 and 25, since there were almost as many 2nd children born in this quinquennium as between 25 and 30, and these 2nd children in the 20-25 group (group x on the table) have a total death rate closely similar to group b. Group a' which contains all the children born to women who are really *very* young to have had the number of children recorded, has the very high total death rate of 163·7/1000. It is thus clear that the age of initial reproduction and the rate of subsequent breeding are factors of great importance.

(vi.) Is a high death-rate at one stage followed by a lower rate at a later stage ?

Most inquiries into this question have tended to reply in the affirmative, but a closer study shows that it cannot be answered simply.

Fig. 2 shows group S, the unvisited middle-class children born in the area in 1930 and 1931. Children born in two successive years are included here because they only numbered 939, and it seems that nothing of value can be deduced from the 474 of this class born in 1930. The groups for the two years give very similar figures, and may safely be considered together. (Fig. 2, page 30).

Fig. 2 also shows group T, all the children born in the area in 1930 other than group S, and the small group of institutional children numbering about 75.

The still-birth rates for S and T at 39·4/1000 and 38·8/1000 are practically identical, but the neo-natal rates at 23/1000 and 41/1000, the rates from one month to twelve at 10·7/1000 and 35·8/1000, and the child death-rates from one to five years at 13·8/1000 and 31·6/1000 show a steady and very great advantage to the socially more fortunately placed. The *low* death-rate at all stages of the first year in the *middle-class* is *not* followed by a compensatory increase in deaths from 1 to 5 years. It is necessary to assume that once the specific dangers of birth are surmounted, the greater care and attention available to the middle-class child greatly increases his chance of survival at all ages. (The figures showing the difference in different classes for infant mortality from birth to one year, are entirely in agreement with those of the Registrar General in his Special Reports of 1911, 1921 and 1931 (Table XXII., Part II., page 140).

Now first, second and third children constitute 92% of the middle-class group, but only 66% of the others. The former group can therefore be more fairly compared with first, second and third children of the latter group. Then we have the following comparison, putting the middle-class group first in each case SB, 39·4, 35·4 ; NN 23·4, 35·0 ; IM' 10·7, 30·2 ; CM 13·8, 27·9 ; all expressed per 1000 total births. The probable reason for the high still-birth rate in the middle-class group will be discussed when the whole influence of social class is considered. (Part II., page 101).

It is, however, here seen that in the three good biological groups (first, second and third children) death-rates at all ages compare favourably with those of all the biological groups in the area, though even these three good groups are not as fortunate as the group of middle-class children.

If however the first, second and third children of the larger group are compared with each other, then Fig. 2 and Table IV show that *there is a definite tendency for the high still-birth and neo-natal rate in first children, (i.e. deaths round about birth) to be offset by a lowered death-rate between one month and five years.* (Table IV., page 76).

The lower figures for deaths around birth in second and third children are followed by higher death-rates between one month and five years, so that the total figure in each of the three groups is about the same. Fourth and fifth children show a death-rate above the first three, but are very similar to each other, in the fourth the relatively low SB + NN rate being followed by a higher rate between one month and five years. After the third child, the death-rate around birth (SB + NN) increases steadily and rapidly, except in the case of the ninth children where a low early rate (compared with the eighth and tenth children) is followed by a very high later rate. The increase in the (IM' + CM) rates (death-rates between one month and five years) with the parity of the mother is much more erratic than is the increase in the earlier rate-death, but it is quite definite, and from about the ninth child onwards is very marked. (Table IV). *Here it is obvious that there are poor biological groups, which despite a heavy weeding-out*

in the early stages of life still show a very high death-rate in the later stages. It seems possible that these groups will have a high death-rate at all stages of life, because of inherent physical weaknesses.

If first children in Fig. 3 are studied, it is clear that in the *good biological groups* (those born to mothers between twenty and thirty-five) there *is again a compensatory reduction in the later death-rates* in the groups which have *high* early death-rates. When however the *bad biological groups* are considered, *i.e.* the children of mothers under twenty or over thirty-five, this *compensation does not appear.* The children of the very young mothers are characterised by an enormously high death-rate from birth to one year, but the death-rate between one year and five is also high. The children of the women over thirty-five have an excessive death-rate around birth, without this being subsequently offset by a lowered death-rate between one month and five years.

Summarising, it may be said that in groups (*b*) and (*c*) (Table IX), which are found in families not exceeding six, and in which the rate of breeding has been reasonably controlled, a high death-rate at an early stage will be followed by a lower rate subsequently and vice versa. On the other hand, group (*a*) the children of young mothers, with the excessively high infant death-rate of 89/1000 has the highest child death-rate (38/1000) of all four groups, while group (*d*) the children of old mothers, with the high still-birth rate of 58/1000 has a subsequent death-rate of 88/1000 which is not appreciably lower than the 92/1000 of the group (*c*), which has a still-birth rate of only 40/1000.

In families of more than six it would seem probable that most of the later born children fall into the groups with high death-rates at all stages.

It is clear therefore that the death-rates of children at various ages are influenced both by social and biological factors. The 16,500 children which formed the major group in which the place in family is known, all belonged to the class generally covered by compulsory health insurance. Some few independent workers such as shop-keepers were not in fact insured, but from housing accommodation and other social factors it is evident that at least 99% of the families fell broadly into this social group. Among these children are obviously some groups with inherent weaknesses which show themselves in high death-rates at all stages. These children are found among the later children in all large families, and in the rapidly bred children of small families. It is not clear whether this means that rapid or prolonged breeding is in itself harmful, or whether under existing social conditions, only people of poor biological stock breed rapidly, and produce large families. It is nevertheless evident from the records that it is precisely those children in large and/or rapidly bred families who need and in the main receive the greatest attention from the social services. Yet despite the care lavished on them, they remain relatively poor stock—individuals likely to need constant care and attention throughout life. *There are, however, between* 10,000 *and* 11,000 *children* (*groups b, c, and x, Table IX*) *of absolutely the same social class, who are born in an area which has suffered severe economic depression for over ten years, and who show a total death-rate up to five years of age of* 130/1000, *which compares very favourably*

with the figure of about 125/1000 *for England and Wales which can be deduced from the Registrar-General's figures of the same period.* Whether these children die ante-natally, intra-natally, neo-natally or at a later period depends mainly on the mother's age, but occasionally other chance factors operate. *In these groups a high death-rate at any stage is followed by a lower death-rate later and vice-versa.* It would seem that among them are a certain proportion of individuals, who are unfit to stand the strains of the life they have to lead, and if carefully nursed through the neo-natal period will merely succumb later. **In the case of first children, birth itself is the dangerous period, but in second and third children where intra-natal dangers are fewer, later death-rates rise. It would thus seem uncertain whether mere improvement in obstetric manipulative technique would have any great value in increasing the child's chance of survival, unless improved conditions at later stages can be guaranteed to the weaker ones who survive birth.**

In the middle-class group, intra-natal difficulties appear to be as great a danger as in the less fortunately placed, *but the skill and care available to halve the neo-natal death-rate is also equally successful in greatly reducing the death-rate between one month and five years.* Thus there are three groups, those with high death-rates at all ages in the period examined, those where high death-rates follow low ones and vice-versa, and those who have low death-rates at all stages (subsequent to birth).

From the Registrar-General's special report on death-rates in relation to occupation [1931] it may be deduced that those occupational groups which show a very low infant mortality, also show a fairly low mortality rate among adults, (*i.e.* broadly the middle and upper class groups) and in general it may be assumed that the class of the child will not differ markedly from that of his father when the latter was young. Hence it must either be concluded that the standard of biological stock rises with social class, or that at any rate up to middle years, the greater protection afforded to the middle and upper classes enables them to maintain a low death-rate. *The social problem would appear to present itself as how to give to the* 11,000 *the knowledge, care, skill and necessary material advantages of the* 474. *The remaining* 5,000 *are a quite separate problem.*

(vii.) Is the increasing rate of still-births with the increasing age of mother associated with increase in the birth weight of the child?

First children only are considered, to eliminate any possible influence of parity. From Table X it may be seen that there is a slow steady rise in average birth-weight with the age of the mother, and that the proportion of children whose birth-weight is 9 lbs. or over also increases steadily. There is, however, enormous variation within the groups, and the differences cannot be accepted as statistically proved, although the change with age is consistent. Moreover, these weights are only for *live* births, and the possibility of some association between still-births and monster births cannot be excluded. In general, it may be concluded that an association between still-birth rate and birth weight is indicated but cannot be stated to be proved. (Table X., page 80).

(viii.) The history of the previous pregnancies in the 16,500 families.

The information given in relation to the previous pregnancies in the 16,500 families was next considered to see how far it confirmed the conclusions drawn from the history of the children born in 1930.

This information comprised :—

(1) The number of previous children alive in 1930.

(2) The number of previous children already dead before the birth of the 1930 child.

(3) The number of previous children who had been still-born.

(4) The number of pregnancies which had resulted in miscarriages.

The statement about dead or still-born children or miscarriages did not give any clue as to their place in the family. Moreover deaths could not be presumed to be infant deaths (under 1 year) nor in the larger families child deaths (under 5 years as here defined).

Previous pregnancies in the families of the second children of the original investigation must clearly all refer to first pregnancies, but in the larger families are 50 : 50 first and second, 33 : 33 : 33 : first, second, and third, etc.

The records were therefore analysed to see how far they agreed with first pregnancies, and then with the suitable combination of pregnancies as found in the 16,500 group. Among the latter of course were no miscarriages, since these are not reported, and are *only recorded at all where a later pregnancy goes to full term*, and the mother informs the health visitor of the earlier miscarriage, under the heading of previous pregnancy.

Table XI sets out the still-birth rate, the death-rate and the miscarriage rate per 1,000 of the previous pregnancies in the different groups. (Page 80).

In counting up still-births, deaths and miscarriages in previous children, care was taken not to count them twice in the case of twins, since it was found that multiple births are associated with a very high death-rate, and that they tend to recur in families. The total number of previous children was however calculated from total numbers in each birth order by multiplying by the appropriate factor, *e.g.* the 2359 third children were calculated to belong to families in which there had been 4718 previous pregnancies. Actually about 1·5% of the births were twin births, and therefore this figure would be about 1·5% too high. Since however there were about 1-2% twin conceptions in the previous pregnancies, the number of 'previous pregnancies' calculated in this way does not differ from the true figure by as much as 1%—a difference which does not affect the validity of the conclusions drawn.

The study of the 16,500 children born in 1930 in the area investigated, has shown that during the period 1930-1935, out of 1,000 children born, 148 failed to reach the age of five. From the death rate in 1931 of those between five and twenty, it would seem that a further 30/1000 die before reaching twenty. If the death-rates for those between 5 and 20 in 1921 are taken, then a further 40/1000 would die before attaining the age of twenty. In Table XI, column TM[1] indicates the number of children expected to die before reaching five, in families of

one child, a first and second child, first, second and third child, etc., calculating the death-rates from those found among the 16,500. If it is assumed that the death-rate beyond five does not vary with the serial order of the child, then the addition of a further 30-40/1000 to the figures under TM' would give the total expected death-rate among these children up to the age of twenty.

Table XI indicates the following facts :—

1. The average still-birth rate among the previous children at 31/1000 is considerably less than the 39·8/1000 among the 16,500 children, and that this is not merely due to the inclusion among the 'previous children' of miscarriages numbering 25/1000. This difference is most marked between the first children who appeared as 'previous children' in the families in which second children were born in 1930, and the first children of the 1930 group itself, the comparative figures being 31·4/1000 and 43·2/1000. Since first children form approximately 30% of all births in the 16,500 and seconds only 20%, it would seem that in this area only 66% of the people who have first children proceed to a second. The highest still-birth rate is found in the children of older women, (*e.g.* in first children in women over 30). If, as is probable, younger women are more likely than older ones to have further children, then the still-birth rate among the first children of two or more would be lower than among all first children. Since moreover an increase in the still-birth rate with age of mother is found in all births, the same argument holds throughout the series.
2. The still-birth rate rises more erratically with increase in size of family than it increases with serial birth order.
3. The total death-rate (still-births + deaths) at 183/1000 lies within the range 178/1000—188/1000 which has been calculated above to represent the total death-rate in this area up to twenty years of age although only very few of the older members of the largest families could possibly have reached that age.
4. The death-rate (exclusive of still-births) among the 3,305 first children in the families in which the second was born in 1930 is 83/1000. This is roughly what would be expected on the basis of an infant mortality 66/1000, and child mortality 23/1000 which has been found for first children, on the assumption that all the 'previous' children had reached the age of four years. If this were not so, then it would be necessary to assume that the rate among 'previous' first children was higher than among all first children.
5. From column TM' which represents the expected death-rates up to 5 years in the different groups (*i.e.* still-births and deaths between 0 and 5 years), it may be seen that the total deaths among 'previous' children in families where the third or fourth child was born in 1930, is much greater than the expected figure if they had all reached five years of age. *In all larger families the total death-rate equals or exceeds that expected if they had all reached twenty years of age.*

Clearly therefore subsequent children tend to be born into families in which the death-rate among the earlier children has been high for

their place in the family. In the smaller families this is possibly a result of deliberate action, *i.e.* where a second child, or one of another sex is desired, the death of one of the first two children may well be followed by a birth which would not have occurred had the other child lived. On general social and biological grounds however, it is improbable that this reasoning is adequate to explain the high mortality rate among 'previous' children in the larger families. The question which seems to be posed is this :—

(ix.) Is the death-rate among children in large families high at all stages, and not merely at later stages ?

This problem must be considered from two points of view. (1) It has already been shewn in the investigation of the 16,500, that children born to too young mothers (*i.e.* to immature mothers or those over-strained by rapid pregnancies) have an extremely high death-rate. It may be true that among the larger families there is a large enough proportion whose earlier children fall into these groups to give the relatively high rate found throughout the large families and indicated in Table XI., page 80.

(2) It may merely be possible that at the time when the earlier children of these large families were born, the average death-rate of children at *that stage of family* was higher than in 1931.

i.e., It may be contended that either :—

(*a*) The death-rate at different stages of family has always differed greatly and that the fall in infant mortality has been largely due to a decrease in the size of family. If this were true it would be necessary to conclude that *the earlier children of large families have a higher death-rate than the earlier children of small families.*

or (*b*) There has been a real and rapid decline in the death-rate at each stage of family, which has augmented the fall in infant death-rate due to decrease in size of family.

Light is thrown on this subject by the results of this investigation, and by the Special Report, already referred to, of the Registrar-General [1911]. From Fig. 4 it may be noted that there is an enormous difference in the previous children's chance of survival at any size of family, according to the age of the mother. In families where the second pregnancy occurs in 1930, and the mother is 20-25, (the under 20 group is too small for significance), the total death-rate in the previous pregnancies (deaths + still-births + miscarriages) is 155/1000, but it is only 100/1000 when the mother is 25-30. The still-birth rate rises among these earlier first pregnancies with the age of the mother as would be expected. Again, 397 women under 25 years of age had their third pregnancy in 1930, and the 794 previous pregnancies show a miscarriage rate of 14/1000 and a still-birth + death rate of 205/1000. The similar figures for the 1896 previous pregnancies of women aged 25-30 years are 8/1000 and 127/1000. (Fig. 4, pages 49 and 50).

Other comparisons are seen on Table XII. (page 81).

Now while it is true that in some large families which are more carefully spread out, some of the older children may be earning before the younger ones are born, nevertheless the fact that the more slowly bred families rear more of their children must involve a greater domestic expenditure, which will in general offset any increase in income due to the employment of adolescent members of the family. It is difficult therefore to see how the families which are slowly bred can be significantly better off socially than the quickly bred ones, when it is remembered that in this investigation 97% of the large families are found among manual workers. The conclusion seems inevitable that the difference is primarily due to biological causes, and that the rate of breeding is one of the most important factors in determining the child's chance of survival, and in large families is the dominant factor. This is entirely borne out by the Registrar-General's Special Report of the investigation made in 1911, and published after the war. In the 1911 census, a special questionnaire was included in which all married women mentioned on the schedules were asked to state the number of completed years their marriage had lasted, the total number of children born alive, the total number still living and the total number who had died. 6,630,284 married women replied to this. In 493,697 cases the husband and wife were not included on the same schedule, and as the investigation primarily related to the fertility of marriage, these records were not included in the analyses. A further 122,000 were rejected because they gave conflicting or inadequate replies. Analysis was thus finally made of about 90% of the original replies. This report gives information as to the probable infant death-rate at different stages of the family at earlier periods. In it the death-rate per 1000 *live* births is found according to

(1) The age of the mother at the time of her marriage.

(2) The duration of the marriage in five-year periods.

(3) The number of children born alive during the given period. From it the following deductions may be made :—

1. Death-rate per 1000 live children according to size of family and duration of marriage.

At every duration of marriage (hereafter DM) there is an increase in death rate with size of family—in the words of the report itself *"rates being generally* 3 *to* 5 *times as high for the largest as for the smallest."*

The following are typical examples : where the marriages have lasted less than 5 years, and only one live child has been born per marriage, the death-rate among the children is 62/1000 ; where three have been born the figure rises to 172/1000. In the 5-10 year D.M. 'only' children have a death-rate of 70/1000, while where 9 have been born per family, the figure rises to 304/1000. In the 15-20 year D.M. group, the following death-rates appear : in families of one 109/1000, of 6, 187/1000, and 16 or more 499/1000.

In appendix 2 is reproduced (by permission of the Controller of H.M. Stationery Office) the whole table showing the death-rate in different sizes of family at different marriage durations.

These figures entirely support the conclusion from the Durham investigation that there is an *excessive death-rate in larger families.*

2. Death-rate per 1000 live children according to rate of breeding.

Where families of the same size are compared at different marriage durations, it is seen that there are two factors at work, as pointed out by the author of the 1911 report. In families of one child, the death-rate per 1000 increases slowly but steadily with marriage duration from 62/1000 where the marriage has lasted less than five years to 268/1000 where it has lasted 50-60 years. Here the death-rate is simply determined by the longer exposure of the individual to chance of death, the members of the first group being children under 4 years of age, while most of those in the latter group are over fifty. But in all larger sizes of family a second factor enters, *i.e. rate of breeding*, and while families of two, born before the marriage has lasted five years, show a death-rate of 106/1000, the figure for this size of family and marriage duration 5-10 years falls to 94/1000 and thereafter rises with longer times of exposure to 299/1000 at 50-60 years. In families of 12, the maximum death-rate is found in the D.M. group 10-15 years, and is 450/1000, the minimum, 288/1000 is found in the 25-30 D.M. group, and then again the figure rises to 354/1000 after 50-60 years.

This again completely confirms the conclusions from the Durham investigation as to the importance not only of size of family but of *rapidity of breeding.* The 1911 report sums up the influence of this factor in the following words: "For all families of 11 children and upwards, mortality decreases with increasing duration of marriage up to 25-30 years; and for families of 2-10 children the duration of lowest mortality is as follows: 2 or 3 children, 5-10 years; 4-5 children, 10-15 years; 6-7 children, 15-20 years; 8-10 children, 20-25 years. Generally speaking it appears that if the mean interval between births is less than 2½-3 years, mortality is increased to such an extent that the loss implied more than counterbalances the advantage of shorter exposure to risk."

In the Durham investigation, only those women were included who bore a child in 1930, and those who had been married 25 years or more would practically not appear, since they would in the main have ceased to bear children, A simple and direct comparison between the Durham figures and those of the Registrar-General is not possible for two reasons.

(1) The Durham figures for measuring the importance of rate of breeding are expressed on *total previous pregnancies* while the Registrar-General's are only on live births. It may be seen that of the 630 previous pregnancies among women having their 11th pregnancy in 1930 in County Durham, in the under 40 age group, only 554 live children had been born in the 63 families, giving an average of 8·7 live children per family, while in the over 40 group, still-births and miscarriages were proportionately fewer, and 10 previous pregnancies had on the average given 9·7 live births per family. The similar figures for live births per family for 12th and 13th pregnancies taken together were 9·6 in the under 40 group and 11·5 in the over 40 group. Thus complete reclassification would be necessary for a simple comparison.

Some comparison can and will however be made when the second difficulty has been considered.

(2) The age of the Durham mothers at marriage is not known, and hence the duration of marriage can only be estimated roughly. But the age of the mother at marriage proves to be in itself a very important factor, and again the Registrar-General's Report lends general confirmation to the Durham figures. Table XIII shows the death-rate (taken from the Registrar-General's Report) among children according to

(*a*) Marriage age of mother (M.A.)

(*b*) Number of children born alive.

(*c*) Marriage duration (D.M.)

The most striking facts to be noted from this are :—

(1) The very high relative death-rate among children of women married between 15-20, in all small families, *e.g.* the death-rate among first children born to these women in the 0-5, 5-10, DM. groups are 84/1000 and 90/1000 respectively. The similar figures for first children of women marrying at 25-30 are 52 and 63. These differences are of the same kind as those found in Durham where the infant death-rate in legitimate first children of women under 20 was 110/1000, and of women between 25 and 30 years 54/1000.

(2) Even in marriages of as long duration as 25-30 years, there is a difference in the death-rates in families of 2 and 3, according to the age at which the mother married, the high figures being found in the children of those marrying very young or very old. This difference has disappeared at this period of marriage in first children.

(3) In families of 10, 11, and 12, in which the marriage has lasted 25-30 years, the death-rate is *lowest* among the children of women married at 15-20, and rises steadily with the age of the mother at marriage. The author of the report explains this as the effect of rapidity of breeding. Women marrying at or over 20 will in general only have about 25 years of fertility ahead. The production of 10, 11 or 12 live children in this period would necessitate a rate of breeding above the 1 in 2·5 or 3 years that he has demonstrated as the optimal rate. Such rapid breeding in these groups has more than offset the initial disadvantages of the earlier children of the very young mothers.

(4) While in marriages of 5-10 years duration there is a great difference between the death-rates of the children of women marrying at 15-20 and those marrying at 20-25, or 25-30, in families of 7, 8, and 9, where the marriage has lasted 25-30 years, this difference has disappeared. Now in families of 7, 8, and 9 born to women married at 25 or later, the argument applied above to families of 10, 11 and 12 would begin to hold, and some rise in death-rate in families of 8 or 9 is to be noted in this group, possibly because of increased rate of breeding. Families of this size born to mothers of 20-25 would not however seriously exceed the optimal rate of breeding. On the disappearance at this stage, of the difference between the deaths of children born to mothers married at 15-20 and those married later, the author of the report bases his opinion *that the high death-rate in children of the very*

young mothers is not a biological phenomenon but a social one, and is due to deficiencies in 'mothercraft' in the very young women. He points out that in small families there is also a drop in death-rate between the children of women married at 20-25, and of those married at 25-30 which he attributes to the greater skill of the latter. When however these women have been married 25-30 years, the maternal technique of the women who married early will have improved to the level of that of the later married groups, and hence the convergence of the death-rates at this stage. This 'social' explanation of the high death-rate in the children of very young mothers does not however commend itself to the present writer. In the Durham figures, which show still-births, the drop in infant death-rates between the first children born to women between 20-25 years, and those to women of 25-30, is almost offset by an increase in still-births. In later children, figures for the 25-30 maternal age group are frequently slightly below those for the 20-25 age group, but over-rapidity of breeding is quite enough to explain this.

It seems extremely unlikely that the convergent figures for the death-rates in families of 7, 8, and 9 after 25-30 years of marriage, irrespective of the marriage age of the mother, is to be explained on the basis of the incompetence of the young mother. Families of 7, 8, and 9 must, in their early stages, have shown the characteristics of fairly rapidly-bred small families, and it has been indicated that in small families the death-rate among the children of very young mothers is always markedly higher than those of older women. If therefore in families of 7 or 8, after 25 years of marriage, the death-rates in these families are *equal*, irrespective of mothers' marriage age, it is clear that the death-rate in the *later* children of women who married under 20 must have been as much *below* the death-rate of the later children of women who married at over 20, as the death-rate of the earlier children of the young women exceeded that of the earlier children of the older group. It is credible that the later children of late marriages should have a high death-rate, either because the mothers are older (Table V) or because rapid breeding has been necessary to produce seven or more children before the menopause. That the standard of mothercraft of the earlier married women should ultimately exceed that of the later married women by as much as it had previously been deficient seems frankly improbable. The evidence that the immature woman is biologically unfitted for the strains of reproduction has already been adduced, and it seems that the figures in the report here discussed may safely be taken to support that thesis. The importance of biological versus social factors can however never adequately be discussed without consideration of the still-birth rate and, where possible, the natural abortion rate.

CHAPTER IV.

COMPARISON BETWEEN THE DURHAM [1931] FIGURES AND THE FIGURES FOR ENGLAND AND WALES [1911].

DEATH AND MISCARRIAGE RATES AMONG PREVIOUS PREGNANCIES, ACCORDING TO STAGE OF FAMILY AND MATERNAL AGE.

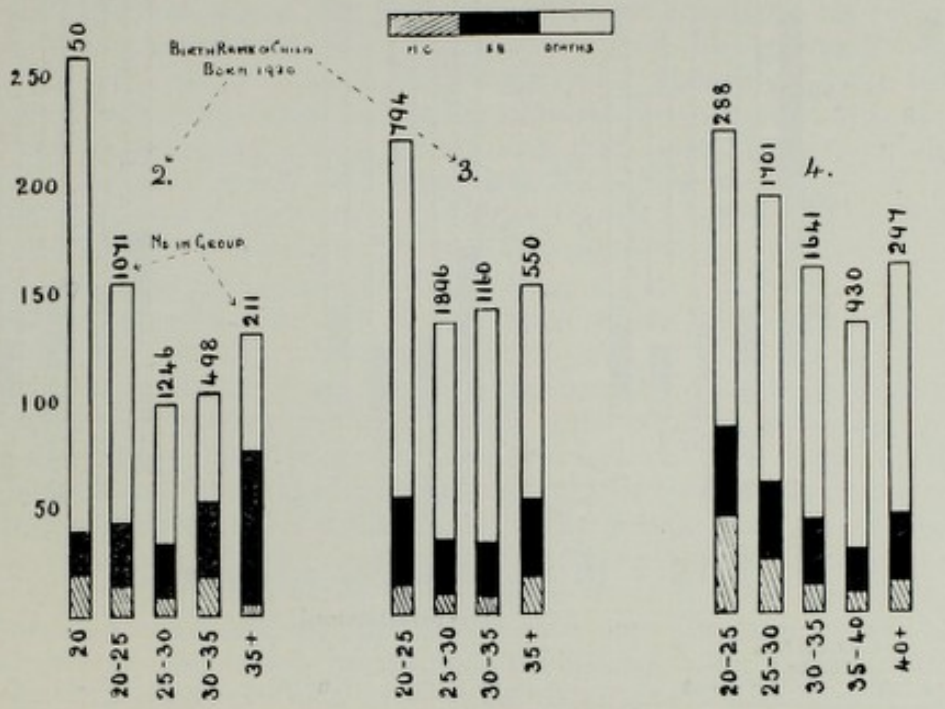

Fig. 4. (a) 2nd, 3rd and 4th pregnancies.

As already pointed out, comparison between the figures of the Registrar-General's Special Report [1911] and the results of the present investigation is difficult, because each investigation gives some information not found in the other. Moreover the social conditions, birth-rate, etc., differed in the two areas as will be considered later. Calculations have however been made along the following lines.

In Fig. 4 (b) is shown the miscarriage rate, still-birth rate and death-rate in the previous pregnancies where the mother had her sixth pregnancy in 1930, and the groups are arranged according to the age of the mother in that year. The 595 pregnancies in 119 families found in the group where the mother's age is 25-30 have produced 548 living children, *i.e.* an average of 4·6 per family. The 1,760 pregnancies in 352 families found in the 30-35 year group have produced 1,694 living children, *i.e.* 4·8 per family. If the former group is first considered, it is seen that among the children born alive, the death-rate per 1000, before the mother's sixth pregnancy is terminated, is 201/1000. Since about 95% of these sixth pregnancies resulted in living offspring, it is clear that this group should be compared with the Registrar-General's figures for families of 5 to 6. But after the birth of the last child (in

DEATH AND MISCARRIAGE RATES AMONG PREVIOUS PREGNANCIES, ACCORDING TO STAGE OF FAMILY AND MATERNAL AGE.

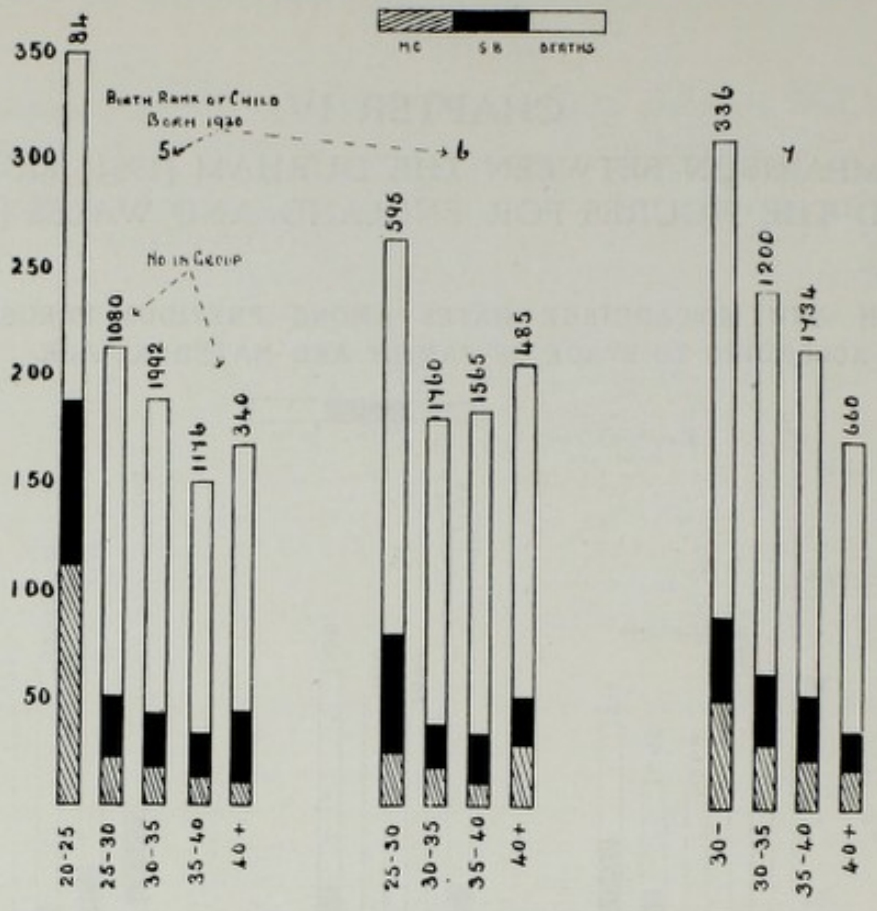

Fig. 4. (b) 5th, 6th and 7th pregnancies.

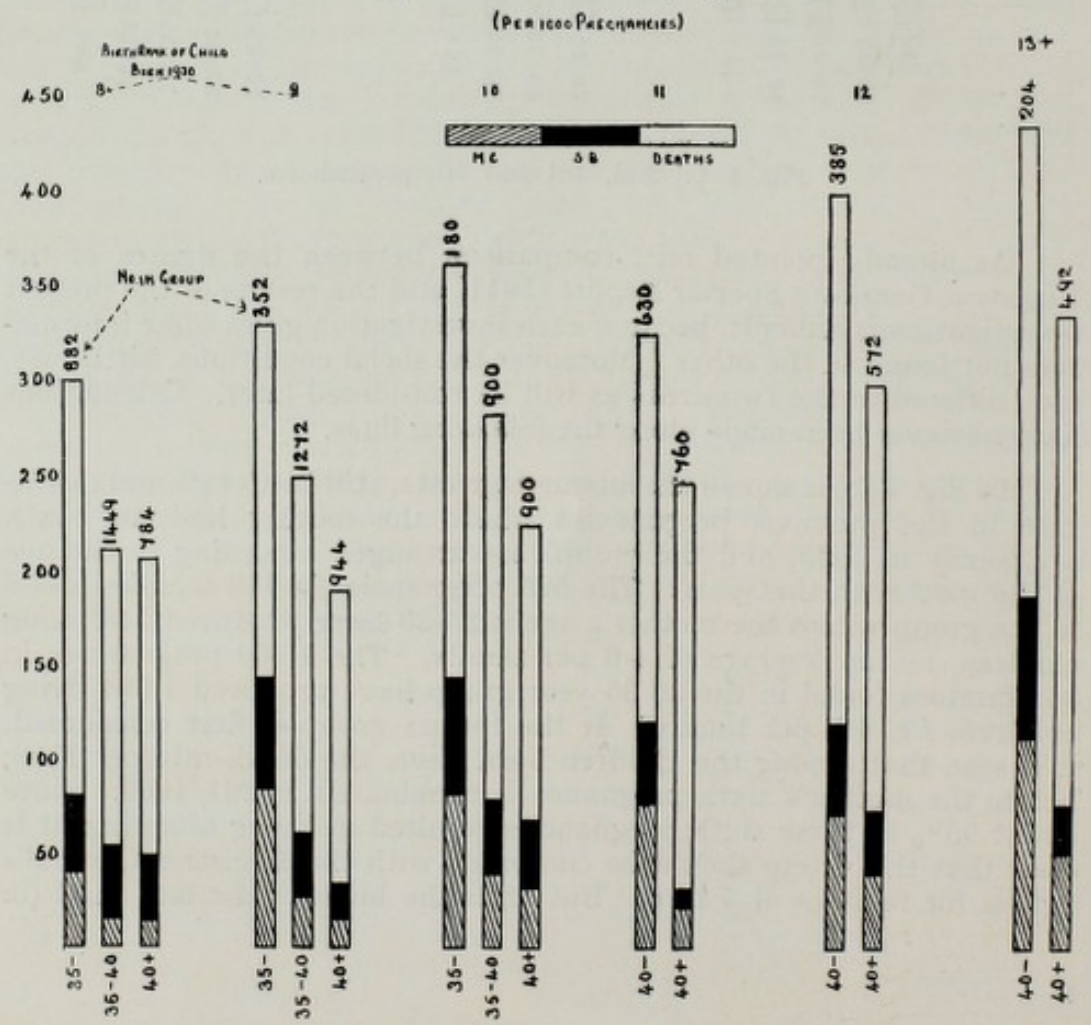

Fig. 4. (c) 8th, 9th, 10th, 11th, 12th, and later pregnancies.

this case the sixth), no details concerning the *subsequent* history of *previous* children is recorded on this child's card. We are therefore left with the following position. The history of the previous children is recorded up to the birth of the child in 1930. No information concerning the previous children is forthcoming after the birth of the 1930 child. The history of the sixth child is known for five years, (or till death if that occurs earlier). It is not therefore possible to include the 1930 child in the family for the purpose of comparing the death-rates in families of known size with the rates given by the Registrar-General, since information about the previous children ceases to be recorded at just the moment at which information about the last child begins. As about 33% of all deaths which take place among children before the age of five years occur before the children are a month old, and as the death-rate is very high among the late born children in large families (see this report and Campbell 1929), the exclusion of these last children causes the death-rate for the Durham families to be slightly underestimated. If however the case is considered in which women of 25-30 in Durham had borne on the average 4·6 live 'previous' children, it must be remembered that such women when they bore their fifth children must on the whole have been younger than the mothers of five children in the same age group in the Registrar-General's investigation, since the Durham women bore a sixth child before passing out of the age group. On the whole, their first five children must therefore have been borne more rapidly than five children to mothers of the same age in the Registrar-General's study. The death-rates for the latter are therefore not strictly comparable to those for the former, being below the really comparable figure, since more quickly bred children have been seen to have a higher death-rate than the more slowly bred. Since however this merely means that the figures taken for a given size of family in Durham in 1930 and for the same size of family in England and Wales in 1911 are both slightly underestimated, comparison is probably reasonably fair.

Now if an average of 4·6 children have been born to women between 25 and 30, these children must fall within certain of the groups given by the 1911 special report of the Registrar-General. Women of this age may have either a *marriage age* (*M.A.*) of 25-30 years, and a *duration of marriage* (*D.M.*) of 0-5 years, or M.A. 20-25 years and D.M. 5-10 years or M.A. 15-20 years and D.M. 10-15 years. Since in this area 48% of all first births take place when the mothers are 20-25, 25% when the mothers are 25-30, and 11% to mothers under 20, it is clear that the group of women whose marriage age is 20-25 will predominate in families of most sizes. In the following tables the figures relating to this group are underlined. The number of women who marry between 25 and 30, and have five pregnancies and bear 4·6 live children before reaching 30 must be negligible. So the following figures from the 1911 report may be compared with the death-rate of 201/1000 found in the Durham families as above. (See also Appendix **3**, page 221.)

Marriage age M.A.	Duration of Marriage D.M.	Per 1000 in 1911		1930
		Death-rate in families of 5	Death-rate in families of 4	Comparable Durham figure M.A. and D.M unknown
20-25	5-10	203	162	201
15-20	10-15	180	158	

Clearly the figures would range in general between 158 and 203/1000 and when they are compared with the 201/1;000 actually found, it is seen that the death-rates in families of *this size born to women of this age show no improvement in the Durham figures for* 1910-1930 *over those for England and Wales in* 1890-1910.

The 4·8 live children born to women of 30-35 may be compared with families of 5 in the other investigation. The death-rate per 1000 live births for these Durham children is 169/1000. For the families of 5 in the 1911 report, it is found :—

M.A.	D.M.	1911 Death-rate per 1000 in families of 5	1930 Comparable Durham figure M.A. and D.M. not known
25-30	5-10	188	169
20-25	10-15	167	
15-20	15-20	180	

Here the figure of 169/1000 found is actually very close to the numerically most important group, *i.e.* those whose mothers married between 20 and 25 years of age, and no significant improvement can be demonstrated.

The 4·8 previous live children born to women of 35-40 in 1930 who bore their sixth child then may be compared with families of 5 in the Registrar- General's investigation. The death-rate per 1000 children born alive in the Durham study, up to 1930 is 153. But women aged 35-40 might have been married at 25-30 and been married 10-15 years, etc. The following comparison may then be made.

M.A.	D.M.	Death-rate per 1000 in families of 5 (R.G.'S Report 1911)	Comparable Durham figure (1930)
15-20	20-25	194	153
20-25	15-20	171	
25-30	10-15	161	
30-35	5-10	182	

There is therefore probably a slight improvement over the twenty years.

A further example may be taken from those women who had their *ninth* pregnancy in 1930, in the two age groups, below 35 (*i.e.* highest death-rate) and over 40 (*i.e.* lowest death-rate). The eight previous pregnancies in women under 35 have resulted in an average of 6·8 live births, and among these children born alive 233/1000 died before the end of the ninth pregnancy. If these are compared with families of 7 in the 1911 report, the following may be noted.

M.A.	D.M.	Death-rate per 1000 in families of 7 (R.G.'s report 1911)	Comparable Durham figure 1930 M.A. and D.M. unknown
25-30	5-10	268	233
20-25	10-15	222	
15-20	15-20	199	

Again, the group whose mothers married at 20-25 years, and who must represent the majority, show a figure very similar to the Durham figure of 233/1000. Again no improvement in the death-rates in this size of family can be demonstrated over the period of 20 years.

In the over 40 group, the eight previous pregnancies have produced 7·7 live births on the average, and among these the death-rate per 1000 is 163.

This may be compared with the following figures.

M.A.	D.M.	Death-rates per 1000 in families of 8 [1911]	7	Comparable Durham figure 1930
30-35	10-15	263	247	163
25-30	15-20	222	197	
20-25	20-25	209	201	
15-20	25-30	221	214	

Here it seems that an actual reduction in the death-rate has taken place, in these, the more slowly bred families, but the statement must be made with great caution. In the 1911 report itself, the author remarks "*In view of this close relationship between the size of family and the mortality of its members it will be seen that the recent decline in the mortality of early life must to a considerable extent be attributed to the reduction in size of family, and must to that extent be discounted as an indication of sanitary progress*".

In an effort to determine whether the Durham figures for 1910-1930 show any improvement over those for the whole country for 1890-1911 when families of the same size, bred at the same rate are considered, the death-rates for each size of family bred at the rate which gives the highest and lowest death-rates respectively have been calculated as above for the Durham families and compared with the 1911 figures. They are found in Appendix 3. In families of 4 (3 previous pregnancies)

in addition to making comparisons in the groups with the highest and lowest death rates respectively, an intermediate group is included. It may be seen from the figures in Appendix 3, that the families of the two different areas which are rapidly bred, and which, both in this investigation and the 1911 report, have been found to show extremely high death-rates, the Durham figures at the later period show no improvement over the earlier figures for the whole country. Moreover in the small families of two or three children, and again in families of eleven or over, *there is likewise no improvement, whatever the rate of breeding.* Amongst the largest families it would seem probable that breeding must inevitably take place at a rate which exhausts the mother and renders her unable to make use of the services provided. But between families of 3 and families of 11, it may be seen (Table XIV) that there is a *definite and consistent lowering of the death-rate in families slowly bred,* even where the minimum possible death-rate is taken for the earlier period. That is, there are certain families, who have succeeded in benefiting from the general rise in the standard of living, and from the social services, both health and educational, which the community has provided. In precisely the same social classes, there are others who have failed to show any improvement. Clearly however neither clinics, hospitals, convalescent homes, village institutes nor any other health or educational facility can be of much use to a woman with two or three tiny children always on her hands, nor will she generally be in a physical condition to cope with more than a minimum of her domestic and social duties. These figures indicate clearly that an improvement has been effected by improvement in social conditions, at certain stages of family. They give no precise measure of the improvement at *different* stages of family. (Table XIV., page 82).

CHAPTER V.

WHAT CHANGES HAVE OCCURRED IN THE LAST FORTY YEARS IN THE DEATH-RATE AMONG FIRST CHILDREN?

In the 1911 report, the number of children in a family refers to the number of children *born alive*. Where only one had been born alive (*i.e.* in all families of one) that child was clearly the first living child. In the Durham investigation in 1930, it was found that approximately 4% of all first children and 2% of all second children were still-born. The proportion of cases in which both first and second children were still-born was negligible. It is thus obvious that in general at least 95% of first children born alive are really first-born. The Special Report referred to above gives the death-rates among these children at different durations of marriage, and from these, something may be deduced about the infant death-rate.

Legitimate children whose parents had been married from 0-5 years in 1911, must have been born between 1906 and 1911. From the table in Appendix 2 it may be seen that the death-rate from birth to 1911 among these children is 62/1000. Now among all children born in England and Wales at that time from 60-67/1000 died before the age of 3 months. If therefore the death-rate in these families of one were to be equal to that among all children, it would be necessary to suppose that their average age in 1911 was 3 months, and that is simply nonsense, for the following reasons. If it be assumed :—

(1) That an equal number of people in the 0-5 group had been married 1 year, 2 years, etc. to 5 years.

(2) That among those married five years, the children were equally distributed as regards age from birth to 4 years ; among those married three years the children were equally distributed from birth to 2 years, etc.

Then it may be calculated that the average age of the children in this group will be round about 1 year, and that the figure of 62/1000 (their death-rate) would not differ significantly from the infant death-rate. Actual figures are difficult to obtain, but general observation suggests that children are most frequently born in the early stages of married life. Charles (see Hogben, 1938) shows that in Australia, for 1908 and 1933, just over 60% of all first births occur within 1 year of marriage and over 90% within 2 years of marriage The above estimate of the probable age is therefore a minimum. It may therefore be concluded that between 1906-1911, the infant death-rate among first children did not exceed 62/1000 and was probably considerably less.

In the 5-10 year marriage duration group (Table of Appendix 2) the death-rate among first children is 70. If it be roughly calculated that the parents in this group would have been married on the average $7\frac{1}{2}$ years, and that their children were equally spaced from newly-born to $6\frac{3}{4}$ years, then the average age of the children in the group would be $3\frac{3}{8}$ years. As their total death-rate is only 70/1000, their infant death-rate could not have exceeded 60/1000, yet these children were born

between 1900 and 1911, when the total infant death-rate ranged from 117/1000 to 138/1000, and when from 63 to 70/1000 of all children died under three months of age, and from 160-190/1000 died before three years of age.

It is moreover possible to go steadily further back. Where parents had been married 10-15 years in 1911, they must have done so between 1896 and 1901. Where only one child had been born to the marriage, for reasons already given it seems safe to say that the majority of such children would be born between 1896 and 1905, and very few would be less than five years old in 1911, while many would be nearer ten years old. Between 1895 and 1900, of every 1000 children born alive, approximately 250 died before reaching the age of five. Between 1900 and 1905, this figure was 210 (Annual Report of the Chief Medical Officer to the Ministry of Health, 1934). From the Table in Appendix 2 however it may be seen that 'only' children of parents married between 1896 and 1901 had a death-rate up to 1911 of 94/1000, although the death-rate of all children to the end of one year was about 150/1000 in 1900. Clearly in the five to fifteen or so years these children had lived, *they had only suffered a death-rate equal to that for the first few months among all children.* These children did not however represent all the children whose parents were married between 1896 and 1901 and only had one child. They represented only the families where *both parents were alive in* 1911. In the report from which all these figures were taken, it is pointed out that where parents had an average age of 27 years at marriage, with the death-rates then prevalent, both parents would still be alive after 12 years of marriage in 83% of the cases. The figure of 94/1000 for the death-rate of only children thus refers only to these 83% of all families. Now if *all 'only'* children had the same death-rate to five years as *all* children at that time, the low figure for the children of the parents who survived being counterbalanced by the high figures of the children of parents who died, then it would be necessary for the latter group to have a death-rate of 900/1000, which seems *improbable.* If not 17% but 50% of all families with one child had lost one parent during the period, ('only' child families being assumed to be in excess in this group because a parent's death had determined the low fertility), then it would still be necessary for the death-rate among the orphaned to be about four times that among the others, to bring the figure for all 'only' children up to that of all children.

Going back a further 10 years, after 22 years of marriage both parents would survive in 65% of the families. The 'only' children of parents married for 22 years may be estimated to have an average age of not less than 15 years, but their death-rate during that period was 122/1000 to be compared with figures of about 140/1000 for the first year and 200/1000 for the first two years and 250/1000 for the first five years for all children. Unless the 'only' children of parents who died had a death-rate over the same period of at least 500/1000, it is obvious that *the child death-rate of 'only' children must be a fraction of that of all children.* A higher death-rate among the children of parents who die while the child is young than among those of parents who survive longer might be expected, but if it were to be of the order indicated by the figures above, it is clear that *parents' survival would*

be easily the most significant factor in child health. Pearl (*ibid*) gives a diagram from Ploetz showing the proportion of children dying under five years of age in relation to the age at death of the respective parents. While the mother's age at death rose from 20 years to 70 years, the child death-rate to five years fell from 370/1000 to 230/1000. Where the father's age at death rose from 25 to 35 years, there was a relatively sharp fall in the child death-rate from about 460 to 370/1000 but thereafter the rate varied with the father's age at death as little as in the case of mothers. This does not suggest that the early death of the parents could cause a sufficiently high death-rate in the orphaned children to counter-balance the low death-rates found in the 1911 investigation. It is however true that Ploetz's investigations referred to royal children, whose social circumstances would not probably be adversely affected by their parent's death. Among all the children of all classes in England and Wales however, the death of a parent must frequently be a very serious cause of poverty or lack of care and might be expected to increase the death-rate. But the social handicaps associated with a parent's death would not be found *before* the parent's death unless that death were preceded by a lengthy illness. Of all deaths up to fifteen years of age (about 280/1000 in the period 1890-1910 under consideration), 200/1000 occurred before the age of two years and 250/1000 before the age of five years. Where a parent was to die of accident, or any acute disease, after the fifth birthday of the child, it is inconceivable that the parent's death should influence the child's death-rate during the period of relatively high death-rate, and subsequent rates would need to be fantastically high, unless it is concluded that the death-rates of 'only' children at that time were quite markedly lower than that of all children. From the figures in the table in Appendix 2 it may be concluded that *where the parents both lived to* 1911, 'only' children born between 1890 and 1900 would have a death-rate up to five years of age not exceeding 90-100/1000. Since the proportion of parents who died in the early stages of the children's lives cannot have been very great, it would seem that it would not be a very low estimate of the probable death-rate up to five years of all 'only' children at that time to put the figure at 150/1000. This would permit of a death-rate among parents of 'only' children greatly in excess of that of all children. and also of a very great influence of parent's death on child death-rates.

Death-rates in families of more than 1.

The investigation of which the results are summarized in the table in Appendix 2 covered a period dating from 1911 backwards to about 1851. During that period the death-rate up to five years of age among children born alive fell from about 270/1000 in 1870-75 to 210/1000 in 1900-05. If Appendix 2 is studied however, it is seen that very few sizes of family at any stage in the investigation show death-rates *up to the end of the investigation* which rise to these figures, *e.g.* where the marriage had lasted 15-20 years and four children had been born the death-rate among the children was 166/1000. For a marriage lasting 25-30 years and six children the rate was 205. But in all these families the children must on an average have reached much more than five years, and the mean death-rate up to five years during the period covered was not less than 230/1000 for all children born alive. If it is

accepted that what has been shown to be true in 1930 held also for 1880-1910, and that the death-rates up to five years of age for all children represents the average of a low death-rate for the children in small families, a slightly higher rate for the early children of large families and an extremely high rate for the late children of large families, then the figures on the table in Appendix 2 become comprehensible. The figures for any size of family or marriage duration only approach those of all children up to five years of age at that period where the *family is large for the duration of the marriage.* Six or more children born in families where the marriage has only lasted 5-10 years show the high death-rates of 262 to 335/1000—high rates typical of rapid breeding. Families of twelve where the marriage has lasted 25-30 years show the rate of 288/1000. These latter large families consist of :—

(*a*) Early children with their relatively low death-rate in infancy and childhood. These children have however a further long period during which they are exposed to further risks of death. Their death-rate therefore represents the total rate up to early adult life.

(*b*) The late children with very high death-rates in infancy and childhood. Many of these late children would still be quite tiny at the end of the twenty-five year marriage period and their death-rates would be mainly those of the first few years of life.

According to this reasoning the death-rate up to five years of age in 1880, 1890, etc. would be the mean of those for the *early* children being born into *new* families just being started, and of the *late* children of *large* families started much earlier. If as has been indicated the death-rate among early children is much below the average for all children, then the rate in late children must always have been much *above* the average, the degree of variation being determined by the relative proportions of early and late children. If the families of three born in the 20-25 years group in the table of Appendix 2 is considered, it will be seen that the marriages must have taken place between 1886 and 1891. The total death-rates in these families up to 1911 was 162/1000. To get an idea of the possible death-rate up to five years of age in such a family, it may be assumed that the first child was born not later than 1890, the second 1895 and the third 1900. In very few families would deaths after five years of age contribute less than this to the total 162. From the death-rates of all children during that period, it may be deduced that in a family spaced as above 31 deaths of the total 162 might be added after the age of five years. Thus the *death-rate up to five years would be* 131/1000. If however the death-rate *after* five years were low as well as the rate *before* five, compared with that for all families, then taking half the average, only 16/1000 would be added after five years, and the rate before five would be 140-150/1000, *i.e. not more than* 60% *of that of all children.* It is thus only possible to interpret the figures in Appendix 2, if it is assumed that the death-rate of children in small families (where the parents survive 10, 20 or 30 years of marriage) was remarkably *low at all stages, i.e. despite the sanitary conditions of forty years ago, and the general ignorance of modern dietary knowledge, it is clear that these small families had a most remarkably low death-rate.* This seems to suggest that they were remarkably 'fit' specimens. But

if the small families and the early children had death-rates much below the average the late children of large families must have had very high rates—not less than 300 or perhaps 400/1000 up to five years of age.

It would therefore seem that about 1890 a figure certainly not exceeding 150/1000 for the death-rate up to five years of age may be estimated for the children of families not exceeding three, and a figure of not less than 300/1000 for the late children of large families. The question posed earlier may then be repeated, viz. :—

Has the infant and child death-rate fallen at each stage of family or is the fall merely due to the decrease in the size of family ?

This may be answered by comparing the estimates made above for death-rates round 1890 with those found in County Durham in 1930, *i.e.* 95/1000 up to five years for first, second and third children, and 236/1000 for tenth and later live-born children (twelfth and later pregnancies). In County Durham, in 1930, however the death-rate up to five years for first, second and third children was largely influenced by class, being 46/1000 for the middle clasess, 60/1000 for black-coated and independent workers covered by the public health services, 80/1000 for manual workers other than miners and 103/1000 for miners. It seems probable therefore that for England and Wales, in which the middle and black-coated classes are more numerous than in County Durham, the figure for the death-rate at this stage of family would lie between 60 and 80/1000. So it seems that the fall in infant and child death-rate has had two distinct components. (*a*) *The death-rate at each stage of family has been reduced, perhaps halved.* (*b*) *The proportion of large families has been decreased and the decrease in the number of the late children of large families with their very high death-rate has contributed the rest of the fall in infant and child death-rate.*

This might seem to be a direct contradiction of the fact previously noted that when families born in County Durham during 1910–1930 were compared with families of the same size and rate of breeding in England and Wales in the period 1890 to 1910, improvement was found in the Durham families only when they were of moderate size and slowly bred. Very small families, and large or rapidly bred families did not show this improvement. Even where improvement had occurred, death-rates were by no means halved. The reason for this would appear to be that Durham County was ten or more years behind the country as a whole in feeling the effects of the changes which produced the fall in infant and child death-rate. Actually it was more than ten years behind the country in lowering the birth-rate, though this decrease once begun continued rapidly. Active steps for the amelioration of the lot of the children were taken by this area very early, but the peculiar difficulties presented which will be discussed at length in the next part of this report made progress slow. The earlier investigation in the whole country covered the periods 1890-1900, and 1900-1911 in which the birth-rate for the country averaged 30 and 27/1000 and the infant death-rates 153 and 128/1000 respectively. The later investigation in County Durham covered the periods 1910-20 and 1920-30, when the birth-rate in the county averaged 28 and 23/1000 and the infant death-rate averaged 125 and 92/1000. It is thus seen that in 1900-1910 England and Wales had a birth-rate of 27/1000 and an infant death-rate

of 128/1000, while ten years later County Durham had a birth-rate of 28/1000 and an infant death-rate of 125/1000. Moreover while England and Wales had a birth-rate of 35/1000 and an infant death-rate of 150/1000 in 1871-80, Durham County still had a birth-rate of 35/1000 and an infant death-rate of 153/1000 in 1900-1910. It would therefore seem that, at a given level of birth-rate, the social advantages accruing to the whole country from having more middle class people than the county are offset by the larger proportion of the derelicts of the slums also found in the whole country, these being of course largely found in the county boroughs which are excluded from a 'county' area. It would seem probable that in the whole country, by the period 1905-1910, many small families, favourably placed had already reached as good a health position as today—it has already been indicated that the infant mortality among such children can only have been a fraction of that of all children. This improvement however was only effected in County Durham during the later twenty years. Many social changes (of which the fall in the birth-rate was an important symptom) only took place in the County area during the later period, although well established in the whole country in the earlier period, and since these social changes, including the development of the social services, and the awakening of the social conscience, largely determined the improvement in child health, comparison of the figures for the two areas over the two periods really gives a comparison of the same sort of social changes occurring twenty years later in one area than in the other. It does not measure the result of changes occurring in one area over 20-40 years. Even so, County Durham, on the whole, had reached a slightly better level in 1930 than the country in 1910 and the lengthy comparison of different sizes of family on pages 49–54 and Appendix 3 seems to indicate that it was in the moderate sized, slowly bred families that this improvement was mainly effected. The very great differences in the social structure of the county and the rate at which social changes have taken place there as compared with the whole country makes it impossible to deduce directly from the figures of the two areas what improvement has taken place generally in the health of different sized families, but it does seem to leave certain that the slowly bred, moderate sized families respond more readily than rapidly bred families to social improvements. (Appendix 3, page 221).

Is the relationship between infant death-rate and size of family biological or social?

The full discussion of this problem must be postponed until the influence of certain social factors has been more carefully considered, but it may be recalled that in the investigation here reported 94% of the total children were found in the homes of manual workers, and 98% in homes belonging to the social classes covered by health and unemployment insurance. 'Class' influences as generally conceived therefore only played a very small part. Practically all the children, and with one single exception, absolutely all the large families (6 or more children) came within the normal scope of the Public Health and Educational Services. The strongest evidence in favour of the view that biological factors are of prime importance lies in the readily demonstrable influence of the rate of breeding. Here there is little reason to suppose that in the families slowly bred the average income

per head is higher than in those more rapidly borne, but it cannot be denied that in general, maternal care must be more limited in families borne rapidly, since the mother can have neither equal time nor strength to devote to the children, and the older children will not usually be old enough to care for the younger ones. On the other hand, the fact that in the more slowly bred families more children survive means that the family is a greater social and domestic strain on the mother, if a lighter one biologically.

But be the cause what it may, it is not only true that larger families have a higher death-rate in the later stages, but at all stages. Thus a small family which is rapidly bred and could potentially become a large family has a higher death-rate than a small family which is going to remain small. This is mainly due to rate of breeding, but is partly associated with the social competence of the parents. It is however of great importance in relation to the official attitude to education in contraception.

From the study of these families, one impressive and depressing factor emerges. Of the very large families only 12% of those of 10, 8% of those of 11, 6% of those of 12, and 0% of the larger ones had all their number alive before the birth of the last child in 1930. These families provide the greater part of the problem which faces our health services, and despite gallant efforts of the latter, the figures show that in families of 7 or more, 22—45% of the children conceived before the last child, have either died or failed to be born alive. Their death-rate is so high at all stages that it is quite safe to assume a further death-rate of 50-100/1000 before the age of twenty, *i.e.* in such families anything from 27-55% of the children conceived do not survive to be of use to the community.

Now it is difficult to determine what proportion these families with high death-rates form of all the population, because the families examined were not necessarily completed families, but the following comparisons are instructive. If attention is first limited to the *previous pregnancies* in the families in which a child was born in 1930, then there are found to be 11,634 such families (16,500 less the 4,866 first children born in 1930). In these 11,634 families there had been 38,877 pregnancies Women who had their seventh or subsequent pregnancy in 1930 (17·7% of the total) had contributed 16,048, or 41·8% of all the pregnancies, and among these 41·8% were found 46·2% of all still-births, 52% of all deaths and 63% of all miscarriages. On the other hand, the women who had their second or third pregnancy in 1930 had contributed 20% of all pregnancies, 19·5% of all still-births, (this relatively high figure for still-births being of course explained by the high proportion of first pregnancies in this group), but only 13% of all deaths and only 9% of all miscarriages (Table XI., page 80).

As has already been explained, the history of the previous children is only known to the point at which the first visit is paid to the 1930 child, which usually occurs about the third week of the latter's life ; it may safely be assumed that the number of previous children who die exactly in the fourth week of the life of the last child is negligible. So it is possible to consider all the previous children (including miscarriages) plus the 1930 children, up to the end of the first month of the latter's

life. This gives 16,500 families, and 55,377 pregnancies. Of these pregnancies 12·5% have occurred in the families in which the seventh or subsequent pregnancy occurred in 1930, but these 12·5% of the families have contributed 33% of all pregnancies, 37% of all still-births, 49% of all deaths, and 63% of all miscarriages. The remaining 87·5% of the families which do not exceed six in number may be seen from Table IX to have a death-rate up to five years of 137/1000, and a figure of about 170/1000 may be estimated as the rate up to 20 years, but in the families of seven or more the comparable figures are 250/1000 to 450/1000 approximately. Yet despite these extremely heavy death-rates among the large families, it is clear that these 12·5% of all families must contribute about 27% of the young adults of next generation, *i.e.* 27% of the next generation of adults is to be recruited *from the families with high death-rates at all stages.* It is significant however that these families do not differ at all from the bulk of their fellows in the area in the availability of educational facilities, or other social services, nor in general, in their opportunities of employment, and it is difficult not to conclude that they represent a specific social type. They display little control over their natural impulses, and singularly little foresight in all affairs. In every way their mental and social energy is minimal. It seems that a great problem is being built up for later generations. The production of a large proportion of the next generation from a comparatively small proportion of the earlier generation is nothing new. In reviewing the population history from 1860 onwards, the author of the 1911 Special Report (*ibid*) says "the share of the most fertile 10% of all the marriages being therefore 29·5% of all the births. . . . The main point brought out . . . is the extent to which recruitment of the population results from a comparatively small proportion of the total marriages." But in all earlier generations, fertility bore a fairly direct relationship to physical vigour, and chance of survival was considerably influenced by parental competence.

It has been shown that (*a*) over the last forty or fifty years, there has been a considerable fall in the death-rate at all stages of family ; (*b*) the death-rate at all stages of family is higher in large rapidly bred families than in small ones ; (*c*) the death-rates at each age, ante-natal and post-natal, is higher among the children of the large families than of the small, *i.e.* these children would appear to be less fit individuals, so that even the early vigorous weeding-out still leaves many weaklings. The combined effort of voluntary and public services is succeeding in keeping alive many more of these children than in the past, *but their continued high death-rate at all stages suggests that they are not yet being made really healthy.*

Problem families.

The following sample of 'problem' families illustrates many of these points. They are a random sample, subject only to the condition that they lived near enough to each other to be visited in one morning by people able to use a car. The present writer accompanied the Superintendent Health Visitor on her visit, paid because some difficulty had arisen in connection with them which needed special advice and help.

Case 1. A young mother not yet quite twenty was imminently expecting the birth of her second child, the first being less than a year old. The midwife engaged had reported that home conditions were too dirty and unsatisfactory for a safe confinement. The husband had had an accident three years before and subsequently had been pronounced fit for light work, though neurasthenic. Having been unable to get work he was classed as 'unemployed'. Without training in the craft, he had made most of the furniture in the house, and done the job excellently. He was clearly not without skill, but his behaviour was almost hysterical and he quite obviously would, in his present condition, be a very difficult individual to fit into industrial life. Whether this was wholly due to the accident, or whether the accident had merely uncovered a latent weakness cannot be stated, but with much capacity and good will on his part, he presented a very grave problem both industrially and clinically. The mother was amiable, but dull and lethargic. Part of this might be explained by her health. In part, her dullness might be merely protective covering necessary to anyone living with a person as excitable as her husband. The child was as well cared for as circumstances permitted. The mother stated—somewhat vaguely—that she herself had attended school regularly when young, and thought she had reached standard V before leaving. This girl, physically little more than a child, and mentally still a child had barely succeeded in coping with the care of one infant. What would happen after the birth of the second seemed problematic.

Case 2. The father, aged 43, was an unemployed miner. The mother was aged 41 years. Two children aged 5 and 3 years lived with their parents; an older child lived with the maternal grandparents. The mother appeared to have married in the thirties, but she was very nervous and excitable and her remarks were somewhat contradictory. She was however very clear that she had never been able to go to school. Despite the fact that they possessed another bedroom, both parents and children and two large dogs were all sleeping in one bed in the living room. Lack of bed-clothes may have contributed to this. The house was not too badly kept and the mother obviously tried to do her best. The only child seen was the three-year-old, who appeared physically and mentally like a normally developed child of eighteen months or so. The mother complained of acute ill-health. Altogether she seemed to be struggling vainly against hopeless odds.

Case 3. The parents here were both 27 years. The father was unemployed. There were four children, the eldest being four years and the youngest seven months. The three eldest were all acutely rachitic. Milk supplied free for their use had been sold. The cod-liver oil supplied to cure the rickets was not being used. The smell of the living room was unbearable. In the children's bed three large wet spots showed where they lay each night—presumably permanently wet spots, as this was the middle of the day. The mother was toothless and obese. She claimed to have attended school regularly but was not sure which class she had reached— she thought it might be standard VI.

Case 4. Here the father was 38 and the mother 34. They had had four children in seven years, the youngest being rachitic and mentally backward—unable to walk at two years of age. The parents

had been prosecuted for child neglect and the father imprisoned. The children had been placed in an institution, where the backward child still remained a grave problem. No more children had been born and the mother now seemed able to cope with her duties to the extent of keeping the house reasonably clean. She looked delicate and undernourished but claimed to be quite well. She stated that as a child she attended school regularly but had no idea what class she reached before leaving. She seemed amiable and well-meaning, but was obviously neither physically nor mentally fit to cope with family duties.

Case 5. The mother was 29 years old. She had had six children in 8½ years. The youngest was three months old, and the next was not walking. One had died at a few days. Of those alive, the eldest had been found at school to be verminous and impetiginous. Superficially the others did not appear diseased, though they did not appear well cared for. The house was a 'council' house, and the living room was not more untidy than might be expected of a room occupied by five children under eight years of age. The mother combined a marvellously clear complexion with an appalling degree of shapeless obesity strongly suggesting some glandular imbalance. She seemed intelligent and firmly stated that she had completed standard VII at school. Nevertheless she viewed her large, small family ruefully. She had clearly set herself a task to which she was unequal.

Case 6. The father, an unemployed miner had joined the army. The mother, aged 31 years, had borne six living children, and had had one miscarriage. One of the six children had died, and one, the eldest, was illegitimate and lived with the maternal grandfather. The mother in a state of nervous collapse had appealed for the return of the father, threatening otherwise to 'do in' herself and the four children who lived with her. She had been given help and was being carefully supervised. She seemed more cheerful but still very helpless. The children did not appear diseased on a superficial examination but they were ill-kept, and wet beds showed that no attempt at training was made. The mother stated that she had attended school regularly but had no idea what class she had reached.

Case 7. The father, aged 46, was a miner unemployed for a long period, but working at the time of the visit. The mother was aged 38 years. She had borne nine living children of whom three had died. The youngest child, fed on milk supplied at the Welfare Centre looked fairly bright and well. The next was to have been admitted to hospital because of acute rickets, but admission had been postponed. The older children at school had been periodically classed as 'neglected'. The house was one on a new estate but was indescribably filthy. A report to this effect from the rent-collector was the initial cause of this special visit. Again, the condition of the beds showed complete absence of child training. The mother herself was toothless and shapeless, obviously well-meaning but helpless. She attended the Welfare Centre with the children and seemed sincere in her wish to follow the advice given, but things were too much for her.

In no single case did there seem to be evidence of any vicious tendency on the part of the parents. On the whole, they seemed well-intentioned but feckless. None of the women reached the level of

intelligence which would permit anyone to engage her as a responsible domestic servant. Yet the whole complicated mechanism of public and voluntary services which over a few weeks had been brought to the aid of these families is most impressive. Moreover aid in one form or another had gone on for a long time. The fact that the *four babies under 1 year, on the whole, looked much fitter than any of the other children visited could with certainty be attributed to the help received at the Welfare Centre.* It would seem quite probable moreover that the four acutely rachitic children and the backward and diseased child taken into an institution might in an earlier time have succumbed to other diseases from general lack of resistance. An enormous amount is being done for these families, but can they be made more self-reliant? Actually only one of these families could be called 'large' but all except the children of the woman who married late were rapidly bred, and five of the mothers still had a long period of fertility ahead of them.

Appendix 6 contains a brief description of families which absorb much of the attention not only of the public health authorities but of the voluntary services. This list was compiled by taking every case found in one week's analysis of the records, where some special help was being given to the family, *e.g.* home helps, special visits because of mental defectives in the house, sanatorium treatment for tuberculosis, etc. Our society is keeping the children in these families alive to a greater extent than before. It is not even yet making them really healthy. These families have failed in the main to adapt themselves to the social changes of the last thirty years, although about 90% of their own class, as that is generally understood, have done so with considerable success. They would seem to afford a close parallel to the poor whites of South Africa. Of these McCleary [1937] says *"The poor whites, many of whom receive support from public funds or charity, live in insanitary conditions, and have a high infant mortality. On the other hand, their birth-rate is high."* The similarity is striking. McCleary also quotes the following extract from the Report of the Carnegie Corporation Committee on Poor Whites: *"The economic decline amongst these people is attributed to their inability to adjust themselves to modern conditions of life, and to the inadequacy of modern educational methods to cope with a backward section of the community which has developed for a long period along the lines of farming tradition."* If for the phrase "farming tradition" is substituted "heavy industry and mining tradition" this paragraph may be applied as it stands to the people under consideration. For them, circumstances have been too much. The available education hitherto has been either inept or inadequate. It is possible that they mainly belong to the stratum of the uneducable with which Cattell [1937] deals at length. But since no one proposes to out-herod Herod, they are going to occur twice as frequently in the next generation as in this, and consideration of the problem they present is long overdue.

CHAPTER VI.

THE POSSIBLE EFFECT ON THE CONCLUSIONS OF CERTAIN FACTORS.

1. The effect of removals from the area on the validity of the conclusions drawn.

Among the 16,500 children studied over the period 1930-35, 1,229 (*i.e.* 7%) moved out of the administrative area, or were removed from the care of the health visitors during that period. The latter group was numerically negligible as it consisted of children who entered institutions, and were thereafter not visited. They formed however a significant proportion of the total illegitimate children, and of the late children in large families, where the sickness or death of the mother necessitated the removal of the child from the home. Just as in the case of children not visited because their social position seemed to render visits unnecessary, deaths occurring among children placed in institutions were duly recorded on the child's card, although the child was not being visited.

Among the visited children, only a negligible proportion left the area in the neo-natal period. A few children whose mothers only came into the area for the birth of the child were found in the 75 cases of whom nothing further was known. Some of these may have left before the end of the first month. But, in general, it may be said that removals had no effect on the figures for the still-birth and neo-natal death-rates, which together accounted for 81/1000 of the total 148/1000 deaths up to five years of age.

Removals were not however found equally distributed among all the different sizes of families. About 5% of first children left the area before they reached 1 year. A further 7% of the first children left before they reached five years. The proportion of children removed from the area during the period studied fell from 12% among firsts, 8% among seconds to a relatively constant level of 1 to 2% in sixth and subsequent children. If the reasonably safe assumption is made that the children removed were a fair sample of all the children, then these removals would not affect the validity of the conculsions drawn. That the smaller families more frequently removed from the area would on general grounds be expected. It was also found that greater mobility existed among families with young parents than with older ones, the figures dropping from 9% among parents under 25 to 4% in those over 40. A great many of the families who left the area, particularly the larger families, did not in fact transfer themselves very far—frequently not out of the geographical county but merely into a neighbouring borough. This mainly accounted for the steady rate of removal among large families and older people. Among the younger people and smaller families there was however a real tendency to outward migration.

2. The frequency and possible physiological significance of the occurrence of miscarriages.

As has been already explained, miscarriages occurring in 1930 cannot be included in an investigation into 1930 births since they are

not notifiable. To that extent therefore, the investigation is incomplete as a record of the outcome of all pregnancies in the period and area. In the records of previous pregnancies however, the number of miscarriages is included, and Table XI shows that among the 38,877 such pregnancies, 25/1000 had ended in miscarriages. Moreover, it is seen that the miscarriage rate like death-rates at all early stages of life *is very much higher in the larger than in the smaller families.* This figure of 25/1000 is so very much lower than the usually accepted figures for the proportions of abortions to viable births that before considering the possible biological significance of these abortions, it seems necessary to study carefully the validity of the figures themselves. (Page 80).

In the special report on abortion [1936] a committee of the British Medical Association considers that abortions probably terminate 15-20% of all conceptions, basing this conclusion on certain inquiries carried out by various gynaecologists. This figure is 6-8 times as high as that found in this 1930 investigation, though the B.M.A. report also quotes figures by Bumm placing the level for spontaneous abortions as low as 5%. It may however be noted that in the records of many maternity hospitals, even among "booked" as distinct from "emergency" patients, the maternal mortality rate, the still-birth rate and the neo-natal death rate are all many times those found in the area served by the hospital, simply because it is the difficult cases which find their way to hospital. Similarly, hospital patients are likely to give atypical figures for abortion. No selection, however large, of women who find their way into the hands of a gynaecologist is likely to be in any way representative of the community.

The limitations of the 1930 figures must however be made clear. *They do not refer to completed families.* It has already been pointed out that a miscarriage is not recorded so as to be available for a study of this kind, *unless the mother subsequently bears a viable child.* Just as it has been shown that large families have a high death-rate and still-birth rate at all stages in the family, so it can be seen from Fig. 4 that miscarriages tend to occur also at a relatively high rate in the rapidly breeding families which of necessity form the bulk of the biggest families. Nevertheless the very great increase in miscarriage rate with size of family must indicate that the miscarriages, like the still-births, and neo-natal deaths *occur at a high and increasing rate in the late stages of large families.* Many miscarriages, therefore, will not be followed by a viable birth and so will be missed in this method of recording. For similar reasons, still-births, which form 40/1000 of all births, only form 30/1000 of the births among previous pregnancies. It may well be that the recorded rate of miscarriage, 25/1000, is only 75% or even 50% of the true rate. But even this figure is still remarkably low as compared with the usually accepted figure, although it is similar to that of Bumm for spontaneous miscarriage, and not startlingly different from that in the B.M.A. report (7·5%) relating to the offspring of German clergymen, among whom it was assumed that all miscarriages would be due to natural causes. It is of interest to compare these figures with those given in the League of Nations Bulletin for peasants in Hungary (61·9/1000), and for cases under pre-natal care in New Haven U.S.A. (44·7/1000). (Fig. 4, pages 49 and 50).

The only British figures available appear to be those of Agnew [1922] who gives still-births and miscarriages together for 2,223 Glasgow families, in which there were 11,384 conceptions. She found that 90/1000 of all conceptions ended in still-birth or miscarriage, but gave no information as to the relative proportions of the two. Since however, as will be seen later, evidence exists that the still-birth rate in Britain has been fairly constant at about 40/1000 for some time, her figures would suggest that the proportion of miscarriages would be about 50 per 1000 total conceptions,—a figure very similar to the German, Hungarian and American figures.

There are however probably further limitations to the accuracy of the figures, although these limitations are not peculiar to this investigation but are common to every study of a subject of this kind. In the first place, early abortions can only be diagnosed with difficulty, and in women characterized by poor physique, nervous instability, physiological irregularity, undeveloped powers of observation and low standards of personal health, many abortions may pass unnoticed, or certainly may be regarded as of insufficient importance to be detailed to the health visitor. On the other hand, when any individual however tactful, sets out deliberately to inquire into the proportion of abortions, it is probable that some such early abortions will be recalled, if the patient gets the idea that the inquirer expects to find a high proportion. The desire of people to give the information they think is wanted is the crucial weakness of any form of social investigation. Hence some discrepancy may be expected between any special investigation into abortion, and the present study where the occurrence of miscarriage *is only inquired into as a matter of routine to secure a general idea of the mother's health.*

In the health visitor's records, no place is set aside for the stage at which the miscarriage occurred, but many women volunteered the information. Most of the reported miscarriages occurred at 3 months or later, only one or two being given as 2 or 3 months. It seems probable that the figures can in fact only be taken to apply to those miscarriages in which the woman's normal routine is interrupted, and because of which she has to get, if not nursing or medical attention, at any rate, a little domestic help from neighbours.

It must be remembered that after the birth of the first child into a family, the health visitor is in fairly regular contact with the mother, and all the evidence shows that a high degree of confidence exists between the two. Most of the miscarriages which occur are in practice recorded not only on the cards of subsequent children, but on those of earlier children still being visited, since such miscarriages are important factors in the health of the mother, and potential care of the children. After the first child therefore, in compiling her records, the health visitor already has a considerable knowledge of the mother and family wherewith to check further statements.

That deliberate suppression of information may take place sometimes cannot be denied, but it must be emphasised that the rural and small urban areas, which form the administrative unit under consideration hold the type of community in which 'private' lives of any kind can only with the greatest difficulty be achieved, and a woman who

must attend to her own needs, or rely on the help of neighbours or of semi-public or charitable services, must find much more difficulty than wealthier women in concealing anything relating to her health. For these reasons, it seems to the writer that the figure of 25/1000, low as it is, is probably an approximately accurate measure of all abortions which (*a*) occur after the second or third month of pregnancy, (*b*) are spontaneous or therapeutic and (*c*) are later followed by a birth.

For purposes of comparison, the information given in his annual reports by the Medical Officer of Health for the County relating to the women attending ante-natal clinics was studied. Only a very small proportion of women attended before the end of the third month of pregnancy, but about half of the total attended between three and six months. Any miscarriages which occurred among the women attending these clinics must therefore mainly be found in this half, and the rate was calculated on this number. The reports for 1930 and 1934 did not happen to be in the writer's hands at the moment, but for the years 1931, 1932, 1933, 1935 and 1936, the miscarriage rate *per* 1000 *pregnancies in this group* was 20, 17, 18, 16, and 19 respectively. This miscarriage rate refers to spontaneous or therapeutic miscarriages occurring after the third month. The figures were deduced from a total of 15,377 terminated pregnancies, and differed little from the earlier results given for the 38,877 pregnancies, where, as has been already indicated, probably only spontaneous miscarriages occurring after the third month or so of pregnancy would be counted.

The miscarriage rate among the *previous pregnancies* of women attending the clinics differs however from that of the area as a whole. In the years studied, 20,459 women attended the clinics, and the outcome of the previous pregnancies of the 16,988 women not bearing their first child is given. There were 42,010 such previous pregnancies and among them 2,299 miscarriages had occurred—a rate of 55/1000. (The figures for the individual years varied from 40 to 60/1000). It might be asked if this disparity was due to greater truthfulness in the matter on the part of the women voluntarily seeking advice at the clinics. There is however so much difference between these women and the 60-75% of all the women in the area who do not attend the clinics that it is difficult to accept them as typical in any way. In the first place, women between 20 and 25 bear 25% of all the children in the area [1930], but women of this age form 32% of those attending the clinics. Women over 35 are correspondingly under-represented. Women bearing their first or second child occur slightly less frequently than in the whole community, and women bearing their seventh or later child quite markedly less than among the whole. But there are other quite striking differences between the 'self-selected' groups attending the clinics, and the total group. The first of these relates to the twinning rate. While for the whole area there are 15 sets of twins per 1000 births, and for England and Wales 11 to 12, among the 15,337 women attending the clinics over 5 years, the outcome of whose pregnancies are given, there were only 48 sets of twins, or just over 3/1000. Why women who are about to have twins should avoid or at any rate neglect the ante-natal clinics, it is impossible to say. There is no doubt that a tendency to twinning is hereditary, and it might have been expected that where any probability of the complications associated

with multiple births was to be expected, ante-natal advice would have been sought. Again, 16,988 women attending the clinics had had 42,010 previous pregnancies—an average of 2·5, but the 11,634 women who had children in 1930 and who had been previously pregnant, had had 38,877 previous pregnancies, an average of 3·3. So that it is quite obvious that even the very large number of women who over several years attend the clinics cannot be accepted as giving information directly applicable to all the women in the area. It might be expected that women who desired a living child, and had had a miscarriage, would seek ante-natal advice more readily than those without that experience. So the women attending clinics may be preferentially self-selected in this way to some extent. Undoubtedly many women attend the ante-natal clinics to secure milk, etc., and miscarriages have been seen to occur most frequently among the rapidly bred families, where the most obvious signs of poverty are seen and where the exhaustion of the mother would make her a likely subject for assistance of various kinds. These factors may explain the discrepancy between the figures for all the women in 1930, and the smaller groups in several years. But it is clear that if figures secured from 17,000 women cannot be relied on to give a true picture of the whole problem, few of the figures adduced on this subject are of any value.

This is admirably demonstrated by certain figures given by Carr-Saunders in his book *World Population* [1936]. He quotes the abortion rate in Berlin in 1929 as being to live births in the ratio 103·4 : 100. By April, 1935, this had fallen to 14 : 100. If this fall in any way represented the general reaction in Germany to attempts to increase the birth-rate, the latter ought to have been increased by about 90%, since abortions amounting to about 90% of the live births had ceased to occur. Carr-Saunders does not give the birth-rate in Berlin for the time under consideration, but cites that for five large German towns. In these, in the period under review, the birth-rate rose not by 90% but by about 25%. For Germany as a whole the birth-rate rose from 16·6 during 1931-1935 to 19·0/1000 in 1936 (League of Nations Statistical Year Book [1937-38]. If therefore the abortion figures had any general application, it is necessary to assume either that the attempt to increase the birth-rate had led to a large concealment of abortions, or somewhat peculiarly to a large reduction in conceptions. No opinion as to the relative probability of these possibilities can be adequately supported.

It is clear then that it is well nigh impossible to arrive at any accurate idea as to the prevalence of miscarriages. But it would seem, that apart from very early miscarriages which produce such slight clinical manifestation as to run the chance of being overlooked in any investigation, the *proportion of miscarriages to viable births is probably very much lower than has been usually accepted on the basis of a study of selected groups*. The following evidence seems to clinch this. The report of the B.M.A. [1936] already referred to, appears to accept figures ranging from 15-20% as indicating the proportion of all conceptions ending as miscarriages. (Here as in that report no distinction is made between miscarriage and abortion, but the report quotes an earlier one on maternal mortality and morbidity [1932] to the effect that of all maternal deaths directly due to child-bearing, 13·4% were caused

by abortion). Now all pregnancies which are begun must end either in parturition or miscarriage. If the 80% (accepting the Beckwith-Whitehouse figures of the B.M.A. report) which end in parturition cause 87% of the maternal deaths, and the 20% which end in abortion cause only 13% of the maternal deaths, it is clear that *for the mother, the dangers of parturition are to the dangers of abortion in the ratio of* 100 : 60, *i.e. a pregnancy terminated by miscarriage is only* 60% *as dangerous to the mother as one which goes to full term.* To accept then the view that abortions are as numerous as 20% of all conceptions, but to conclude that *"The high degree in which abortion in this country is contributing to the maternal death-rate is recognised as constituting a public health problem of great gravity"* is merely weak arithmetic. If abortions are numerous, then relative to parturition they are innocuous ; if they are dangerous, then they must be relatively few. It is not possible on the basis of the evidence available, to believe simultaneously that they are both numerous and dangerous. Most of the people who deal with the subject seem to accept implicitly the assumption that a woman who dies as the result of an abortion would necessarily have survived the ordeal of parturition, had the pregnancy not been previously terminated. But this is a gratuitous assumption. Death in or because of parturition would seem to depend on (*a*) the general health of the woman and (*b*) the skill and attention available to her ante-natally, (perhaps even ante-conceptionally), intra-natally, and post-natally. To assume that all the women who die as the result of abortions must belong to (1) the healthiest groups, and (2) the social classes able to command the most skilled attention, and therefore presumably least likely to die as a result of parturition, is mere superstition. There is no reason to suppose that women who die as the result of abortions, however produced, would have been subjected to fewer risks in full-term parturition than other women. As will be seen later the converse is true. On general biological grounds it is difficult to believe that miscarriage after the third month is markedly safer for the mother than parturition. If such miscarriages terminate spontaneously about 5% of all conceptions, they presumably supply about 5% of all maternal deaths, leaving a further 8% of maternal deaths to be related to deliberate abortions. The latter would appear to be usually initiated (see the B.M.A. report) under conditions so likely to conduce to sepsis, and the actual expulsion of the foetus must frequently take place with such a minimum of skilled attention, that on general grounds, it is difficult to believe that they are not in fact several times more dangerous to the mother than normal parturition. It would seem then that they must be relatively rare.

On the whole, it would seem reasonable to accept the low figures of 30 to 50/1000 as measuring the proportion of pregnancies spontaneously terminated between the second to third and seventh months. Fig. 4 shows that the miscarriage rate at all sizes of family follows very closely on the still-birth rate with one significant exception. There is no parallel among miscarriages to the high still-birth rate associated with first full-time parturitions. This would seem to be illuminated by Campbell's finding [1929] that *a large proportion of still-births among first births is due to intra-natal causes.* Again also there is no evidence of increased miscarriage rate among the oldest women at any given size

of family, though at all maternal ages, the miscarriage rate is higher in large than in small families. There is, however, the closest correlation between high still-birth rate, high death-rate and high miscarriage-rate in the rapidly bred children of youngish mothers at all stages of family, which becomes really marked at about the fifth child. It was about this stage of family that Campbell [*ibid*] found the still-births began to be largely ante-natal, *i.e.* there is here a great increase in ante-natal deaths, some of which are classed as miscarriages and some as still-births. The similarity between the distribution of spontaneous miscarriages and still-births due to ante-natal causes would seem to be strong presumptive evidence in favour of common causes underlying both. Maternal exhaustion is clearly the most important of these.

Table XI shows the proportion of miscarriages occurring in previous pregnancies according to the size of family. From these the miscarriage rate in the first, second and third, etc. pregnancy has been calculated as follows. Where a second pregnancy occurred in 1930, all previous pregnancies must have been first, and the miscarriage rate among these could be directly calculated. Where a third pregnancy occurred in 1930, previous pregnancies were an equal mixture of firsts and seconds. If the miscarriage rate in the mixture is known, and also in the firsts it is possible to calculate the rate for seconds and so on. Table XV shows these figures, and also indicates that the assumption underlying these calculations cannot be simply accepted, since the miscarriage rate associated with seventh births is mathematically negative. This is due to the fact that the number of miscarriages in the previous pregnancies of families in which a seventh child was born in 1930 is excessively high, and it is clear that the distribution of the miscarriages throughout the various families is too irregular for the *individual* figures on Table XV to have any significance, but there does seem significance in the fact that the miscarriage rate rises from 10/1000 associated with first or second births to 200/1000 associated with twelfth or subsequent births. Since in a comparatively small number of miscarriages the presence in a group of one or two women addicted to miscarriage might make a great difference to the figures, (*e.g.* of the 81 miscarriages found in families where a tenth child was born in 1930, 17 had been contributed by three women), Table XVI shows the number of women producing the miscarriages in each group. (Page 83).

That the miscarriage rate is highest where most conceptions take place, and particularly where they take place in rapid succession may be regarded as certain. Table XV is strong presumptive evidence that the miscarriage rate is also highest at the *later* stages of the large families. (Page 82).

These conclusions are broadly supported by figures given by Huntington [1938], who quotes the results of an investigation by Kopp in New York. Kopp made enquiries from 10,000 maternity patients, covering roughly 40,000 pregnancies, and found a total of 8% *spontaneous* abortions, rising from 6% in first pregnancies to 12% in sixth and later pregnancies. These figures show the increase in spontaneous abortions at the later states of the family, but the figures for the early stages of the family are greatly in excess of those found in Durham. Huntington describes Kopp's results as being secured *after careful questioning*, and it is probable that in such an investigation early abor-

tions would be counted which would be neglected by the Durham mothers as being unimportant to anyone. This might explain the disparity between the results, but it seems more probable that the explanation lies in part in a real difference of material. The 10,000 New York mothers had had an *average* of 4 pregnancies each—a figure only reached in Durham among the miners' families, among whom a significantly high proportion of the large rapidly-bred families were found. Since it is among these families that abortions are commonest, this doubtless provides an explanation of some at least of the difference.

Table XVII and XVIII show Kopp's figures for the proportion of abortions at each stage of family and also at each stage of pregnancy. Table XVIII shows considerable disparity between Kopp's results on the latter question and similar figures from a German source also quoted by Huntington. (Page 83).

The evidence relating to miscarriages is always unsatisfactory and the limitations of the evidence here adduced must be stressed, but it does refer to much larger groups of women than has been elsewhere given, and may prove of use to other investigators.

3. The influence of multiple births on total child death-rates.

At an early stage in the investigation it became obvious that irrespective of their place in family, the death-rate among twins is abnormally high. The distribution of multiple births according to place in family, and the ante-natal and neo-natal and later death-rates was studied. The results are shown in Table XIX. Among the 16,500 children there were 15·6 per 1000 twin births, and eight sets of triplets. Of the latter, only three children survived to the age of five years, six being still-born and fifteen dying in the first month of life.

From Table XIX (page 84) the following facts may also be noted.

(1). The number of twin births per 1000 total births rises steadily from 10·7 in first births to 29·1 in sixth, and thereafter varies erratically round a figure about twice that characteristic of first births. (The failure to rise beyond the sixth birth may be associated with the increase in abortions beyond this point, but of this there is no direct evidence).

(2). The still-birth rate is high at all stages, and for all the twin children is from two to three times that of the whole 16,500.

(3). The neo-natal rate at 259/1000 is about 6 times that of the whole group.

(4). The death-rate between one month and twelve (IM') at 56/1000 is nearly twice the ordinary rate.

(5). The death-rate between one and five years compares quite favourably at 27/1000 with the 31·6/1000 of the whole group.

(6). The total death-rate up to five years of age is 441/1000.

(7). The drop in still-births between first and second children from 144/1000 to 93/1000 is offset by a rise in subsequent deaths.

(8). The very high total death-rate at all stages of family indicates that multiple-births produce children of low vitality whose chance of surviving to the end of the first year is very small. The sturdier ones who do survive, however, thereafter display quite normal death-rates.

Analysis of the details concerning the twin births show also that in 79 cases out of the total 257, both children died before reaching the age of five. Only in 6 cases however were both children still-born.

These figures for twins may be compared with those taken from the reports of three large maternity hospitals (Table XX). From these it may be noticed that the twinning-rate in emergency cases (or in in-patients in the one hospital which classed all its in-patients together) is much higher than in 'booked' cases or among out-patients. This probably indicates a relation between multiple births and obstetric complications, which will again be noted in dealing with maternal mortality. (Table XX., page 84).

The figure usually given for twin-births for the population of this country is about 1 in 80 to 90 or 11 to 12/1000 (Eden and Holland). It would thus seem that the booked and district patients of hospitals 1 and 2 are similar in this respect to the total population, but that the emergency cases of these hospitals and all the patients of hospital 3 are characterised by a higher twinning-rate. It may also be noted that where the still-birth and death-rate in hospital is given separately for twins, these rates show no significant improvement over the Durham figures :—the superior facilities of hospital have given no markedly more successful results. Clearly multiple births have a very special set of problems.

That there is a considerable hereditary factor in the production of twins seems to be generally recognised. County Durham is an area in which in the past the villages and small towns have tended to be cut off from each other and in which in-breeding might be expected to occur frequently. This might be hazarded as a possible explanation of the high twinning-rate, but the increase in twinning-rate with place in family seems to indicate that it is not the sole explanation. The appallingly high death-rate among twins, and even more markedly among triplets, seems to justify the conclusion that multiple births are an undesirable abnormality. The fact that total death-rate increases with place in family and that twinning-rate changes in the same way suggest that both may be influenced by unsuitable environment, and that the latter is related to size of family. It is possible that beside the hereditary factor there is some environmental influence. It is interesting to speculate that some adverse factor might influence the splitting of the ovum to give uniovular twins, but it was not possible to get evidence as to the distribution of these.

Whatever determines the twinning-rate, the latter may be of considerable importance in the total infant death-rate. In the year under consideration, the twinning-rate in this area exceeded the average for the whole country by 4 to 5 sets of twins per 1000 births. As the still-birth plus infant death-rate among these twins is 451/1000, it may be seen that this excess of twins contributed about 4/1000 of the roughly 20/1000 by which the still-birth and infant death-rate in the area exceeded that for the country.

The problem of multiple births is one which would repay study, as will be seen later in the investigation of factors influencing maternal mortality.

Tables I. — XX.

Pertaining to Part I.

TABLE I.

DEATH RATES PER 1000 OF THE POPULATION AT EACH AGE.

1931	England and Wales.				Durham-Administrative County.				Durham County Boroughs.			
	Male.		Female.		Male.		Female.		Male.		Female.	
Age	D.	D-A	D.	D-A	D.	D-A	D.	D-A	D.	D-A	D.	D-A
0- 5	22·1	21·4	17·2	15·3	30·8	30·2	24·4	23·8	40·9	40·0	31·5	31·1
5-15	1·9	1·6	1·7	1·6	2·2	2·0	2·3	2·1	3·1	2·9	2·7	2·6
15-25	2·9	2·3	2·6	2·5	3·9	3·2	3·8	3·6	4·5	4·0	3·8	3·7
25-35	3·7	3·1	3·3	3·1	3·8	3·3	3·9	3·8	4·9	4·3	4·6	4·4
35-45	5·9	5·3	4·5	4·3	6·1	5·3	6·0	5·9	8·8	8·0	5·4	5·3
45-55	11·6	10·7	8·2	7·9	9·6	8·5	9·1	8·8	13·6	12·7	10·5	10·2
55-65	24·1	22·7	17·8	17·4	21·6	20·5	20·7	20·4	25·9	24·9	20·8	20·5
65–	86·5	84·3	75·9	74·3	83·9	82·4	78·8	77·3	86·9	84·7	77·5	75·8
15- 45	**4·0**	**3·4**	**3·4**	**3·3**	**4·5**	**3·8**	**4·5**	**4·4**	**5·8**	**5·0**	**4·5**	**4·4**
1921												
0- 5	31·6	30·9	25·2	24·6	46·3	45·7	37·8	37·3	47·1	46·3	38·8	38·2
5-15	2·2	1·9	2·2	2·1	2·8	2·5	2·9	2·8	3·1	2·7	2·8	2·7
15-45	**4·4**	**3·9**	**3·8**	**3·7**	**4·6**	**3·9**	**4·9**	**4·8**	**6·2**	**5·5**	**4·8**	**4·6**
45-65	18·0	16·9	13·3	13·0	16·4	15·3	14·8	14·6	20·6	19·4	16·3	15·7
65 +	79·0	78·1	73·2	72·2	83·0	81·2	77·3	75·6	94·5	92·6	82·1	80·7

TABLE II.

DEATH-RATE PER 1000 WOMEN PER ANNUM.

S = single M = married

Age Group	1910-12		1920-22		1930-32	
	S.	M.	S.	M.	S.	M.
15-20 years ...	2·6	6·2	2·6	4·3	2·3	3·8
20-25 years ...	2·9	3·9	3·1	3·7	2·7	3·0

TABLE III.

DEATHS PER 1000 TOTAL BIRTHS.

Group	SB	IM	CM	TM
Total 17049	40·1	75·7	31·1	146·9
75 of unknown maternal age or parity	80·0	93·4	13·3	186·7
990 of unknown maternal age	35·4	75·7	26·2	137·3
15,510 of known age and parity	40·0	77·0	31·9	148·9
16,500 of known parity ...	39·8	77·0	31·6	148·4
474 "unvisited" Group S. ...	44·3	29·5	16·9	90·7

TABLE IV.

DEATH-RATES AT DIFFERENT AGES IN RELATION TO BIRTH-RANK OF CHILD.

(NN + IM' = IM)

Parity	% of Total	No.	SB	NN	IM'	CM	TM	SB + NN	IM' + CM	NN+IM' =IM
1	29·5	4866	43·2	39·5	26·3	23·4	132·4	82·7	49·7	65·8
2	20·1	3305	25·7	33·9	32·7	29·7	122·0	59·6	62·4	66·6
3	14·3	2359	31·8	28·4	35·2	34·8	130·2	60·2	70·0	63·6
4	10·5	1733	34·6	35·2	49·6	32·3	151·7	69·8	81·9	84·8
5	7·5	1243	40·2	34·6	37·8	41·2	153·8	74·8	79·0	72·4
6	5·6	927	48·5	58·3	43·1	36·7	186·6	106·8	79·8	101·4
7	4·1	684	68·7	67·2	30·8	43·9	210·6	135·9	74·7	98·0
8	2·8	470	70·2	74·5	38·3	38·3	221·3	144·7	76·6	112·8
9	2·0	332	39·1	69·3	66·2	45·3	219·9	108·4	111·5	135·5
10	1·4	230	56·5	69·5	47·9	30·5	204·4	126·0	78·4	117·4
11	0·8	139	64·8	79·2	50·8	36·0	230·8	144·0	86·8	130·0
12	0·55	91	77·0	66·0	88·0	44·0	275	143·0	132·0	154·0
13	0·35	60	50·0	100·0	66·6	50·0	267	150·0	116·0	166·6
13 +	0·35	61	98·3	115·0	131·0	65·6	410	213·3	296·6	246·0
9 &9 +	5·45	913	55·9	75·6	65·7	41·6	238·8	131·5	107·3	141·3
All	100·0	16500								

TABLE V.

VARIATION OF DEATH-RATES WITH AGE OF MOTHER.

Age	% of total	No.	Type of area	SB	IM	CM	Mean of Rural and Urban			
							SB	IM	CM	TM
Under 20	4·0	340	Rural	23·5	120·5	26·5	25·8	122·2	27·4	175·4
		281	Urban	28·5	124·5	28·5				
20-25	25·2	2026	Rural	32·1	67·6	29·1	31·5	70·9	31·5	133·9
		1883	Urban	30·8	74·3	34·3				
25-30	28·6	2197	Rural	29·6	63·7	33·7	36·3	62·5	30·9	129·7
		2237	Urban	42·9	61·2	27·7				
30-35	20·7	1681	Rural	38·1	72·1	36·3	41·7	74·8	35·2	151·7
		1527	Urban	45·9	77·9	34·1				
35-40	14·9	1196	Rural	46·0	85·3	38·5	48·9	87·0	31·6	167·5
		1116	Urban	52·0	88·7	24·2				
40-45	5·9	491	Rural	65·2	110·0	34·6	68·3	113·7	32·5	214·5
		432	Urban	71·8	115·8	30·1				
45 +	0·7	103	Rural	}			107·0	194·0	29·1	330·0
			Urban	}						

Age group 20-25 refers to all women who have reached 20 but are under 25, etc.

TABLE VI.

DEATH-RATE AMONG CHILDREN ACCORDING TO THE AGE OF THE MOTHER IN ALL FIRST CHILDREN AND ILLEGITIMATE FIRST CHILDREN.

	Maternal Age	No. in group	SB	Death Rates per 1000 IM	CM	TM
All children ...	under 17	29	—	276	—	276
Illeg. children ...	,, 17	26	—	270	—	270
All children ...	17	81	12·3	123	74	209·3
Illeg. children ...	17	38	26·3	133	26·3	185·6
All children ...	18	159	31·4	138·3	18·9	188·6
Illeg. children ...	18	48	20·8	166·5	20·8	208·1
All children ...	19	299	30·1	93·7	26·7	150·5
Illeg. children ...	19	66	45·4	75·8	15·1	136·3
All children ...	under 20	568	26·4	120	29·9	176·3
Illeg. children ...	,, 20	178	28·1	146·1	16·8	191·0
All children ...	20-25	2324	40·4	63·7	25·4	129·5
Illeg. children ...	20-25	201	44·8	64·7	34·8	144·3

TABLE VII.

CHANGE IN DEATH-RATES WITH INCREASE IN MATERNAL AGE AND PARITY.

Parity.	DEATH-RATES PER 1000 TOTAL BIRTHS.														
	30-35 years.					MATERNAL AGE. 35-40 years					40+ years.				
	No.	SB	IM	CM	TM	No.	SB	IM	CM	TM	No.	SB	IM	CM	TM
1	345	69·6	49·3	8·7	127·6	129°	69·8	77·5	31·0	178·3					
2,3,4	1625	31·4	65·2	32·0	128·6	727	44·0	61·9	22·0	127·9	168	77·4	119·1	11·9	208·4
5 &6	850	38·9	88·3	41·2	168·4	606	44·5	77·6	38·0	160·1	182	65·9	77·0	27·5	170·4
7 &8	383†	70·5	112.6	65·3	248·4	496	52·4	96·8	30·2	179·4	222	99·1	112·6	36·0	247·7
8+						*449	49·0	133·7	40·1	222·8	433	62·3	143·1	41·6	247·0

° All over 35 † All under 35 * All under 40.

TABLE VIII.

MATERNAL AGE AT WHICH MOST CHILDREN ARE BORN IN EACH BIRTH-RANK.

Birth-rank	Maternal Age.					
	20	20-25	25-30	30-35	35-40	40+
1	568	2324	1215	345	108	21
2	50	1071	1246	498	176	35
3	3	394	948	580	241	34
4	—	96	567	547	310	99
5	—	21	270	498	294	85
6	—	1	119	353	313	97
7	—	2	54	201	289	110
8	—	—	10	116	207	112
9 & 9 + ...	—	—	5	69	375	433

Modal period outlined

TABLE IX.

DEATH-RATES IN GROUPS a, b, c, d (per 1000 births).

Group	Number	SB	IM	CM	TM
All births ...	16,500	39·8	77·0	31·6	148·4
All 1st to 6th births ...	14,433	36·4	70·1	30·1	136·6
a ...	2,593	23·9	89·5	38·2	151·6
b (modal group)	5,936	34·9	67·2	30·6	132·7
c ...	3,447	40·0	63·5	29·0	132·5
d ...	1,551	58·0	69·1	19·3	146·4
Unknown age ...	906	33·2	70·7	26·5	130·4
x ...	1,071	18·6	76·6	39·0	134·2
a' ...	1,522	27·6	98·6	37·5	163·7

TABLE X.

BIRTH WEIGHT OF CHILD AND AGE OF MOTHER.

FIRST CHILDREN.

Maternal age	20	20-25	25-30	30-35	Over 35
No. of children in group ...	86	316	190	70	20
Mean weight (lbs.)	7·3	7·4	7·6	7·8	8·0
% of total with birth weight of 9 lbs. or more	12·8	11·1	14·2	21·4	25·0

TABLE XI.

DEATH-RATES AMONG "PREVIOUS" CHILDREN.

Birth order of child born in 1930	No. of children of that birth order in 1930	No. of previous pregnancies.	Deaths per 1000 pregnancies.			SB†D† MC	SB†D	TM' Calculated death-rate up to 5 yrs	Calculated death-rate up to 20 yrs.
			SB	Deaths (D)	MC (Miscarriages)				
2	3305	3305	31·4	82·6	10·9	124·9	114	132	162-172
3	2359	4718	27·8	114·6	10·8	153·2	142	127	157-167
4	1733	5199	31·7	120	18·2	170	152	128	158-168
5	1243	4972	25·9	139	18·7	184	165	134	164-174
6	927	4635	26·3	152	17·5	196	178	138	168-178
7	684	4104	28·3	164	28·3	220	192	146	176-186
8	470	3290	39·0	176	22·5	237	215	155	185-195
9	332	2656	32·8	182	32·4	247	215	163	193-203
10	230	2070	39·6	185	39·1	264	225	167	197-207
11	139	1390	24·4	208	47·5	280	232	173	203-213
12	91	1001	43·0	239	56·0	338	282	178	208-218
13	60	720	40·0	249	66·6	356	289	187	217-227
13 +	61	817	48·9	303	89·4	441	352	192	222-232
Total	11634	38877	31·1	152	24·6	207	183	—	

TABLE XII.

TOTAL DEATHS PER 1000 PREGNANCIES (SB + deaths + miscarriages) AMONG PREVIOUS PREGNANCIES, ACCORDING TO BIRTH-RANK OF CHILD BORN IN 1930, AND AGE OF MOTHER THEN.

Pregnancy in 1930	4th		5th		6th		7th		12th	
Mother's age group in 1930 ...	25-30	35-40	25-30	35-40	25-30	35-40	less than 30	Over 40	less than 40	Over 40
Total deaths per 1000 among previous pregnancies	190	148	212	150	265	180	310	170	400	300

TABLE XIII.

DEATH-RATES PER 1000 CHILDREN BORN ALIVE ACCORDING TO MARRIAGE AGE OF MOTHER (MA), DURATION OF MARRIAGE (DM) AND NUMBER OF CHILDREN. (Figures from the Census of England and Wales 1911, Vol. XIII, Fertility of Marriage, Part II).

DM	Number of children born alive	MA			
		15-20	20-25	25-30	30-35
0- 5	1	84	62	52	61
	2	127	107	94	97
	3	212	176	145	150
5-10	1	90	68	63	76
	2	104	93	87	98
	3	144	125	116	127
25-30	1	136	131	129	131
	2	171	145	139	171
	3	182	169	167	188
5-10	7	340	313	268	283
	8	408	365	320	262
	9	522	344	266	253
25-30	7	214	208	214	258
	8	221	217	233	278
	9	226	225	248	287
25-30	10	244	243	273	349
	11	254	255	302	—
	12	276	290	347	—

TABLE XIV.

Comparison of death-rates per 1000 children born alive among the best biological groups of the previous children in the Durham families with those found in families of similar size in the 1911 report, taking the minimum possible death-rate for the latter group.

Birth rank of child born in 1930	Mother's age in 1930	Death-rate among previous children born alive	Minimum death-rate for comparable group in 1911 report
2 ...	25-30	66	52
3 ...	25-30	105	93
4 ...	35-40	109	129
5 ...	35-40	121	150
6 ...	35-40	153	161
7 ...	40 +	139	187
8 ...	40 +	164	187
9 ...	40 +	163	197
10 ...	40 +	170	209
11 ...	40 +	222	219
12 ...	40 +	246	241
13 ...	40 +	279	254

TABLE XV.

DISTRIBUTION OF MISCARRIAGES ACCORDING TO THE PARITY OF THE MOTHER (OR BIRTH-RANK OF CHILD).

(Calculated from previous pregnancies).

Parity of Mother or birth-rank of child	Miscarriages per 1000 pregnancies	
1	10·9	
2	10·8	
3	33·2	
4	20·2	22·0
5	12·7	
6	82·3	
7	—12·7	57·0
8	101·7	
9	92·7	
10	123·1	118·9
11	141	
12	183	
13	401	

TABLE XVI.

NUMBER OF WOMEN HAVING HAD VARYING NUMBER OF MISCARRIAGES AT DIFFERENT STAGES OF FAMILY.

No. of miscarriages per woman		No. of women having had number of miscarriages below							
		1	2	3	4	5	6	7	10
Birth rank of 1930 child	No. of MCs in prev. pregnan.								
2	36	36							
3	51	49	1						
4	95	73	5	4					
5	93	61	10	4					
6	81	52	8	3	1				
7	116	74	13	2	0	2			
8	74	45	13	1					
9	86	42	13	6					
10	81	23	12	3	2	1	2		
11	66	15	13	3	1	1	—	1	
12	56	13	8	2	2	0	1	1	
13	48	11	6	7	1				
13 +	73	15	8	4	2	1	0	1	1

TABLE XVII.

BIRTH RANK AND PROPORTION OF SPONTANEOUS ABORTIONS.

(Taken from Huntington).

Birth-rank	No. of pregnancies (Kopp)	% terminated by spontaneous abortion (Kopp)
1 ...	9583	6
2 ...	8101	7
3 ...	6271	9
4 ...	4593	9
5 ...	3242	9
6 ...	2273	12
7 ...	1579	11
8 ...	1071	13
9 ...	709	12
10 & 10 + ...	1563	10

TABLE XVIII.

PERCENTAGE OF ABORTIONS AT DIFFERENT STAGES OF PREGNANCY.

(Taken from Huntington).

Month	3060 spontaneous abortions (Kopp)	7166 induced (Kopp)	Spontaneous and induced at Magdeburg
1	9	27	0·4
2	42	58	8·0
3	32	13	34·0
4	17	2	31·0
5			16·0
6			7·0

TABLE XIX.

PROPORTION OF TWINS AT DIFFERENT BIRTH-RANK AND DEATH-RATE AMONG TWINS AND TRIPLETS.

Birth order	No. of births	No. of twin births	Twin births per 1000 births	Death-rate among twins per 1000 twin children born					Sets of Triplets	
				SB	NN	IM[1]	CM	TM	No. of sets	Fate of children
1	4866	52	10·7	144	260	38·5	9·7	452	2	2NN 1a 3SB
2	3305	43	13·0	93	278	46·5	46·5	464	1	2 SB 1 NN
3	2359	40	16·9	150	200	62·5	50·0	462		
4	1733	26	15·0	77	193	96·3	30·6	397		
5	1243	28	22·5	53	161	71	0	285	1	3 NN
6	927	27	29·1	93	296	37	55	481	1	2 a 1 NN
7-9	1486	28	18·8	35·7	357	90	0	483	2	1 SB 5 NN
10 & 10+	581	13	22·3	77	385	38	0	500		
Total	16500	257	15·6	99	259	56	27	441		

a—alive

TABLE XX.

DISTRIBUTION OF TWINS IN HOSPITAL CASES, AND STILL-BIRTHS AND INFANT-DEATHS IN HOSPITAL AMONG TWINS.

Hospital	Type of case	No.	Twins per 1000 births	SB per 1000 twin children	Deaths in hospital per 1000 children
1	District	3776	11	—	—
	In-patients booked	6267	11	123	196
	In-patients (emergencies)	2141	25	195	250
	Total ...	12184	14	155	220
2	District	3547	10	—	—
	In-patients	5990	18	—	—
	Total ...	9537	15	—	—
3	Booked ...	7104	16	126	—
	Emergencies	3705	24	189	—
	Others ...	1150	23	77	—
	Total ...	11959	19	145	—

PART II.

SOME SOCIAL FACTORS INFLUENCING INFANT AND CHILD MORTALITY.

CHAPTER VII.

THE PROBLEM.

Any study of the part played by social factors in influencing mortality rates was not originally envisaged, but the occupation of the father, the number of rooms occupied per family, and the number of people in the household were recorded, to prevent any chance of changes being attributed to biological factors which were clearly more closely related to social amenities.

As already indicated, some families were either not visited at all, or were visited only once, because their general social position was such as to make it clear that they would normally receive all necessary help from their own medical adviser. (After all, two sets of advice, possibly conflicting, are to be avoided). The death-rate among the children in these families was recorded, and is shown in Table III, Group S. As has been noted the still-birth rate is a little higher than that of the 16,500 (Table III), though this difference is not significant, but the death-rate from birth to five years at 46/1000 is less than half that of the rest of the child community. The apparently curious fact that the ante- or intra-natal death rate is not diminished by superior social amenities, but the post-natal death-rate up to five is halved, seems to call for some further analysis of the influence of social position on health. It seems necessary first to consider in what ways social position may influence health. In general, improved social position may be taken to indicate increased opportunities to secure certain goods and services. The environmental conditions which are important to health and are determined broadly by social position may possibly be enumerated as follows :— (Table III., page 76).

(1) Food.
(2) Clothes.
(3) Shelter.
(4) External warmth.
(5) Exposure to infection.
(6) Exposure to certain conditions, industrial and otherwise, pre-disposing to certain definite types of disease.
(7) In the case of children, the available care of some adult.
(8) In the case of the sick, skilled attention.

Exposure to adverse industrial conditions will only very indirectly influence the health of the children, and is a specialist concern. Exposure to infection is probably in the main determined on the one hand by contact with people suffering from disease, or with materials which have been in contact with them, and on the other by the efficiency of the public control of the sanitary services. Any considerable congestion of people will increase the first possibility, and render more difficult the problems of an efficient sanitary service. Broadly, therefore, it would seem that the amount of house space per person which can be commanded is of primary importance here, but it is at least possible

that the supply of beds and linen is of considerable relevance. It would therefore seem that the number of rooms per person in any household might be an approximate measure of the possible spread of disease in a family, once the disease had been introduced. The congestion of the population per acre is perhaps some measure of the likelihood that any infectious disease may be introduced there. Large numbers of people going about their work and returning to one area must greatly increase the chance of contact with infection. Clothes, shelter (housing) and the artificial warming of the latter may all be regarded as determining the capacity to control the environment to avoid sharp contrasts of conditions. The problem of food is so much aired that at this stage nothing need be said except that the process of relating clothes, housing, fuel and food to each other and to social position bristles with difficulty. Measurements of any kind are almost impossible to achieve. Even more difficult is it to measure the grade and amount of care available for children and for the sick, except in so far as such care is provided by public services or voluntary organizations.

In the last forty years, many attempts have been made to study the various factors influencing health by means of carefully controlled animal experiments, and it seemed possible that such experiments might serve as a basis for the analysis of the social pattern which grew up gradually from the records of these human lives.

Much valuable information has been secured from these animal experiments, but a careful examination of the nature of the experiments makes it clear that the direct applicability of this information to human problems is often doubtful. Recently a paper has been published on the influence of certain diets on the growth, appearance of health, reproductive capacity and longevity of rats (Sherman and Campbell 1937). The least good of these diets was carefully thought out to contain all the known essential nutritional elements. All other conditions essential to health such as room temperature, etc. were carefully controlled. This experiment made clear two things. (1) That diets successful in promoting *good growth* and the appearance of *good health* in the *young* may not necessarily increase *longevity* or *improve reproductive capacity*, and vice versa. (2) These rats which were given diets greatly superior, as judged by the usual physiological standards, to the diets enjoyed by large numbers of people, and whose physical environment was maintained at a high level, showed an infant mortality rate of 440/1000 in the best group and 540/1000 in the worst. (It is not clear whether this included still-births or not). But while this kind of death-rate in the young is comparable to that among primitive peoples as described by Orr and Gilks [1931], it seems to indicate a state of affairs which has little relevance to the problems of health among children in this country. Study of a number of similar experiments has shewn that the death-rates common among the rats used in them are of a similar order. Orr, Thomson and Garry [1936] published the results of a long term experiment with rats on a human dietary. They found that among the group given a diet which contained twice as much milk as the diet of a large section of poor people [Burns 1933], but in which the other constituents were similar to the diet of the latter, the still-birth rate + death-rate before weaning was approximately 200/1000, but fell to 120-130/1000 when the rats were allowed to eat

as much green food and milk as they liked *in addition to* the original diet. *These workers destroyed rats in all litters exceeding eight.* This makes their figures less readily comparable with those of other workers, since it is not clear how many they destroyed, nor whether they chose the animals at random, or slew the least fit. The animal houses in these experiments were maintained at a temperature of 68°-70° F, so that change of external temperature was avoided. Every care was taken to keep the conditions as hygienic as possible. Slonaker [1931] reported a similar long term experiment, in which diets differing in their protein content but believed to be complete in every essential were given to rats for several generations. The death-rate before weaning, in rats born alive, varied from 280/1000 to 500/1000—this despite a rigorous control over environment calculated to give the best possible conditions. It is of course very difficult to control hygienic conditions among rats. This also is true for the immediate environment of a human baby.

These colonies of experimental animals were not studied intensively with a view to improving the health of the rat population, but precisely with the object of applying information secured to the problems of human health. In order to decide how far this is justifiable it is necessary to consider just how far there are underlying biological factors common to the health of all mammals ; how far there are environmental factors common to the health of all, and how far there are striking and perhaps fundamental differences between the groups both as regards biological and environmental influences.

Experimental rat colonies seem to differ from human communities in the following fundamantal respects.

1. The rats are usually bred from stock of *known* heredity chosen for their *good* health. Human communities have hitherto been bred with a remarkable lack of consideration of the part played by heredity in health.

2. The rats are usually only permitted to breed at a controlled rate. In the experiments referred to, the breeding rate was the maximum that biological conditions allowed, with the one limitation that pregnancy and lactation were not permitted to overlap. In human communities, breeding rates are sometimes carefully controlled, sometimes not at all, and in this respect little comparison may be made between the two types of community.

3. Among the rats, apart from the particular factor studied, every care is taken to make conditions the *healthiest possible.*

4. Early diagnosis of many diseases in rats is difficult, and the special care of sick animals is usually of little avail by the time gross pathological conditions have been noted. *There is thus in the care of these animals absolutely nothing to compare with the medical and nursing care of sick and unfit children, which has done so much to permit the survival of the latter.*

It seems probable that among the human young there exists a much greater degree of malnutrition than occurred in any of the animal experiments described. In the League of Nations report on nutrition [1937] occurs the phrase "The malnutrition which exists in all countries

is at once a challenge and an opportunity—a challenge to men's consciences and an opportunity to eradicate a social evil." It is difficult to believe that "malnutrition which exists in all countries" can be absent from an area which has been industrially stagnant for many years, even although the area has been a pioneer in the development of the social services. Yet notwithstanding this, and the poverty which touches life at all points and is associated with prolonged unemployment, a much larger proportion of the human young born in this area are reared over the early stages of life than in the scientifically bred, well-fed, much cared-for animal colonies. This appears to be accomplished by the *concentration of care on the individual child*,—in the first place parental care, and where necessary, specially skilled care. Our human community has not succeeded in providing for all ideal physical conditions for health and growth, but has *built up an elaborate scheme for caring for the health of those who fall below a certain level.* Whether great improvement in the food and physical conditions of the majority of the people would greatly decrease the numbers of the sick and unfit would seem to be rather a matter for experiment than speculation. Casual survey of the more prosperous classes would not seem to indicate that all the biological problems of abounding health have yet been solved.

Since, broadly speaking, in any community with a money economy, food, housing, care, etc. all tend to vary with money income, it is very difficult in any study of the influence of social factors to determine which is the most important one.

What social factors can be measured with any degree of reliability?

1 Food.

Many food surveys have been carried out of recent years and two of them, Cathcart et al [1924] and Burns [1933] refer to the area under consideration. Cathcart studied the type and amount of food consumed in certain Durham miners' households, and compared this with the food consumption among Derbyshire miners who were at that time markedly more prosperous. He also studied the weight and height of the Durham miners' children and compared them with (*a*) children of the same age in Glasgow and Derbyshire, (*b*) all children of the same age in Durham schools. Cathcart says, "Taking the available data as a whole it will be seen from the graphs that in height the miners' sons (all areas) are the same as the boys of Class B schools (poor, but not the poorest, districts) in Glasgow, but that in weight they are about 1 lb. less at each age. In height, the miners' daughters are slightly above the Glasgow girls of Class B schools, and in weight, slightly below at the early and late ages, though approximately the same at ages 9 to 12." Later he says, "In Derbyshire, where the weekly income per 'man' of the miners' families examined is 16s. and the calorie intake 3,336, at ages 4-13 the heights for boys at all schools was above that of miners' sons (44 in number) except at the two extreme ends of the curve. In weight, the miners' sons were slightly below at the ages 8-11. In the case of miners' daughters (50 in number) the general trend was the same as in Derbyshire school girls in general, though there was a good deal of fluctuation in the individual age groups owing to the small

numbers. In weight they were slightly below the general average except at the ages 7, 8, and 9.

In Durham, where the weekly income per 'man' of the miners' families examined is only 9s. and the calorie intake 2,830, the miners' sons (53 in number) are below the general school standard in height except at age 6 (in which group there are only two observations) ; and in weight they are well below the general average, most nearly approaching at the two extreme ends of the curve. In height the miners' daughters (57 in number) more nearly approach the general standard for the county than do the boys, but only at ages 6 and 11 do they exceed it. In weight they at no point exceed the standard, approaching it only at ages 6, 8 and 11". After further analysis of the evidence, Cathcart concludes, *"Consequently we are entitled to infer that the children in our sample of Durham miners' families are, judged by the standard of all school children in the county, under weight"*.

This at least suggested that in 1924 the general health of miners' children in the county was inferior to that of other children, and that this might be associated with food intake.

For 1931, Burns gave figures secured with the co-operation of the County Medical Officer of Health, and the Superintendent Health Visitor for the area. This related milk purchase to income (less rent) in 1000 families of known size who were receiving milk assistance. It was clear that in these families milk consumption, apart from that allowed at nominal price was very low. Moreover in most of the 1000 families, the income did not permit of much increase in such milk consumption.

The extent to which the food of children has needed to be supplemented for some years may be deduced from the following figures taken from the County Medical Officer's reports. During the years 1930-1936 there was always approximately 50,000 children between birth and five years of age under the care of the health visitors ; of these children about 30% occurred in about 15% of the homes where there were two children under five, and about 7% of the children were in 2% of the homes where there were three or more children under five. In 1937, the actual figures were 56,718 children in 45,065 homes. This means that in any year there were roughly 40,000 homes in which there were children who were of the age potentially to receive milk assistance from the maternity and child welfare centres. In addition, during the period under review about 4000 pregnant women annually attended the ante-natal clinics. So that some 44,000 households might each year have received milk assistance if necessity had arisen. The actual numbers receiving such assistance from 1930-1936 were 9,560, 12,355, 13,352, 9,678, 10,189, 11,180 and 10,326, *i.e.* throughout the period, some 20-25% of mothers and children covered by the maternity and child welfare work were deemed to need this particular form of assistance. This supports the evidence adduced by Cathcart of a low nutritional level, although, of course, neither the 1000 families studied by Burns, nor the 44,000 households referred to above were necessarily miners. Of the 17,049 births studied in 1930, 9.296 belonged to the mining population. (It might have been expected that the gardens with which many miners are provided, and of which they appear to make excellent use, would have in some degree improved their diet as against urban workers of the same financial level).

2. Father's Employment.

Other social factors studied in the investigation relating to the children born in 1930 however show that food is only one of many such factors to be considered, before giving a purely biological interpretation to any figures. The first social factor recorded was the nature of the father's employment. This may influence the health of the children in the following ways :—

(*a*) By determining the place of residence (urban or rural conditions).

(*b*) By the standard of remuneration and the amenities purchasable.

(*c*) By variation in the security of employment and consequent variation in the standard of life.

(*d*) By the broad variations in the general standards of education and competence among those who seek to earn their living in different ways. These variations tend to make themselves felt in all an individual's contacts with life.

In 1911, 1921, and 1931 the Registrar-General published figures relating infant mortality to paternal occupation. He classified occupations into five groups, Group I being the professional classes, Group III skilled workers, Group V unskilled workers, with Groups II and IV as intermediates. Table XXII shows the death-rate per 1000 children born alive in each group. There is a steady rise from Group I to Group V, but *the rate in Group V in* 1931 *is that of Group I in* 1911. This might indicate a simple inverse relationship between poverty and survival chance, and this is party true, but there are complications. It seems at least possible that in the few years just after the war, before the economic depression had begun, and before the professional organisations had secured the re-adjustment of salaries to the changed conditions, that the financial gap between many teachers and clergymen on the one hand, and skilled men in industry on the other would be comparatively small, yet the infant death-rate among the children of teachers was in 1921 42/1000, and of clergymen 38/1000 as against 77/1000 among the children of skilled industrial workers. Further, in the case of miners, well paid then, if ever, the infant death-rate found was 103/1000. Clearly two of the factors of great importance here were those noted in this study—size of family and rate of breeding. This again is not enough to explain all anomalies. Farm labourers who usually have (or had) large families and low wages appeared in the list with an infant death-rate of 68/1000, to set against the 99/1000 of similarly paid town workers. Here fresh air and fresh food presumably gave an advantage to the rural families, despite the insanitary conditions of many rural cottages. But the children of fishermen who presumably have as favourable surroundings as farm labourers showed the relatively high death-rate of 99/1000. In-breeding perhaps accounts for much here but obviously there are many factors. (Table XXII, page 140). Some of these factors are considered in the next chapter.

CHAPTER VIII.

THE DIVISION OF THE CHILDREN INTO GROUPS ACCORDING TO THE OCCUPATION OF THE FATHERS.

In studying the whole group in the County Durham investigation, the influence of size of family and rate of breeding has been indicated. It is possible therefore to estimate how far these factors are responsible for determining differences in death-rate, when the children are classified according to the nature of the father's employment.

This classification is not however easy. Some form of grouping of occupations is essential as otherwise the figures would be too scanty and diffuse to be of value. But as has been already indicated, it is difficult to get groupings which *constantly* measure any important social conditions. Ultimately the following method was used. It was decided to accept as a basis the initial classification of the health visitors of those families to whom visits need not be paid, or to whom return visits were deemed unnecessary. This group was labelled 'S'. The occupations in this group comprised all the professions, 'business' men, colliery managers and officials, farmers, inn keepers, shop-keepers and managers, commercial travellers, clerks, electricians (if in business for themselves), engineers, draughtsmen, sanitary inspectors and one 'foreman'.

A second group was then prepared from the *visited* children by taking out all those whose father's occupation fell into the above list. It was found impossible to distinguish between shop-owners and assistants, as the phrase 'grocer-out-of-work' occurred. So to this second group all shop assistants were added. In view of the inclusion of the one foreman in Group S, all industrial workers who had attained to any supervisory capacity (*e.g.* deputy-officials in the mines) were also added to this second group. Since this group would be (it was hoped) intermediate socially between the manual workers on the one hand, and Group S on the other, from it were excluded the children of all men marked as unemployed, and also all families occupying less than three rooms. (This is an area where the modern labour-saving flat, with rooms specially designed to fulfil several different purposes, is unknown, and by any standard which does not include a living room as a bed-room, even parents and one child will be almost overcrowded in a two-roomed house). Actually among first children born to mothers under 25, there were 161 in group S^{I} and S^{II} (see below), and there were only 16 children whose fathers belonged to the occupations in the S groups who were excluded therefrom because the family only occupied two rooms. Among these 16 only one failed to reach 5 years of age and therefore their inclusion in the S^{I} and S^{II} groups would not have affected the figures for the latter. Similarly among first children born to women 25-30, there were 143 in the S groups, and there were only 9 children excluded from the group because the family lived in only two rooms. None of these nine died, so that again their inclusion in the S groups would not have raised the death-rates for the latter. Nevertheless, anyone acquainted with the type of housing in this area would find it very difficult to believe that the occupants of two-roomed houses enjoyed anything in the nature of middle-class amenities.

Finally then, groups S^{I} and S^{II} contained all the *visited* families in which the father was engaged in professional work, in business on his own account, in retail trade, in clerical work, and in management or supervision in industry, provided that the man was actually employed, and the family occupied at least three rooms. It was quite clear that these groups contained the owners of small general shops, ice-cream salesmen, etc. Those specifically described as hawkers were not included, but those described as 'vendors' and salesmen were so included. The S groups, therefore, included a number of people who did not enjoy any very considerable social amenities. Difficulties also arose in the process of differentiating between mechanics and engineers. It seemed possible that a man might be described by one person as an engineer and by another as a mechanic. If he appeared on the records as the former he was classed in one of the S groups ; if as the latter then he was not so classed. The dividing line was therefore not sharp. Moreover it was clearly recognised that many skilled men in industry would probably be much better off than many in retail trade, but in the case of a large proportion of the men in industry the only information given was the name of the employers, and no classification into skilled and unskilled could therefore be made. (See Appendix 4, page 226).

The visited families not included in the S^{I} or S^{II} groups were then divided into (1) Group M—where the father was employed in or about a mine. In this group was included anyone described as miner-out-of-work. (2) Group R. This contained all visited families who did not fall into Groups S^{I} S^{II} and M. In it were included all who were described as 'out-of-work' or 'on-the-dole' without any indication as to the nature of their occupation when employed, as well as all those whose occupations were given.

At the outset a difficulty arose about the 'unvisited' group. The cards in this group were usually marked 'no need to visit' or 'no need to re-visit'. But there were some cards referring to dead children whose families obviously belonged to the classes not usually visited, but which were not actually marked 'no need to visit'. Since a dead child would not in fact be further visited, it is clear that the above remark would be in any case redundant, although it was frequently put on cards to indicate that visits need not be paid to any subsequent children. It seemed however possible that the very low death-rate early noted in Group S might be accounted for by the fact that a certain number of dead children belonging to this class had not been marked 'no need for visits', and had therefore not been included in their proper class. Since the total number of children in this class was small, and the total number of deaths extremely small, the exclusion of a very few deaths would make a considerable difference to the death-rates. There were also quite a number of cases where the child was visited at intervals, but where the cards were labelled 'every care—no need to visit, but visits desired', etc. It seemed necessary to include these in the unvisited Group S, since again they so clearly belonged socially to the group.

Group S therefore finally contained those who actually were not visited, and those who fulfilled the following conditions. (1) The father's occupation was such that the family usually would be in the unvisited group. (2) The record card bore some remark indicating socially superior

home conditions. (3) For the birth of the child, the mother had engaged a doctor, and had resident in the house some woman capable of giving to mother and child all general care. This woman might be a qualified maternity nurse, or in some cases the special nursing of mother and child might be done by a visiting nurse, with a housekeeper for more general attention. In this area, it seemed to the writer to be generally true that much of the actual maternity nursing was done throughout the whole social range of which anything was known, by much the same women acting sometimes as midwives, and sometimes as maternity nurses, and that it was much more in the *general full-time care of the mother and child that differences in social amenities occurred.* Group S' occupied more than 4 rooms; S", 3 or 4.

The separating out of Groups S' and S" was prompted by the difficulty of delimiting Group S. It was thought that any tendency for dead children to be classed with the visited instead of the unvisited would then show itself by an inflated death-rate in the S' or S" groups.

Table XXI, page 139 shows the most important facts about the different social groups. (Few details were of course available for the unvisited group).

1. Among *all* the members of the respective groups, the highest still-birth rate *for* 1930. is found in *Group S*

2. The neo-natal death-rate, the rate between one month and one year, and the rate between one year and five all fall steadily from the M (miners) to the S group. although there is little difference between the S group and the S' + S" groups *after the first month.*

3. In *every* group the still-birth and neo-natal death-rate is very high in first children and falls to a much lower figure for seconds and thirds. In Group R there is a rise in later death-rates among second and third children which more than compensates for the fall in still-birth rate. Both Group M and Group S' and S" have however excessively high still-birth rates in first children (for quite different reasons which will be dealt with later), and the considerable fall in still-birth rate between first and the next two children is not quite compensated for by rise in later death rates.

4. After the second and third children, there is a steady rise in death-rates at the *later stage of family in each social group.*

5. In seventh and subsequent children differences between the social groups is proportionately reduced.

6. The distribution of size of family is very different in the different groups. Among Group S' + S", 77·5% of all children are first, second or thirds, with low death-rates, and only 4% are seventh or later children with high death rates. The corresponding figures for miners are 59% and 14%.

Clearly however the biological influence of the mother's parity makes itself felt in all the social groups. The influence of maternal age will be discussed later.

The report of the Registrar-General [1921] relating infant mortality to father's occupation showed that the children of farm-labourers had death-rates which were low relative to the children of similarly paid urban labourers. In group R, there were altogether 213 children of farmers occupying less than three rooms, or of farm labourers. The distribution of these children by birth-rank was very similar to that in Group R as a whole, viz. 1st 32·4%, 2nd and 3rd, 30·5% ; 4th, 5th and 6th, 25·4% and 7th and later children, 11·7%. The death-rates were SB, 42·2/1000, IM 70·4/1000, CM 23·5/1000 and TM 136·1/1000. This indicates no superiority over Group R, but considerable superiority over Group M. In particular, this group of rural children show a marked superiority over miners' children in the 1 year to 5 years stage. The significance of this is not obvious. The steady superiority of the R group over the M group is very impressive since both belong to what are broadly regarded as the same social class, and are subjected to similar climatic conditions and to much the same 'services'. Perhaps before the significance of these differences is discussed some study of the nature of the occupations classified under R is desirable. There were 5,512 children in Group R, and it did not seem possible to classify the occupations of all the parents, but there were 879 first children in this social group born to mothers under 25, and this one sub-group was examined in great detail. The details available concerning the occupations of the fathers in this group are given in Appendix 4, but Table XXIII shows an attempt to classify these workers into two groups.

(*a*) Those who are performing the essential services which supply the daily needs of a community, even if that community is living largely in enforced idleness on grants from the state. This group may perhaps be regarded as relatively immune from unemployment though in a depressed area, it can hardly be prosperous.

(*b*) Those who are directly employed in industry, or in undertakings such as transport where the work available is largely dependent on industrial activity. Group (*a*) contained 158 workers and Group (*b*) 626. A further 95 made up the total 879. These were men whose occupation was either not stated, or who were simply described as out-of-work. The main industries of the area, apart from mining, centre round ship-building and iron and steel. During the period studied these industries were fully as depressed as the mining industry, and the county health area included some of the most 'distressed' areas of the country. The other industries, brick-works, quarries, chemical works, etc. suffered from the trade depression to a varying degree. Under-employment seems to have been very general. Some industries were relatively prosperous—in one area a new industry was attracting workers from other parts, and the number of children reaching five years of age there in 1935 was 20%-30% higher than the number born in 1930. Group R therefore contained some 20% of workers relatively immune to unemployment, and 80% whose condition varied from comparative prosperity to industrial devastation. It is perhaps true that Group R suffered on the whole less from unemployment than Group M, but the former contained a considerable proportion of casual labourers (whose children showed a very high infant death-rate in the Registrar-General's Special Reports of 1921 and 1931).

The actual numbers of men recorded as unemployed on the record cards was not studied for all the 16,500, but for all first and seventh children, there were between 5% and 6% so recorded. Since even now (May 1938) after considerable recovery has taken place, the figures for unemployment in the area as taken from the daily press are 15-20% of all insured workers, and in 1930 were more than 25%, it seems improbable that the recorded figures were any real measure of unemployment, although the figures might be influenced by the fact that unemployment is heaviest among older men least likely to appear as fathers of new babies.

It seemed generally true that only men were described as unemployed whose chance of employment had practically disappeared because of the permanent shutting-down of the industrial concern employing them. This was supported by the fact that the heaviest figures for unemployment were recorded in certain areas where the main industry had ceased.

On the whole therefore the miners may have suffered more from unemployment during the period studied than the Group R, but it is doubtful whether there was any great difference.

Death-rates in different social groups.

It has already been noted that the death-rates in Group M are significantly higher than in Group R in all but the largest families. The total infant-death-rate (from birth to 1 year) among Group M for 1930 is 82·9/1000 on all births, or 85/1000 on live births. Thus despite the prolonged depression in the industry, this figure shows a very marked improvement on the figures of 100-110/1000 given by the Registrar-General in 1921 for miners' children in England and Wales, and is very similar to the figures he gives for various categories of mine-workers in 1931, *i.e.* 81·6 and 82·8/1000. Clearly, unemployment is only one of many factors. Table XXI indicates that size of family is a second factor.

Detailed examination of the biological groups also shows that rate of breeding is another factor. Miners' children form 51% of all first children, but 60% of legitimate first children of mothers under 20. Similarly they form 58% of all second children, but 66% of all seconds born to mothers under 25, etc. Some part of the excess death-rate in this group is due therefore to the fact that even *compared with other manual workers, miners marry young and breed large families rapidly.* This is no new phenomenon. In his special report [1911] the Registrar-General says "*A second inference which may be drawn from this relationship is the need for great caution in comparing the infant or child mortalities of different occupations or sections of society. The fact that the child mortality experienced by coal miners during the first five years of marriage is more than double that of the middle classes must be viewed in light of the fact that their standardized fertility is* 51% *in excess, and that therefore the much larger size of their families would of itself lead to considerable excess of mortality in their case. Without a record of the numbers of families of different sizes in each occupation and of the corresponding deaths, it is impossible to measure the effect of this consideration, but there can be no doubt that it is very substantial. At the same time it must be*

remembered that the rates must tend to exaggerate the influence of size of family upon mortality, the classes whose mortality is low being over-represented in the small family groups, and those of high mortality in the large. Here again it would be very desirable to have the data for homogeneous sections of society".

It seems significant that in the years 1930-35, in an area suffering from acute industrial depression, people in the Groups S^{I} and S^{II}—groups normally covered by public health and educational services, and compulsory insurance, or independent workers of the same financial level—have in families of not more than three children an infant death rate of 46·2/1000 and child death-rate of 15·7/1000 (approximately 48/1000 and 17/1000 on *live* births) to compare with the 60-65/1000 for infant death-rate, and roughly 25/1000 for child death-rate for *all* children in England and Wales at the same period. Even the *small* families (not more than 3) of Group R compare very well with *all* the children of the country. This seems to suggest *that geographical and climatic conditions are not very important in determining infant and child death-rates, compared with other biological and social factors.*

The miners' children however show considerable difference from the other groups even in the small families, and this difference is proportionately greatest between 1 year and 5. It is moreover at this later age that the greatest proportionate difference is found in all stages of family. In the very largest families, it is only during the 1 to 5 year period that miners' children are at a disadvantage as compared with Group R. In Appendix 5 is shown the details of the largest biological groups for M and R respectively, and it may be seen that with quite remarkable regularity the figures for Group M are worse than for Group R. *Obviously this cannot be explained by early marriage or rapidity of breeding or size of family.* It is interesting to note for instance that miners' first children born to mothers between 20 and 25 have a total death-rate to five years of 145/1000, to compare with 144/1000 for the first *illegitimate* children of mothers of that age on the one hand, but a figure of 98/1000 in the Group R. There must, therefore, be some other adverse factor in Group M. If this adverse factor was poor stock (due say to inbreeding) it might generally be expected to show itself in a relatively high death-rate in all children at all stages. If, on the other hand, it was largely a matter of environment, the death-rate might be high just at certain points where this particular environmental factor was most important.

From Table XXI and more in detail from Appendix 5, it may be seen that the difference in death-rates between social Groups M and R is somewhat curiously most marked in the 'good' biological groups, and almost disappears in the 'worst' biological groups, *e.g.* the excess death-rate up to five years for miners' children, compared with other manual workers'. is for all children in the area 29/1000 on a total of 161/1000 ; for first children it is 38/1000 on a total of 147/1000, and for seventh and later children 26/1000 on a total figure of 236/1000. Moreover, among first children, where mothers are under 20 and all death-rates are high, the miners' children show an excess of only 14/1000 but in the groups where the mothers are 20-25, or 25-30, the excess is 47/1000 and 33/1000. (Table XXI, page 139).

Again from Table XXI it may be seen that only in first children is there any real excess in the sum of the still-birth and neo-natal death-rates among Group M as compared with Group R. There is, however, a steady excess in death-rates between 1 month and 5 years, although this is only 10/1000 in second and third children. As already noted, this excess is heaviest in the 1-5 year group. It is interesting to note that the Registrar-General [1931] reports a death-rate between 1 and 2 years of 22·6/1000 in miners' children to compare with 12·6 for the children of similarly skilled workers in other industries. This quite specific distribution of the 'excess' death-rates in the miners' children would seem to indicate that the excess is not due to hereditary factors. If it were due to the poorer food of Group M as compared with Group R, it would be expected again that the excess would occur at all stages of family and period of life, unless suckling infants were protected at the expense of their mothers. In the latter case it might be expected that the extra drain on the mother's organism would cause an excessive rise in the still-birth and neo-natal death-rate of children born late into miners' families. This does not occur. (The absence of adequate information about miscarriages is here important since it may conceal a real increase in the women's incapacity to bear viable children).

It would seem that the increased still-birth and neo-natal rate among first children in miners' families is probably associated most *closely with the availability of skilled care and attention.* Many of the still-births and neo-natal deaths among first children are associated with birth-injuries (Campbell 1929) and it seems that among first children the availability of highly skilled care and attention during and subsequent to birth is of paramount importance. Difficulties associated with later births are probably more dependent on the general health of the mother. The children of women worn out by prolonged and rapid breeding have little chance of life however carefully they are attended to at and after birth. Among these, the availability of skilled nursing and medical attention is of less importance than among the earlier and sturdier children, who, if helped over the crisis of birth stand a fair chance of survival. Now the mining villages show many of the social disadvantages of urbanization (palls of smoke, etc.), but many of them still show some of the disadvantages of rural life. The population is isolated in relatively small groups, and skilled medical and nursing attention cannot be as readily secured in many of these as in the larger villages or small towns. Moreover tradition is still somewhat against the use of some available services—whether state or voluntary. *Education in its broadest terms is doing much to change this state of mind, and the motor-bus is doing much to break down isolation, both mental and physical, but a good deal still remains to be done.*

It was pointed out at an earlier stage in this discussion that in relation to the health of children, (more particularly infants), one extremely important factor is the availability of the general care of some adult. In most cases this adult is the mother. In the stages under consideration, the mother is primarily responsible for the health of the child from the age of 1 month to 5 years, *i.e.* the period to which the death-rates $1M^1$ and CM refer. The care a woman is able to bestow on any individual child will depend on a great many factors, (even where social position, as that is generally understood, is left more or less

constant). Probably the most important factor is the mother's health. This may be influenced by many things, congenital make-up, food, environment generally, and the number of children and frequency of births. But not only may the health of a child be biologically influenced by his predecessors in the family and their effect on the mother's health, but it may be equally influenced socially by subsequent births and the consequent periods of maternal unfitness of varying length and degree. It may be noted here that one of the outstanding impressions received from studying the records relating to some 50,000 women with children was the very low standard of personal health which the women tolerate uncomplainingly. How far this tends to make them overlook many of the minor illnesses of children which may so readily become major illnesses cannot be stated. But on general grounds it might be expected to do so.

The second factor determining the amount of care a child receives is the mother's other duties. The civilized human being is without parallel in the animal world in that the offspring resulting from one gestation is still making demands on the parents during the periods of later births. The mother's duties will vary directly with the size of family, but the age of the children and the degree to which they can help themselves and each other will all be of great importance. It is perfectly clear from the records, for instance, that a woman with two or three children under school age does find much greater difficulty in attending clinics, etc. than those with only one child at that stage. Since there is no doubt that too rapid breeding handicaps the offspring biologically, it also follows that it is frequently just those mothers whose children are most in need of expert help and advice who are unable to take advantage of the facilities provided. The rural areas are moreover undoubtedly still lacking in many of the facilities offered by the towns.

It has been suggested that the shift system is responsible for much domestic difficulty and that for this reason maternal care of the individual child may be less in Group M. Radford [1935] reported an investigation into the hours of work of the women in a group of miners' homes, and found that they averaged twelve daily, and varied from 7 hours where the work was shared between the mother of one child and the grandmother, to 17 hours where a family of mother and father, and six children under 13 occupied 3 rooms. He found that on the average in these families the mother spent 45-50% of her time in making meals and washing-up. While the shift system undoubtedly complicates the domestic routine, it would seem that this complication would be expected to show itself at least as acutely in the larger families as in the small. The fact therefore that the disparity between Groups M and R is greater in the smaller families seems to indicate that this is not the most important factor in determining this disparity.

Thirdly, the care available for the child must depend on the facilities the mother has for doing her work. As will be seen later, measured by rooms per person or rooms per household, miners are not less well-housed than the other workers of the district, but it seems certain that facilities in many of the houses of the mining villages are inferior to the urban areas in such matters as "laid-on" water. In a

miner's home, where washing must be so important, the lack of hot water supplies must frequently be a source of maternal fatigue and an important factor in the amount of care available to children. Another factor possibly connected with child health and indirectly with maternal care is the fact that in a mining community fuel is cheap (or free). The tendency to substitute warm houses for warm clothes and perhaps for fuel foods is inevitable in periods of stress, but children at the crawling or toddling stage must thereby be frequently exposed to sharper contrasts of temperature than is desirable, and it is difficult for a busy mother to prevent it.

It is necessary to realise that although it sounds considerable as 20/1000 the difference in death-rates between groups R and M in the period 1 month to five years only really means 2% and that the exposure of a community to a *number of small adverse factors* not found in another somewhat similar community may readily account for the difference.

It is not perhaps irrelevant however to mention here that in his prolonged rat experiments, Slonaker (*ibid*) measured the influence of pregnancy and lactation on the *spontaneous* activities of the female, and found that such activities were reduced during these periods by 60%. No quantitative comparison can be made between a rat, which during the processes of pregnancy and lactation has to set aside from its own food enough material and energy to build up young who altogether at weaning may equal the mother in weight, and a woman who weans her baby at something about one-tenth of her own weight ; but the human mother has not only biologically to feed but socially to care for her young, not through a brief but for a prolonged period, during which several children may thus be dependent on her. There is thus no real parallel to the human family in 'natural' mammalian life. Still less is there any real parallel in the experimental animal colonies of the physiologist, where the functions of the parents are limited to the period of actual biological connection. Bearing in mind the fact that the social conditions of human life necessitate that a woman's physical duties are greatly increased at those biological periods in which the lower animals curtail their physical activity, and realizing the *enormous part played by specific care of the individual in achieving the measure of health already arrived at, it is not unexpected that the death-rate among children should remain relatively high among communities whose domestic facilities still lag far behind that of the majority of the people.* The whole problem of the care of the human young is much greater when viewed critically, than is generally realized either by those who rely vaguely on tradition, or by those who acclaim enthusiastically the 'newer knowledge'. In the book already referred to, Radford sums up the problem facing working-class wives as follows : *"There is of course one way in which they can under present conditions relieve the pressure upon them, namely by reducing the size of their families. That, however, would raise great social problems."* Radford appears to be unaware of the enormous part played by just that reduction in size of family in the improvement of child life which has characterized this century—acting as it did in two ways, first to improve the biological fitness of the individual born, and secondly to enable the family as a unit to profit by the educational and social opportunities being offered. *To produce and rear in the fifteen to twenty years of fertile life of the average*

marriage of to-day, a family of eight to fifteen children, to fit them for the varied life of to-day, and to maintain her own vitality unimpaired, a woman would need the vigour of Diana, the wisdom of Minerva, the economic lore of Mrs. Barbara Wooton, and the dietetic skill of Professor Mary Schwartz Rose, and such women are rare.

Comparison of the S groups with the manual workers.

An attempt has been made in the previous section to determine why one section of manual workers should show a consistently and significantly higher infant and child death-rate than the other manual workers of the same administrative area, and the difficulties of interpreting the meaning of the figures has been indicated. If a colony of rats is carefully bred from the healthiest stock, carefully provided with every condition known to be necessary to health, is then made unhealthy in a specific way by depriving it of some factor in the food, and is then given the missing factor, it is to be expected that good health will be restored in the dramatic way so often seen in this type of experiment. Where clearly defined disease associated with specific food lack is found in man, that disease can be largely eliminated by supplying the lacking factor. Here cause and effect are clear, but in human life such acute lack is rarely found except associated with a large number of other bad conditions, social and biological. Men and women have largely brought these conditions under control by limiting the size of family to what can be satisfactorily dealt with financially and domestically, but in so doing other problems have been produced. One of these, a biological one, becomes obvious when a study of the differences between the S groups—and the rest of the community (M and R) is made.

I. COMPARISON OF STILL-BIRTH RATES.

Table XXI shows that while the death-rate between birth and five years is much smaller in Groups S and S^{I} + S^{II} than even in Group R, at the same stage of family, there is no corresponding improvement in the still-birth rate, and the improvement in the neo-natal rate is slight and irregular as compared with Group R. It is true that the still-birth rate for seconds and thirds, in Group S^{I} + S^{II} is the best recorded, but for firsts, and 4th-6th, the still-birth rate is as high as for Group R if not for Group M, while in seventh and later births, the still-birth plus neo-natal death-rate in the S groups is as high as in the others. It is necessary to find therefore why the conditions which improve the chance of survival in these groups after 1 month are apparently inoperative before that period. It would seem at least probable that that part of the still-birth rate or neo-natal death-rate which is associated with poor general health of the mother ought to be largely eliminated. Small as are the S groups in numbers, and limited as are the details available for the unvisited group, they can nevertheless by careful study be made to shed light on this problem.

It has already been noted that the biological factors influencing the proportion of still-births are two,—parity and age of mother. It has been emphasised that first births are quite peculiar in this respect, being associated with a much higher still-birth rate than is found among second, third and fourth births, although with later births the rate

again rises. Among first births moreover, the rate rises with extreme steepness with age of mother.

The questions posed therefore were :—

(1) What is the age distribution of mothers in the different classes ?

(2) What is the parity distribution ?

(3) Do these factors explain the relative stability of the still-birth rate throughout the social range examined ?

Table XXIV shows the age distribution of mothers in groups S, S^{I}, S^{II} and the total 16,500 which of course contains S^{I}, S^{II} and illegitimate children. The figures marked ° for Group S are calculated from the small number (125) whose age was given but who were actually found in this group in 1930 and 1936. The figures marked † are based on the 49 women in Group S in 1930 whose age was given.

(These by no means represented all those who were actually visited at least once ; on the contrary the fact that the age was not filled in frequently indicated that the health visitor considered the home 'superior'. Among all the 16,500, the age was not filled in in 6% of the cards ; in the S^{II} group this rose to 12% and in the S^{I} group to 17%. Among those visited once or occasionally, age was given in less than 50% of the cases even where parity was stated. In a considerable number of cases where one visit was paid, no information was given on either point. Where no visits were paid no information was available.)

From Table XXIV it would appear that S^{II} is little differentiated as regards the age of the woman bearing children, from the whole 16,500. Group S on the other hand differs fairly sharply in that the proportion to births to *women under* 25 is markedly decreased. This is true to a lesser though probably significant degree in the intermediate group S^{I}. Group S however shows no excess over the others in the 35 + group, the deficiency in the under 25 group being compensated for in the 25-35 groups, which contain (1930 and 1936) 68·0%, of all births as against 49·1% in the visited 16,500. Groups S^{I} and S^{II} are peculiar, and at first sight difficult to interpret, because Group S^{II} actually shows the lowest proportion of births over 35, and with 57% of births between 25 and 35, shows a greater excess over the 49% at that age in the whole 16,500 than does Group S^{I} with 52% *i.e.* Group S^{II} might be regarded as lying between the whole group and S in a way hardly true of Group S^{I}, although the latter is intermediate in the under 25 age period. There is however no real contradiction ; the position rises inevitably from the basis of classification. S^{I} and S^{II} do not differ as regards the nature of the father's employment, but in the number of rooms occupied by the household. Where younger parents occupy larger houses this usually means that they are slightly better off and can afford to do so, *i.e.* there is a real difference in power to purchase social amenities. But the older parents of the larger families find that they must have larger houses if they respect the decencies of life, whether they can really afford to do so or not. Hence it is found (Table XXV) that Group S^{I} contains 26·9% of families with more than three children, while Group S^{II} only contains 19·6%, and Group S^{I} contains 6·5% with seven or more while S^{II} contains only 3·0%. (Table XXV, page 141),

This transference of the larger families to larger houses and therefore in this classification from S^{II} to S^{I}, means that S^{I} contains more of the older women. If S^{I} and S^{II} are classed together, then it is seen that the proportion of women over 35 bearing children is approximately constant throughout the social range shown. (It must of course be borne in mind that nothing is known about the age of 84% of the women in Group S and of the parity of 69% of them. It is however broadly true that the age is much more likely to be given in the case of a young woman than of an older one, and that therefore a complete statement of age would tend to exaggerate rather than diminish the class differences). Detailed examination of the M and R groups revealed no marked difference in age distribution between the mothers in them. (Table XXVI, page 142).

It would therefore seem that the wealthier classes S and S^{I} postpone child-birth more than the other groups. The parity distribution of all births in any year in any class does not necessarily equal the distribution of first, second, third births, etc. in completed families but it must be roughly proportional to it. If the parity distribution in the different social groups in 1930 really gives the distribution in completed families, then it could be stated that Group S with 51·7% of first children produced rather less than 2 per fertile family. S^{I} + S^{II} produced 2·5, R 3·3, and M just over 4. Actual existing 'average' sizes of family are probably in this proportion. So that, despite the postponement of births in the wealthier sections of the community, the diminished number of births prevents any rise in the proportion of older women bearing children in these classes.

Table XXVII brings out however quite startlingly the real and important difference between the groups. Here is shown the proportion of *first* children produced in each age group, and the postponement of first births with improvement in social position is made clear. In the under 25 group are found 68% of all miners' first children, but only 22% of Group S. At the other end, 40% of all first children in Group S are born to mothers over 30, but only 8% in Group M. The different groups show a steady transition from M to S. It is interesting to note that in his special report [1911] the Registrar-General indicates that 75% of all miners' wives marry under 25, and only 10% after 30. Such marriage figures might well give 68% of all first children to women under 25 and 8% to women over 30. It would appear therefore that in the intervening 20 years the marriage customs of the miners has changed little, although there has been a great fall in the birth-rate, presumably in this case brought about by the spacing of births or the lopping off of later births, rather than by the postponement of first births. In the R group, with only 56% of all first births in the under 25 group, there is some postponement of child-birth relative to the M group, and in the S^{I} group this figure has fallen to 34%. The Registrar-General [1911] reported that less than one-third of all women in the professional classes (Class I) married before twenty-five, and slightly more than one-third after thirty. This would correspond reasonably well with the birth of 22% of first children in Group S and 34% in Group S^{I} to mothers under 25, and 40% and 29·7% respectively to mothers over 30. Most of the occupations in Group S and S^{I} would

however fall into his Class II, with a few into Class I, and some (those of supervisory status in industrial life) into Class III, and he found in 1911 little difference between the marriage habits of Class II and industrial workers generally. It would therefore seem probable that during the years 1911-1930 there has been a considerable tendency for the business people, etc. who comprised Class II in the earlier classification to adopt the marriage and reproductive habits of Class I, with consequent postponement of child-birth.

This view is supported by the figures given in the recently published special report on the results of the 1931 census. (The Registrar-General [1931] "II a. Occupational Mortality"). In this report there is some re-classification of occupations as compared with the similar earlier reports, from which it would seem that Group S of the Durham investigation would fall mainly into Class II in the Registrar-General's new classification, with very few in Class I. Groups S^{I} and S^{II} would be divided between Classes II and III with a fairly large proportion in Class III. The infant death-rates in these Groups are roughly what might be expected from this classification, *i.e.* the rates per 1000 live births for Group S are 30·9, 40·2, and 30·4 for 1930, 1931 and 1936, to compare with 33 for Class I. For Group S^{I} and S^{II} the figure for 1930 is 50·8 to compare with 45 in Class II and 58 in Class III. *i.e.* Group S^{I} plus S^{II} which lies partly in Social Class II and partly in Class III has an infant death-rate expressed on live births which lies between those given by the Registrar-General for these Classes in 1931.

Table XXIV shows the age distribution of the births in the different classes in both investigations. From this it is seen that there is marked similarity between Group S and Classes I and II. The 16,500 births in Durham in 1930 differ in distribution from any of the classes in the whole country by having a slightly larger proportion in the under 25 group, with a corresponding drop in the 25-35 group. This is partly due to the inclusion of illegitimate births, and partly to the fact that in the miners' group 27·4% of births occurred at this age even among legitimate births. Groups S^{I} and S^{II} taken together are remarkably like Class III, but considering these two groups together in this way, although necessary in the later age groups, as pointed out before, nevertheless conceals the fact that certainly in the younger age groups Group S^{I} enjoys amenities approaching those of many in Group S, and also shows some of the postponement of first births found to such a marked degree in Group S, *i.e.* in marriage and reproductive habits Group S^{I} approximates more to Group S and Classes I and II than to the manual workers.

First births constitute about 50% of all births in Group S, 95% of the few in the under 25 group, 55% of those between 25 and 30, 50% of those between 30 and 35, and 33% of those over 35. This indicates the extent to which reproduction is delayed in this group.

The close similarity between the age groups in Classes I and II and Group S, the earlier evidence of the Registrar-General in relation to marriage in Class I, and the known fact that in the middle-classes generally, the one or two child families are now commonest, all tend to show that the *limitation in size of family in these classes is largely produced by postponement of first births, and wider spacing of subsequent*

births. While 20 years ago this was only found in the professional classes, it has now spread throughout the sections of the community covered by Class II and to some extent Class III,—mainly perhaps among the clerical workers now included in the latter class who in 1911 were included in Class I. The figures in Table XXIV for Classes III, IV, and V however show that among these nearly one quarter of all births occur in the under 25 age group, which is improbably associated with any great postponement of first births. Since births in Classes I and II only form about 12% of all births, it is clear that the great reduction in the birth-rate since the opening of the century cannot be attributed solely to these classes, since if they had wiped themselves out, this would only have reduced the birth-rate from 30/1000 to about 26/1000. *The fall in birth-rate to a figure round about* 14/1000 *could only be achieved by a fall in all classes.* Since however Classes III, IV, and V do not postpone first births markedly, family limitation must be brought about, as already suggested for miners, by a more adequate spacing of later births. This difference in the method of achieving family limitation is of great importance in influencing still-birth rate, neo-natal death-rate and maternal death-rate in different classes.

It has been shown that the biological groups in which still-births are most common are first births to women over 30 and seventh and subsequent births. (All first births are associated with a much higher still-birth rate than second, third or fourth births.)

Table XXVIII shows the proportion of births in the groups associated with high still-birth rate ; the still-birth rate in each social class, together with the actual still-birth rates found in the biological groups with high figures, in each social class. *It is clear that the social classes S and S*^{I} *have the largest proportions of births in the biological groups with high still-birth rate, this being entirely due to their very high proportion of first births to women over* 30. Group S^{II} with no tendency to postpone first births, and a marked tendency to lose its larger families to Group S^{I} for need of house-room, shows the lowest proportion of births in these groups, as it shows the lowest proportion of still-births. Groups M and R show a high total of births in the 'bad' groups, but here the predominant factors are the seventh and subsequent births. Obviously there are here two totally different types of social and biological phenomena which require different methods of approach and must be clearly differentiated. There is no evidence (Table XXI) however that as far as still-births are concerned there is any advantage in any biological group to the middle-class. The 47 children in the S^{I} and S^{II} groups who are seventh or later children have a still-birth rate of only 42/1000 against the 64/1000 of Groups M and R (Table XXI), but the still-birth plus neo-natal death-rates at this stage of family are for Group M—135/1000, and for Group S^{I} plus S^{II}—149/1000.

It seems necessary to conclude that such advantages as may be possessed by the S groups over the others are not of such a nature as to influence the problems associated with still-births. These problems in the S groups are undoubtedly different from those in the others. They are the biological problems associated with first births and are *mainly intra-natal*. There is little evidence that in an area such as this, members of this class are in fact able to command any considerably

greater degree of obstetric skill than the rest of the community. This is not, as might at first seem, a contradiction of the previous statement that the increased still-birth and neo-natal rate among first children in miners' families is probably associated most closely with the availability of skilled care and attention. Broadly speaking, all classes here are attended by the same doctors and nurses. In the larger urban areas, there is no evidence that these are in any way more readily available to Groups S, S^{I} or S^{II} than to Groups R or M. *In some of the mining villages, without resident doctor or nurse, it is clear that considerable time must frequently elapse before skilled help can be secured, and the records bear out the truth of this.* This might of course apply with equal truth to other residents in rural areas, but the farmers in the S groups probably have more adequate means of keeping in touch with the towns, than the miners, while the 210 families of the agricultural community who were classed in Group R were so few that nothing can be concluded from a study of their death-rates. The still-birth rate in this small group was however 42/1000—even higher than that of the miners. A representative of St. Bartholomew's hospital has recently put to a select committee of the House of Lords the suggestion that people with incomes of £500-£1000 a year must now, when ill, be regarded as the 'sick poor' [Daily Press, May 26th, 1938]. If this be accepted as true, it is clear that in the area concerned only a fractional proportion of the people, whatever their group, would be able to command the very highest skill, presumably available to the sick who are not poor, and there is in fact little evidence of any great difference in the availability of *different standards of skill* as between class and class. The fact of course that the area is a large and scattered one, at almost all points far distant from any large hospital must complicate conditions in many cases, irrespective of class. That a very large proportion of births does occur in the S and S^{I} classes in the biological groups with highest still-birth rate due to intra-natal difficulties, but that there is no tendency for the still-birth rate to *rise* with social class, probably means that obstetric skill has just about kept pace with the increased demands on it, *i.e.* it might seem that there has been a real if slight improvement but this improvement has not been demonstrable in the figures, as the need has increased *pari passu* with the skill. It was pointed out earlier that, if social groups were considered as a whole, and 1930 figures alone taken then Group S (the wealthiest social group, though few of its members would think of themselves as wealthy) had the highest still-birth rate at 44/1000. This group was however studied for 1930, 1931, and 1936, and if the mean still-birth rate for the three years is taken, it is seen that at 36·6/1000 it is just less than the 39-40/1000 of the Groups R and M. It would not seem irrelevant to quote here from Dame Janet Campbell's conclusions [1929]—*"The importance laid upon sound ante-natal advice must not obscure the need for fully skilled attendance at the confinement".*— and again *"The findings of the inquiry indicate, moreover, that the prevention of intra-natal death has not perhaps received its due share of attention and interest".*

II. COMPARISON OF LATER DEATHS AMONG CHILDREN BORN ALIVE IN THE S GROUPS AND IN GROUPS M AND R.

The total number of records in the wealthier class S for 1930 was only 474. The similar records for this class in 1931 were therefore

examined and numbered 465. The cards returned to the health office for children born in 1936 whom it was not necessary to visit, were also examined for still-births and deaths under one year. This latter group did not of course contain the cards referring to children who belong to this social class, but who were visited occasionally at the request of the parents, since such cards were still in the hands of the health visitors. Table XXI shows that the total death-rate up to 5 years in this class in 1930 was 90·7 and in 1931, 83·9/1000 ; for 1930, 1931 and 1936 the death-rates up to the end of the first year (including still-births) were 73·8, 73·2 and 59/1000. The latter figure however requires modification, since among the cards of dead children born in 1936 and returned to the office during 1937 were four which, by the criteria enumerated before, would be classed in the S group. If these were added then the death-rate up to 1 year (including still-births) for children born in 1936 would become 69·8/1000, and the neo-natal rate would be 29·2/1000.

The figures for the three years are therefore fairly close to each other and markedly different from the M and R groups. The total death-rate up to 5 years for the S^{I} plus S^{II} group is 102/1000 and up to 1 year only, 86·5/1000. Thus there may be some slight advantage to the S group over groups most closely approaching it in domestic habits and social outlook, but on the whole undoubtedly slightly poorer. The difference however is not convincing. Only slight comparison can be made between biological groups in Class S and similar groups in other classes, because of the paucity of information about class S. Such few details relating to parity and age of mother in the 1931 records as were available were unfortunately not studied, but, for 1930 and 1936 together, parity was given in 267 cases, and age and parity in 125. In only one case in the three years, (this fact was the only one noted re parity in 1931) was a child later than sixth recorded as being born to a mother in this class. This was the ninth child of the one 'foreman' classed in the S class in 1931. Among the 267 children of known stage of family 92% were first, second or third children. The individual groups of known age and parity in group S are too small for study, but it seems reasonably fair to compare group S as a whole with the first, second and third children of the other groups although the position is complicated by the excess of first births with the inevitable relative excess of still-births in the better-off class. It may then be seen from Table XXIX that among such first, second and third births the total death rate up to five years falls steadily from 139/1000 in Group M to 87/1000 in Group S. Between Groups S and S^{I} plus S^{II} there is now no significant difference in the total death-rate. There is however the fact already dealt with that still-births contribute a higher proportion of the total in Group S, because of the tendency to the postponement of the first childbirth. This slight increase in still-births is noticeable when comparison is limited to Group S and the first three children of the other groups, but is almost eliminated when S is compared with all the children in all the groups because of the high still-births associated with the later children in the latter. This high still-birth rate in Group S is offset as compared with Groups S^{I} and S^{II} by a slight lowering of the neo-natal rate from 30/1000 to a figure between 20 and 25/1000. For the country as a whole, the neo-natal rate ranges

round 30/1000. It seems probable that in the few fortunate areas (and a few sections of the more prosperous classes), with a total infant death-rate of about 30/1000, the neo-natal death-rate will lie around 20/1000. This is the case among the children in Class I [Registrar-General 1931]. It is possible that this low neo-natal death-rate indicates that, although there is no advantage to Group S in availability of skill for intra-natal problems, the neo-natal difficulties are more adequately coped with in that class. The figures are however few, and of doubtful significance. There is no doubt that the wealthier woman and her child do receive very much more attention during the first month of the child's life than is possible for any but the most lucky of Groups R and M, or even for a large number of S^{I} and S^{II} It is interesting to note however that there is no valid difference between the death-rate from 1 month to 5 years ($1M^{I}$ and CM) between the middle-class S, and the visited groups S^{I} and S^{II}; and that in both these groups the death-rates during that period are extremely low. Campbell [*ibid*] says (speaking of one of the County Boroughs adjoining this administrative area), "The climate in the north is more damaging to infant health than in the south." It would seem that this might be more accurately expressed **"The climate in the north offers greater obstacles to infant health among the poor than in the south.**

Table XXI shows that in the S^{I} + S^{II} group there is a rise in total death-rate in 4th, 5th, and 6th as compared with earlier children, and that in seventh and later births the difference between this social class and the others is proportionately slight. These fourth and later births in this group are of some interest since they seem to throw light on a question which has puzzled many people.

The quotation from the Registrar-General's report [1911] in which he calls attention to the relationship between decrease in size of family and decrease in infant and child death-rate has already been given (page 53). This report went on, "*Viewed in this light the fact that infant mortality rather increased than decreased during the closing years of the nineteenth century becomes all the more remarkable since it did so notwithstanding both sanitary progress and rapid reduction of family size.*" But in any community where there is a great difference in death-rates in (*a*) different sizes of family and (*b*) different social classes, a decrease in average size of family will influence death-rates in a way which is determined by whose families are decreasing and which stage of family is being eliminated. The fall in birth-rate in the late nineteenth century is well recognised to have occurred mainly among the wealthier sections of the community. The 1911 Special Report quotes Ansell as giving the fertility rate for all classes in 1874 as 5·39 per family, and 5·25, 5·18 and 4·82 for clergymen, lawyers and doctors respectively, *i.e.* these professional classes even then fell below, though only just below the whole community in fertility. It also shows that by 1911, among women over 45 (*i.e.* completed families), the number of children born per family in all classes had fallen to 4·9. For Class I this figure was 3·6, Class II, 4·4 ; Classes III and IV, 5·0 ; Class V, 5·3 ; textile workers, 4·6 ; miners, 6·3 ; and agricultural labourers, 5·7. [In 1911 however, Class I constituted 10% of the whole as it contained clerks and other workers later put into Classes II and III. Class II was 16%

of the whole, but was also slightly different in constitution from the later classifications]. The death-rates among the children in these classes was in the following ratio, Class I, 70 ; Class II, 85 ; Class III, 96 ; Class IV, 99 ; Class V, 116 ; textile workers, 116 ; miners, 122, and agricultural labourers, 75. These death-rates are not infant death-rates but must have been proportional to the infant death-rates in the different classes, since infant deaths in all classes form the majority of all child deaths. Where women were 50 in 1911, most of their families would be complete in 1901, and the fall in fertility in the families of these women would occur between 1880 and 1900. Where women were between 45 and 50 in 1911, some of their families would be born between 1900 and 1911, and the fall in fertility in these families would not measure the fall between 1880 and 1900 but must have been generally proportional to it. This fall in these different classes would hardly seem to explain the fall in birth-rate to be noted between 1870 and 1900 which amounted to about 16%, but there would appear to have been yet another factor at work. In the Registrar-General's report for 1903 occurs the statement *"In the period under review* (1871-1901) *the female population aged* 15-45 *years contained a constantly decreasing proportion of married women."* In so far as this change, due perhaps to male emigration, indicated an increasing proportion of women who never married at all it would tend to cause a lowering of the birth-rate in proportion to the total population, without influencing the fertility per married couple. But it may thus be seen that decrease in size of family occurred mainly in the classes with relatively low child death-rates —the only exception to this being the textile group who only formed 4% of the population. But removal of the worst biological groups of the best social classes (using the terms 'best' and 'worst' to connote merely survival chance) does not necessarily cause a fall in the infant or child death-rate. These children, had they been born, would have had a death-rate greater than those of the rest of their class, but it is more than probable that their death-rate would have been below that of the whole community. An example may be taken from Table XXI— Fourth and later children of Group S^{I} + S^{II} have a total death-rate up to five years of 129/1000 and an infant death-rate of 58/1000. They are members of a child community with average death-rates for the same periods of 147/1000 and 77/1000. The elimination of children with potential death-rates to five years of 129/1000 and infant death-rate of 58/1000 from the latter community would cause death-rates to rise not fall. On the other hand, the elimination of later born children in Classes III and IV, skilled and semi-skilled workers, and in the textile group, would tend to cause a decrease in the death-rates of the young. These two effects more or less counterbalanced each other. *An enormous fall in birth-rate may well at any time be accompanied by a rise in infant death-rates, if the children who are not born are from the potentially healthier section. Crude birth-rates give little information.*

It is perhaps of interest here to note just what were the occupations of the 28 men in Group S^{I}, and the 19 in Group S^{II} to whom seventh or later children were born in 1930. Those in Group S^{I} were 6 farmers, 4 mining officials, 4 shop-keepers, 3 clerks, 3 charge-hands, 2 electricians, 1 manager, 1 commercial traveller, 1 salesman, 1 contractor, 1 engineer, and 1 inn-keeper. Group S^{II}, occupying only 3 or 4 rooms per family

contained 10 shop-keepers (including 2 ice-cream vendors), 3 engineers, 2 mining officials, 1 stores manager, 1 attendance officer, 1 A.A. officer and 1 contractor. The total absence of the teaching profession from this list is the only thing which differentiates it sharply from the rest of the S^{I} and S^{II} groups.

For purposes of analysis of the influence of social factors on child death-rates, Groups S^{I} and S^{II} have been taken together, since their figures were fairly similar, and the dissection of the individual classes gave groups too small to be of value. But the original intention in examining the record of Group S^{I} was to find out whether the cards of dead children from Group S might not have strayed into it for the reasons already given. This appears to be the case since the total death-rate for Group S^{I} is 112·3/1000, and for Group S^{II} 95·9/1000. Part of this excess is due to the fact that fourth and later children occur more frequently in Group S^{I} than in S^{II}, but among the earlier children of Group S^{I} there were almost certainly two or three who would have been classed in Group S (as 'no need to visit') if they had not been already dead at the health visitor's first call. The steadiness of the figures for Group S for three years, and for S^{I} and S^{II} for 1930 round a value of about 100/1000 does however seem to make clear that these families do enjoy a higher grade of health than the average for their area.

In order to improve child health in Group S, and to some extent in Group S^{I}, it is necessary to look to improved obstetric skill, greater scientific knowledge and greater availability of such knowledge. This need is caused by the prevalence of late marriage and postponed child-birth which under present social conditions is almost inevitable in these classes. In other classes some reduction of the neo-natal death rate might well be looked for with present knowledge, given adequate co-operation between parents and community.

That there is a very real difference between the S^{I} and S^{II} groups and M and R seems to be supported by the following evidence :—(1) The twinning rate in the different groups, and (2) the death-rates among the previous children in the different groups. On Table XXX is shown the twinning rate in the different groups, and for purposes of comparison that found among 1805 births reported consecutively in a middle-class daily newspaper. The figure rises from the 10/1000 found in the middle-class to 15·6/1000 found among the total 16,500 (which of course includes the S^{I} and S^{II} group). Since it has been shown that up to a point twinning rate increases rapidly with stage in family, the decrease in twinning rate with social class and size of family might be considered to be related. In actual fact however, among the 434 first births in Class S^{I} and S^{II} there were six sets of twins, a figure at variance with the figure for first children found in the 16,500. The numbers relating to twins are so small that little statistically significant can be deduced from them, but they may be regarded as pointers for future work.

It has already been pointed out that while the difference in death-rate between the M and R group diminishes steadily in the later stages in the family. the difference between these two groups and S^{I} and S^{II} remains marked until seventh and subsequent children are considered, (and the figures for the 47 children in this biological group and social

class are not of much statistical value). It seems moreover doubtful whether these 47 families were really distinguishable in the matter of social amenities from similar sized families in Groups M and R. Table XXXI however shows certain interesting facts about the previous conceptions in the families of the S^{I} and S^{II} classes. Where the child born in 1930 was a second to sixth child, there had been 519 previous conceptions in the S^{I} class. Of these 106/1000 had ended as still-births or the children had died before the birth of the 1930 child, and 21·2/1000 had resulted in miscarriages. The corresponding figures for S^{II} class were 699 conceptions, and 127/1000 still-births and deaths before 1930 and 15·7/1000 miscarriages. These may be compared with the 152/1000 still-births and deaths, and 15·6/1000 miscarriages for families of the same size in the whole 16,500. It may be concluded that Group S^{I} has a *real* advantage over the whole 16,500 but for Group S^{II} the difference from the main group is not large enough in relation to the number in the group for definite conclusions to be drawn. This difference is only 'probably' significant. When however the previous conceptions of the families in which the seventh or later child was born in 1930, are considered, it is seen that there are 191 such previous conceptions in Class S^{I} and 135 in Class S^{II}. Class S^{I} moreover still shows a very good record, only 110/1000 of the previous children being still-born or dead before 1930 and 15·7/1000 conceptions ending in miscarriage. The 135 previous conceptions in Class S^{II} however are very different, there being 251/1000 still-births and deaths, and 29·6/1000 miscarriages among them. These actually compare unfavourably with families of the same size in the total 16,500, although the difference between the S^{II} and the major group is not valid. Small as are the numbers for S^{I} however, it seems probable that the difference between the figures for this class and the total group do represent a real difference. Although the later children born into this group do not have any better chance than children at the same stage in the other classes, it does seem that the earlier children have a quite conspicuously better chance of survival.

CHAPTER IX.

THE RELATION OF HOUSING TO DEATH-RATES.

Group S^{I} differed from the rest of the visited groups by being on the whole quite definitely better housed, and it seemed worth while asking if the advantage shown by Group S^{I} was mainly due to this social factor. The relationship between death-rates and housing was therefore studied, and for this purpose death-rates were correlated with the rooms occupied by *person* (R/P) and with the number of rooms per *household*. This gave of course no measure of the sanitary conditions of the houses—perhaps the most important factor—nor did it measure the degree of congestion of the houses themselves.

Certain broad comparisons must however first be made. (1) Radford [*ibid*] states that in England and Wales 75% of the population live in 5 rooms or less, but of the families studied in this investigation 98% live in houses of 5 rooms or less. (Table XXXII, page 145).

(2) Similarly the same authority states that in England and Wales, 50% of all families live in 4 rooms or less. Here the figure is 88%. (Table XXXII).

(3) Among the families investigated here, 7·4% of all families with one child live in *one room*. These form 50% of all the families who occupy only one room, who form 4% of all the families investigated.

(4) The commonest type of house is four-roomed. Such houses accommodate 35% of all the households.

(5) Two and three-roomed households each form about 24% of the total.

(6) There is a tendency for the larger families to occupy larger houses. This is exemplified by the fact that whereas 47% of all families occupy 4 rooms or more, where seven or more conceptions have occurred, this figure rises to 57%; this rise is accompanied by a decrease in the proportion of one and two roomed houses occupied by such families from 28% to 18%. This change is not adequate to secure for the larger families a reasonable level of accommodation viewed by modern standards, but it indicates that an attempt is made to secure more accommodation for larger families.

The information available seems to make possible a much more penetrating examination of the influence of housing on health than is usually possible. Many people who discuss the influence of housing on health seem very vague as to whether they are measuring some definitely physical factor such as 'vitiation' of air, or excess warmth or moisture acting directly to produce malaise in the individual and indirectly to favour the growth of bacteria, or whether they are merely measuring the general poverty of the people concerned. Great variations occur, but it is generally those who are badly-housed who are also poorly fed, inadequately clad and lacking the skilled attention which most people from time to time need. Clearly in the case of these latter,

larger and better houses would go only a small way towards improving their health. If however the influence of housing were primarily a direct physical one, better housing would be a first essential to improved health.

It has been shown that even within the classes normally covered by the public health and educational services there is a marked improvement in health with slight improvement in social circumstances. The first question asked was therefore :—*What is the relationship of housing to social class, in the area and classes covered by the investigation ?*

Of the unvisited Group S, nothing was known of the housing accommodation. Even where one visit was paid, it was rare to find information on this subject. Figures therefore can only be given for the visited group, and of these 16,500 the number of rooms occupied per family was given in 16,040 cases.

In order to disentangle the influences of housing and size of family, the number of rooms per person was studied in each case in families of known size. Table XXXIII shows the number of rooms per person in different sizes of family (size of family as measured by number of conceptions, not by number of living members), and in different social groups. As is inevitable from the basis of classfication used, the number of rooms per living person (R/P) is highest in Group S^{I} and least in the whole 16,500. The difference is most marked in the small families, and decreases with increase in size of family, until with seven or more pregnancies in the family, the difference between Group S^{II} and the whole 16,500 has disappeared. As has been already noted, death-rates in seventh or later children and death-rates in 'previous' children at this stage in Group S^{II} show no advantage over the whole, and it seems probable that any social advantage of any kind has in fact disappeared.

In determining the figures for Table XXXIII it was noted that the housing accommodation (R/P) varied steadily with the age of the mother, (in practice with the age of both parents—but it was the mother's age which was actually recorded for this analysis. In this area, there is normally little difference between the ages of the parents). In Table XXXIV is shown the variations of (R/P) with (1) size of family, (2) social class, (3) age of mother. In all social classes, families with one child are better housed as the mother's age increases. This does not mean merely that the older people occupy much larger houses, but it indicates in part that young newly-married people in this area frequently share houses with their parents or other relatives. (Actual sub-letting was classified as such). There is however some tendency for those who marry later and can presumably afford to do so, to take larger houses. Among families with first children born to mothers of 20-25, 45% occupy houses of four rooms or more. This figure rises to 55% in the 30-40 age group. The change in R/P with different ages of parent at all sizes of family was not studied for all the 16,500, but was studied for the S^{I} and S^{II} groups. Among these it is found that improvement of housing with the age of parent ceases to exist in families with three children. This mainly indicates that sharing a house with relatives becomes rare at this size of family.

Among the 16,500 families those with seven and ten pregnancies were also examined in detail, and Table XXXIV shows that R/P for this size of family remains constant at all parental ages, and also that there is only a slow decrease in R/P with increasing size of family after about the fourth child. This is chiefly due to the fact that in the larger families some of the elder children have usually left home, and the larger the family, the more children are likely to have left. That a larger proportion of previous children have died in the larger families also helps to maintain a steady R/P among them. Table XXXIV gives the figures for families with one, two, four, seven and ten children, of mothers 25-30. It may be noted that these figures show a very definite and steady fall from the 0·91 for families of one, to 0·40 for families of 10 or more. As it has been shown that the infant death-rate is higher in the later stages of the family, and it is here shown that the families with many pregnancies have the lowest R/P ratio, it follows inevitably that those families which have a low R/P are the families which also have a high infant death-rate.

Does the infant death-rate follow the degree of overcrowding as represented by rooms per person, or does it follow stage in family?

To test this, comparisons of groups with different R/P ratios were limited to groups at the same stage of family, and the question was asked "Are children at the same stage of family more likely to die if they are born into over-crowded homes, *i.e.* homes with low R/P?" The R/P ratio for children dying at each stage—still-births, neo-natal deaths, etc., was compared with the R/P ratio for all children in the same biological group. Table XXXV gives these figures. It is seen that where the children died between 1 and 12 months (IM') or 1 and 5 years (CM), the figure is very similar to that for the group as a whole. In many groups, the number of dead children was very small, and therefore the R/P found for these groups varies considerably but it varies from the mean of the whole group in both directions, and the difference is never greater than is to be expected from the smallness of the numbers. The figures for still-births and neo-natal deaths present however quite a different picture, since they are steadily and *consistently above* the mean for the whole group, in every case. For the still-births, the figures are anything from 10 to 30% above those for their whole group; the difference is less for the neo-natal deaths, but nevertheless considerable. This entirely confirms the findings of Campbell [1929], who says, "*We would reach the astonishing conclusion that ante-natal and first-day deaths are very much more frequent relative to births in the better-housed parts of the district.*" At first sight the result does seem astonishing, but scrutiny of the actual records shows that at any rate in this investigation it is merely an arithmetical quibble, due entirely to the fact that a "still-birth" is not legally a person. Similarly in practice, at least half of the children dying in the first month (*i.e.* those dying in the first ten or fourteen days, before the health visitor's call, are not included in the 'persons' stated as residing in the house. Obviously during the ante-natal period, a child who is going to be still-born may have exactly the same 'housing' conditions, as a child who is to be born alive, but the mere fact that the latter is born alive would, under existing methods of computation, cause it to appear to be worse housed.

A child, born into a house occupied only by his parents, increases the number of people residing there by 50%, and decreases the R/P by 33·3%. If other people are in the house, the ratio is always reduced but by smaller proportions. Slightly more than half the neo-natal deaths have taken place usually before the health visitor's call, but a few health visitors include the dead child in the 'numbers residing'—which is of course correct if any attempt is to be made to correlate overcrowding as measured in this way, with death-rates. The majority however do not. In Table XXXV rows SB* and NN* give the R/P which would have been found if the child had lived, since only in this way can any real comparison be made. Since some of the children in the NN group were originally counted as persons, in NN* these are counted twice. It will then be seen that the corrected SB* figures lie very close to the means for the groups, while NN* tends to lie as much below the mean, as NN lay above it. [The figures for fourth and seventh births were calculated to the second decimal place ; all others only to the nearest ·05].

It is clear then that no real difference can be demonstrated between the housing conditions (R/P) of the children who died and those who lived when *comparison is limited to the same stage of family*. Since however the average R/P for all first children who died is *just* lower than the average for all first children, it was thought that it might be possible to demonstrate the influence of poor housing by approaching the subject slightly differently. The 2,324 first children born to mothers aged 20–25 years were studied. They were divided into three classes—those living in homes where the R/P ratio was 0·1-0·5 inclusive, 0·6 to 1 inclusive and more than 1. Table XXXVI shows that where the classification is made on the basis of the uncorrected R/P ratio, the conclusion would be arrived at that the death-rate is *significantly higher in the best-housed group*, the excess again being found in the children dying in the early stages. The R/P ratios were then re-calculated on the assumptions that the still-born children had lived, and that those dying in the first fortnight of life before the health visitor's first call, had not been counted in arriving at the number of persons in the R/P ratio above. Table XXXVI shows that the death-rate is then constant throughout the housing range where R/P represents one room per person or less, but that among the best-housed where R/P is more than 1, the death-rate is less than that for the groups where R/P is less than 1, by 22/1000. Since, however, there were only 317 families with more than one room per person, this difference is not quite statistically valid. The death-rates were therefore calculated for first children whose mothers were 25-30, and 30-35, and who, when comparable corrections were also made, lived in houses where there were more than one room per person. (R/P > 1). Table XXXVIII shows the results. When these death-rates are compared with the death-rates of all first children born to mothers of their age group, it is seen that in each case there is a slight, but not statistically valid difference in favour of the better housed. This may indicate that the general social amenities of the better-housed (as measured in this way) are slightly advantageous to the group. It is difficult to believe that just as R/P equals 1, some physical factor relating to housing should come into play. Actually of course, in each age group where R/P is greater than 1, the S^{I} and S^{II}

social groups are largely found. Among the 680 first children whose mothers were 20-25, and who lived two or more persons to the room (*i.e.* R/P = 0·5 or less) there must have been many who were living under conditions approaching the legally overcrowded. Yet in this worst-housed group it was not possible to demonstrate from the death-rates any inferiority when the children were compared with the better housed group with only from 1 to 2 persons per room. (Since in the definition of legal overcrowding, children under ten count as half a person, while in this investigation children and adults alike were classed as persons, no figures could be deduced for the legally overcrowded).

Since it had not been possible to demonstrate any clear connection between death-rates and the number of rooms per person, the question of housing was tackled from yet another point of view. The relationship between number of rooms per *household* and death-rates was studied. In order not to confuse the effect of housing *per se* with that of other factors which vary with occupation, the occupational groups were considered separately.

Table XXXVII shows the age and parity groups studied, and the number of families, with the death-rates found in each group. The families are classified into those which occupied two rooms or less, and those which had three rooms or more. It may be seen that among first children of mothers aged 20-25, the death-rate is *higher* in the *better*-housed section in Group M by an amount which is not statistically valid, and the reverse holds where the mother's age is 25-30. No difference exists between the housing groups if all the 1,759 first children of mothers between 20 and 30 in Group M are considered together.

Comparison was also made between the families of miners with 6-9 children living in 2 rooms or less, and 3 rooms or more. The numbers in the former group for each size of family were very small, and the difference in death-rates for each size of family was not consistently in one direction. When families of 6-9 were taken together however, the average difference indicated a slightly higher death-rate among the worst housed, though owing to the considerable variation in the constituent groups this difference was not statistically valid. (238/1000 as against 201/1000). (Table XXXVII, page 147).

The figures for the children of other manual workers (Group R) in the same age groups were similarly determined, and also appear in Table XXXVII. This shows that although in first children the total death-rates are consistently lower in Group R than in Group M, there is again no significant difference between the death-rates of children in the *same occupational and biological group with different standards of housing*. Actually in this social group, among first children of mothers 25-30, the death-rate among the *best housed* exceeded that among the *worst housed* by 30/1000, but as there were only 135 families among the worst-housed, this difference is not significant. Among Group R, it was not possible to demonstrate any difference between the best and worst housed even in the large families. The conclusion would seem to be compelled that overcrowding as measured by rooms per person or by rooms per family is not in itself an important factor in influencing death-rates. The influence of over-crowding as compared with stage

in family may be deduced from the following facts. (Table XXXVII). First children of miners in homes where the R/P ratio is ·90 (range ·87 to ·93) have a total death-rate varying from 133 to 152, and averaging 145/1000. Children from the same occupational and biological group, in homes where the R/P ratio is ·55 (*i.e.* not much more than half the previous figure) have death-rates ranging from 135/1000 to 160/1000, and the same average. Sixth to ninth children of the same occupational group in homes where the R/P ratio is little lower than the poorer-housed first children (*i.e.* a mean of ·45, and a range of ·40 to ·50, as against a mean of ·55, and a range of ·50-·60), have a total death-rate of 201/1000. Therefore a very great decrease in the housing accommodation of first children makes no difference to their death-rates. Slight decrease in housing accommodation (from R/P,·55 to R/P,·45) accompanied by a change in stage of family from first to 'sixth to ninth' is accompanied by a great increase in death-rates. Since, as has been noted, the large families with the high death-rate are on the whole the worst-housed, this does not contradict the well-established fact that death-rates are high under bad-housing conditions. It merely indicates that the *high death-rates are more dependent on the size of family than on the housing conditions, as measured by rooms per person, or rooms per family.*

No measure of the sanitary conditions or of the quality of the housing could of course be made, and the statement concerning the lack of connection between death-rate and housing accommodation must be clearly understood only to relate to housing accommodation as measured by rooms per person, or rooms per household. This area is also of course comparatively free from the congested districts found in the slums of large towns. In towns, such congested areas might be expected to contain a large proportion of the population who had a low figure for rooms per person. The connection between the smoke and sunlessness of such congested areas and respiratory disease at all ages seems well-established, but since these areas usually show a low R/P ratio for their population, the latter figure has frequently been used as a measure of housing. The usefulness of this measure may be questioned.

It had seemed possible that the difference between the occupational groups might really be slight, being due not so much to a lower modal standard of health in certain groups, but to the fact that a combination of economic factors had caused a larger number of the very poor or the markedly unfit to be found in certain occupational groups—*i.e.* here Group M. Careful study of the record cards seemed to support this view. [Very *large numbers of Groups M and R seemed to enjoy fully as good health as the S groups.*] It was thought possible that the occupation of only one or two rooms per household might be an objective measure of such poverty. and mark off the sections with bad health in the different occupational groups. The figures adduced above show however that this is not so, and indeed it seems doubtful just how the number of rooms occupied is determined. Young people who manage to get one or two rooms of their own may actually be the luckier and better-off ones, as compared with those who have to share the four or even five roomed houses of their parents. On the other hand, where a house is shared and real overcrowding exists, the saving

on rent, and the extra care that a child may get from having more than one adult female in the house may well counterbalance the effect of the overcrowding.

The meaninglessness of measurements of housing in relation to health can perhaps best be demonstrated by a few examples. One woman of 24 had her seventh pregnancy in 1930, having accomplished all seven in six years. One pregnancy had ended in miscarriage; one child—the first was still alive. All the other children, including the one born in 1930, died a few hours after birth. The family occupied three rooms. All the five children who died must therefore during their brief lives have lived in a three-roomed house containing four people, *i.e.* R/P ratio of 0·75, which by the standards common in this area is not bad. But only one out of seven pregnancies had resulted in a child capable of living. The only other woman who in 1930 had her seventh pregnancy before she was twenty-five had had three miscarriages, but three previous children had survived and the 1930 child also lived to be of school age. This family only occupied one room; these four fairly healthy children were living under conditions only giving ·16 rooms per person—a very low standard indeed. Again, in another family occupying two rooms, a woman of 29 bore her eighth and ninth children in January and November respectively of 1930. Out of the total nine, only the first survived, six being still-born, and two dying shortly after birth. There were therefore never more than four occupants of the two rooms. Another family which also occupied two rooms had an eighth child born to a mother of twenty-eight. This woman succeeded in rearing seven out of the eight, and therefore during the period of this investigation, the family lived under housing conditions which gave only ·2 rooms per person. From this it may be seen that it is quite impossible to state what the influence of 'housing' as ordinarily measured may be. An unhealthy family which dies off is thus apparently better housed in a given number of rooms than a tougher family which survives. It might of course be possible to measure dampness, draughtiness, etc. and such measurements might have physiological value.

From Table XXXIX it may be seen that while 40% of the miners' households where the wives are aged 20-30 at the birth of the first child occupy 2 rooms or less, this figure is only 31% for Group R. For sixth to ninth children, the figure for miners has fallen to 18·7 while for Group R it has remained at 28%. This is probably associated with the fact that the cottages provided by the collieries go mainly to the older men, and are probably on the whole larger than the accommodation that the young miner can secure for himself.

Clearly however a study of housing in the *quantitative* sense is no objective measure of either poverty or health, and offers no means of explaining differences found between occupational groups.

CHAPTER X.

THE INFLUENCE OF ILLEGITIMACY ON DEATH-RATE.

It has already been shown in relation to the influence of maternal age on the offspring's chance of survival, that some considerable part of the alleged harmful influence of illegitimacy is due simply to the fact that a much larger proportion of illegitimate children are born to young and immature mothers than is the case among legitimate children. In the area under consideration, in 1930, there were 630 illegitimate children known as such to health visitors. The age of the mother was known in 599 cases, the remainder being mainly cases where the child was born in an institution, and remained there, never being supervised by the health visitor. Any deaths among these latter children were of course reported, but no details concerning the mothers were available. Of the 599 children, 79% were firsts (Table XL) and of these 37·7% were born to mothers under 20, *i.e.* first children of mothers under 20 constituted 29·8% of all illegitimate children, while the comparable figure for legitimate children was only 2·5%. Moreover Table VI shows that 26 out of 29 mothers of 16 years or less were unmarried, about half the mothers of 17, one-third of those of 18, one-fourth of those of 19, but only about one-tenth of those from 20-25.

Table XLI however indicates that there are social factors involved too, although the exact nature of the social factors is not clear. Among first children born to mothers under 20, there is no significant difference between the illegitimate children, children of miners, and children of other manual workers, the numbers in the groups being small. Where the mothers are 20-25, there is a marked drop in all total death-rates, but illegitimate children and miner's children show a significantly higher figure than the other group. It may broadly be concluded that the physical immaturity of the mother is the main cause of the high figure in the under 20 group, but that this group probably also contains a high proportion of the socially least competent and fortunate. In the 20-25 groups, social factors which may be guessed at but cannot at present be determined cause the figure for illegitimate children and for Group M to be higher than for Group R.

Illegitimate children, other than those dealt with above, fall into three biological classes which seem to represent broadly three different sets of social conditions and problems. These classes are (1) first children born to mothers over 25. These constituted 19·7% of all first illegitimate births to women of known age, and 15·5% of all illegitimate births. There were actually only 93 births in this class, but from Table XLI it may be seen that the still-birth rate at 86/1000 and the neo-natal rate at 121·8/1000 are extremely high. In many cases it would seem that the mothers do not take full advantage of such services as are provided, but under existing social conditions, this is perhaps inevitable. This group undoubtedly represents a special social problem. (2) Third and subsequent children. Of these there were 68. In only three families however were all the children illegitimate, except where parents were co-habiting. These parents seemed mainly to be people who in more fortunate social circumstances would have re-adjusted

their lives by means of divorce and a second marriage, and illegitimacy was really only technical, the social life of the children being that of the other members of their class. In a certain proportion of cases, widows gave birth to illegitimate children after having borne a number of legitimate children. In these cases again, the parents were co-habiting—at any rate temporarily—the mother usually being described as 'housekeeper'. The death-rate up to five years among the children in this class is 147/1000, almost exactly that of the whole county area. The figures are too few for valid conclusions, but they serve to confirm the impression given by the study of the records, that in this group illegitimacy is socially unimportant. (3) Second illegitimate children. Of these there were 64, and Table XLI shows that they had a total death-rate of 187/1000, with a still-birth rate of 31·1/1000, a neo-natal death-rate of 62·5/1000 and a death-rate of 62·5/1000 between one month and twelve, to compare with 25·7/1000, 33·9/1000 and 32·7/1000 for all second children. The existence of poverty, squalor, and ill-health suggested by these figures was borne out by the evidence in the records. This group again presents a very acute social and psychological problem, though it is numerically insignificant.

It is thus clear that illegitimacy is not associated with any one single set of adverse factors, but that different influences are operative among different biological groups.

CHAPTER XI.

THE RELATIVE INFLUENCE OF SOCIAL AND BIOLOGICAL CHANGES IN DECREASING THE INFANT AND CHILD DEATH-RATE.

It has already been shown that the death-rate up to five years of age for those born alive must have been much reduced in the last forty or fifty years, at each stage of family. While the average infant death-rate in England and Wales in 1900 was 150/1000 for those born alive, in Durham in 1930 only twelfth or subsequent children (tenth or subsequent live-born children) had infant death-rates which reached 150/1000 although ninth or later children (seventh or later live-born children) reached a figure of 140/1000. Close study of the 1930 Durham figures showed however that the earlier, rapidly bred children, *i.e.* first and second children born to women under 20, fourth or fifth to women under 25, and sixth, seventh or eighth children born to women under 35, all had an infant death-rate greatly in excess of that of children of the same birth-rank born into families bred more slowly, but their infant death-rates at 120-150/1000 were not high enough to give an average of 150/1000, even if the entire child population were produced in rapidly bred families. It must of course be borne in mind that since the birth-ranks mentioned above take into account miscarriages and still-births, many Victorian families who only visibly reared three or four well-spaced children, would nevertheless come into the class of rapidly bred families, because of the miscarriages and still-births which were not officially recorded. Obviously, however, considerable decrease in infant death-rate at different stage of family had occurred since no combination of the 1930 rates could have given the 1900 average. Between 1930 and 1936 the birth-rate (live and still) in the maternity and child welfare unit of the County fell from 21·6/1000 to 17·8/1000 and the actual number of births (live and still) fell from about 17,547 to 13,896. During 1936, a thinly populated part of the County was ceded to the County Boroughs but, as the total births in the administrative unit under consideration were 14,107 in 1935 and 13,896 in 1936, it is clear that if all the fall in the births between 1935 and 1936 were due to this cession of land with its population and not to fall in birth-rate it would be a negligible part of the total drop between 1930 and 1936.

The figure 17,547 has to be taken for total births in 1930, instead of the 17,049 given on Table III for births in the area examined, because one area which was included in the maternity and child welfare unit in 1936 was autonomous in 1930. Nothing was known of the age of mothers or birth-rank of children among the children who were still-born in this area in 1930, or who died there or removed from the area before it was added to the County unit. The 282 children whose records were handed over however proved to have a maternal age and child birth-rank distribution closely similar to that of the 16,500 analysed in detail. (Table III, page 76).

It seemed that an analysis of the 1936 figures and comparison with those of 1930 might indicate how far the fall in infant death-rate over

that period was due to the fact that fewer children were born in the bad biological groups, and how far to actual improvement within the groups. It might also give an indication as to how the different size of families was being affected by the changes producing the fall in the birth-rate.

During the period under consideration the population of the maternity and child welfare unit fell by about 4%, approximately one-third of the fall being due to the cession to the County Boroughs of areas round them. The population in these ceded areas presumably had much the same age distribution as in the County. The 3% fall due to emigration of population from the County would not however probably be a true sample of the whole. Generally it is the young unmarried, or newly married people who migrate elsewhere in search of work. This has already been noted in considering the removal of children born in 1930, of whom 7% left the area before the end of 1935. Some of these removals, in all sizes of family, were merely local moves to and fro over the County boundaries. This was particularly true with the large families, but occurred even in the small ones. Such local moves tend to be balanced by a similar move from County Boroughs to County. There has been however a real movement away from the County and this was most true among the 12% of the families with first children in 1930 and the 8% with second children in 1930 who left the County before 1936. Knowledge of the working of many of the agencies for finding employment indicates that even more unmarried people leave the area. In each succeeding year then, there are a smaller number of people of a given age to bear children than would be the case if the area was able to absorb in employment those whom it reared. In so far as this migration of potential parents is responsible for the fall in the birth-rate, it would be expected that it would be found that fewer births were taking place among young women, the older women, less affected by migration presumably continuing to produce about the same number of children. One would therefore expect to get a drop in the number of children born at the early stages of the family and to young women. On the other hand, in so far as the drop in the number of births is due to the cutting down of late births in large families, a drop in the number of children born to older women and a decrease in the large families would be expected. Table XLIII (page 150) shows the actual figures.

In 1930, of the 16,500 women of known parity, 15,510 were of known age, *i.e.* some 6% of the women were of known parity but unknown age. The women of unknown age varied from 5% to 7% in the various parity groups, *i.e.* women of unknown age were distributed fairly evenly through the parity groups. It seemed therefore safe to allot the 990 of unknown age to the age groups in which they would be found if their age was distributed as for the 15,510. There were a further 282 records of mothers in the area autonomous in 1930 but included in 1936. This gave 16,782 from the total 17,073 births occurring among the visited classes in 1930. In 1936, of the 13,896 births officially recorded, 373 belonged to the unvisited group. For 43, only the birth was recorded ; for 13,289 parity of mother was known, and for 13,235, age and parity of mother was known. This gave a total of 13,705 out of the 13,896. The 54 mothers of known parity but

unknown age were again distributed for age as though their distribution was that of the whole 13,235.

From Table XLIII it may be seen that the changes determining size of family are complicated. The number of first children fell from 4,960 to 4,401, and, as might be expected from removals, this fall occurred entirely in the age groups under 25. Of the total drop of 3,493 among the groups in which the necessary information was given, no less than 1,272, or more than one-third was found in first, second and third children, and the drop in numbers of first children was entirely among those born to women under 25 ; the drop among second children occurred among all women under 30 but mainly among those under 25 and in third children among women under 35, but mainly among those under 30. Migration did not begin in the area in 1930 but had continued for some time. If it were argued then that the drop in numbers in first and second children to women under 25 was merely due to the fact that women of this age had been removed in excessive numbers, then there ought to be a drop of similar proportion in third, fourth, etc. children born to women of this age. *Actually however there is a greater proportional drop in the larger families.* But the mere fact that these families had these larger numbers at all stages, makes it more difficult for them to move and more unlikely that any organisation will move them. Table XLIII shows that there was a drop of 18% among women of 20-25 bearing *first* children, but of 40% among women of the same age bearing *fourth* children. In the 30-35 age group, there was no drop in the numbers of women bearing first and second children, a small drop in those bearing third children, *but a large drop at all later stages of the family.* There was a decrease of about 40% in sixth and later births. This on the whole was greatest in the earlier age groups but was fairly evenly distributed in all age groups. These decreases can only be explained if it is assumed that in addition to a decrease in births due to the withdrawal of potential parents by outward migration, there is a real tendency on the part of those left to have smaller families and to space the births at greater intervals. The complication introduced by the greater migration of young men and women makes this less certain, but it seems probable that there is a tendency also to postpone the founding of the family. Table XLII shows however that the net result of all these quite considerable changes is a *relatively small change* in the age and parity distribution of the mothers in 1936 as compared with 1930. Although seventh and later children are fewer by 40% in numbers, their proportion of the total has only fallen from 12·4% to 9·5% and the proportion of mothers over 35 has only fallen from 21·5% to 19%. *This serves most admirably to demonstrate how impossible it is to deduce from crude birth-rates what is really happening, and emphasises how unfortunate it is that a failure to appreciate the importance of these changes has prevented legislation which might have made possible the study of them on a national scale, which is so much needed.*

Still-births, neo-natal death-rates and death-rates between 1 month and 12 months among children born in 1936.

Records of 13,135 children born alive in the unit administered by the County were studied, and records of 579 still-births. Of the 13,135 children born alive, 845 died before reaching the age of one year—

i.e. an infant death-rate of 64·4/1000. The infant death-rate for the years 1936 and 1937 as given by the Medical Officer's report averages 70·5/1000, but as was pointed out earlier in dealing with the 1930 births (Appendix 1); the death-rate among children *born* in 1936 would be expected to be about the mean of the death-rates of children under one year, during the two years 1936 and 1937. Actually it was 6/1000 below this. This was not due to the failure to find records of deaths which have taken place. This was checked in the following way. Records of all infant deaths in the area are compiled from the death registers and sent to the Superintendent Health Visitor. These give date of death, and age of child in days during the first fortnight or so, in weeks for the first two months or so, and thereafter in months, or years and months. Of children born in 1936, there were 868 who died aged 12 months or under. It was not clear whether children classed as aged 12 months were just under or just over that age. Clearly only a negligible number would be exactly 1 year. If all the 868 were under 12 months, this would mean that 23 deaths had been missed, *i.e.* 2·6% of all deaths. Actually however most of the disparity is explained by the inclusion in the 868 of several children who had actually reached the age of 1 year, and who would not be so included where exact age was given. 486 neo-natal deaths were found in the health-visitors' records (giving date of birth and date of death), and 493 deaths were recorded from the Registrar's list as occurring at 1 month or under. In fact to give the expected 70 or 71/1000 death-rate, 920-933 deaths ought to have taken place. By chance then, the children born in 1936 would appear to have a slightly lower infant death-rate than those born in the same area in 1935 or 1937. This difference is not great, but it is necessary to deal fully with the fact since it complicates the interpretation of the figures found for 1936 in relation to those found in 1930.

The figures for the unvisited group have already been dealt with in the detailed consideration of the 'S' groups. Here the groups of known parity and age for the two years are compared. On the 16,500 births (live and still) of known parity in 1930, the still-birth rate was 39·8/1000, the neo-natal death-rate was 41·2/1000 and the death-rate between one month and one year was 35·8, giving a total death-rate before the end of one month of 81/1000 and before the end of one year 116·8/1000. On the 13,298 births of known parity in 1936, the still-birth rate was 42·6/1000, the neo-natal rate was 35·8/1000, and the death-rate between one month and one year was 26·7/1000. These give a total death-rate up to the end of the first month of 78·4 to compare with 81/1000 in 1930, and a total death-rate of 105·1/1000 up to the end of the first year, an improvement of 11·7/1000 on the earlier year. But the births in 1936 were found in larger proportion in the groups with low death-rates, and therefore the death-rates were calculated on the assumption that births were distributed according to parity as in 1936, but with the death-rates of each group as in 1930. Table XLIV shows these figures and compares them with the figures actually found in 1936. It may be seen that the apparent improvement in still-birth and neo-natal rate *may* be explained by the different parity distribution. The still-birth rate in 1936 is higher than the calculated figure for 1930, but the neo-natal figure is lower by an equal amount, so that the total

death-rate up to the end of one month is the same in both cases. This means that the apparent improvement in still-birth or neo-natal death-rate may be entirely due to the fact that births are commoner in 1936 in those groups with lower rates at this stage, and not to an actual improvement in health. This change in *parity* distribution would only cause the death-rate between one month and one year to drop from 35·8 to 34·4, so that the total death-rate up to one year calculated on the 1936 distribution and the 1930 rates would be 112·9/1000, It is therefore seen that of the 11·7/1000 by which the 1936 figures improve on those of 1930, 4/1000 or slightly more than one-third may be attributed simply to change in parity distribution. The rest of the improvement is presumably due to change in social conditions, though it is impossible to say in just what conditions.

COMPARISON OF STILL-BIRTH (SB) AND INFANT DEATH-RATES (IM = NM + IM') IN CHILDREN BORN IN 1930 WITH THOSE BORN IN 1936 AT DIFFERENT STAGES OF FAMILY.

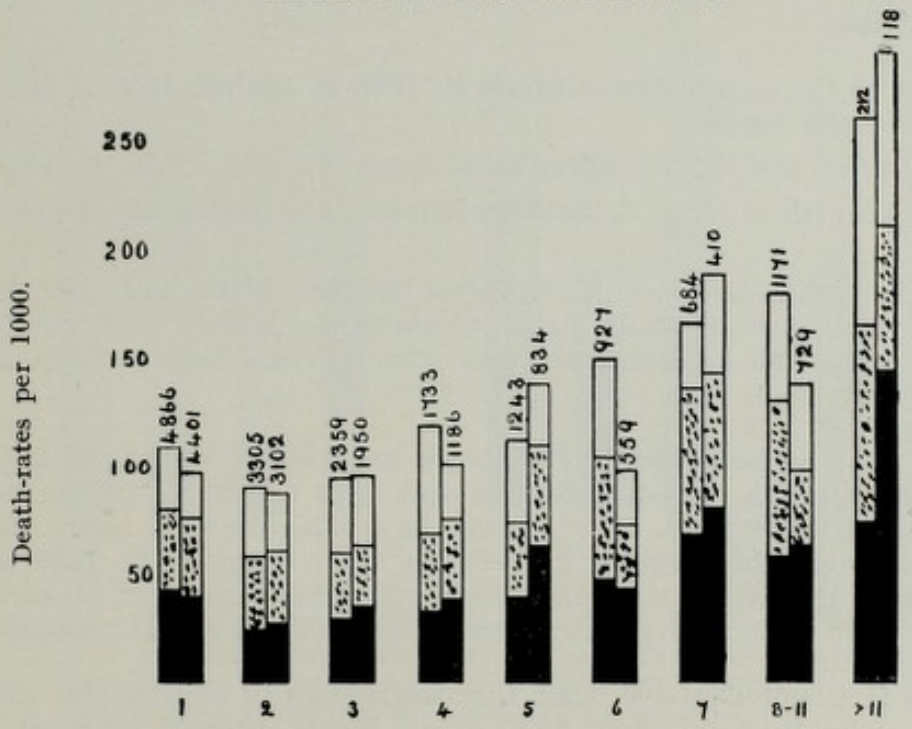

Fig. 5. Each double column represents the birth rank marked below it. The first of each pair of columns gives the rate in 1930 : the other column is from 1936 figures. The figures above each column are the numbers in that group. Stippling as in previous figures.

The records of the children born in 1936 were analysed in the same age and parity groups as those of 1930, and comparison of death-rates to the end of one year was made group for group. Figs. 5 and 6 and Appendix 12 show the results of this comparison. If the groups classified by the mothers' parity are first considered, (Fig. 5), it is seen that it is not possible to demonstrate any consistent change in the sum of the still-birth and neo-natal death-rate. In most groups the figures for the two years are very close, but in some cases the 1936 figures are slightly higher and in some cases slightly lower than for 1930. In 1936

as in 1930, total death-rates increase with birth rank, and this is particularly true of the still-birth rate, although the fall in still-birth rate between first and second births is again noticeable.

When the total death-rates up to one year (S.B. + I.M.) of each birth-rank group are examined, it may be seen that these groups fall into three categories :—

1. Those in which there is little difference between the death-rates in the two years. This is found among second and third children, *i.e.* nearly 40% of the total births.

2. Those in which the death-rates are lower in 1936 than in 1930. They comprise first, fourth, sixth and eighth to eleventh children.

3. Those in which the death-rates for 1936 were higher than for 1930. This is seen in fifth, seventh and twelfth and later children. 1936 is thus a better year only for certain birth groups and at certain stages of life.

Most of the improvement found in 1936 as against 1930 is due to a fall in death rates.

(*a*) In *first* and sixth children *at all stages*, *i.e.* S.B., N.N., and I.M[1].

(*b*) In fourth children at the stage between one month and one year ; and

(*c*) In eighth to eleventh children between birth and one year. (As the numbers were small, eighth to eleventh children were grouped together. The fall in death-rate was actually consistent at each age in this group.)

The improvement seen in 1936 tends to be offset by the rise in the death-rates in fifth, seventh, twelfth and later children, but the nett result still favours 1936. The change in death-rate with birth rank, which is remarkably regular in 1930, is not so regular in 1936 due probably to the fact that in the latter year, the number of all births after the third were much smaller than in 1930. (Table XLIII, page 150).

The fact, noted above, that the death-rates of second and third children, who formed nearly 40% of all births, showed little or no improvement in 1936 over 1930 coupled with the extreme irregularity of the improvement in other groups in 1936 would suggest that the improvement which did occur was not due to any specific social change taking place over the intervening six years, but was the result of a large number of chance factors operating variously.

Since the effect of maternal age on the survival of the infant had been found to have considerable importance in 1930, this factor was studied in detail for 1936.

DEATH RATES, AS IN FIG. 5, ANALYSED IN GROUPS BY BIRTH RANK AND MATERNAL AGE.

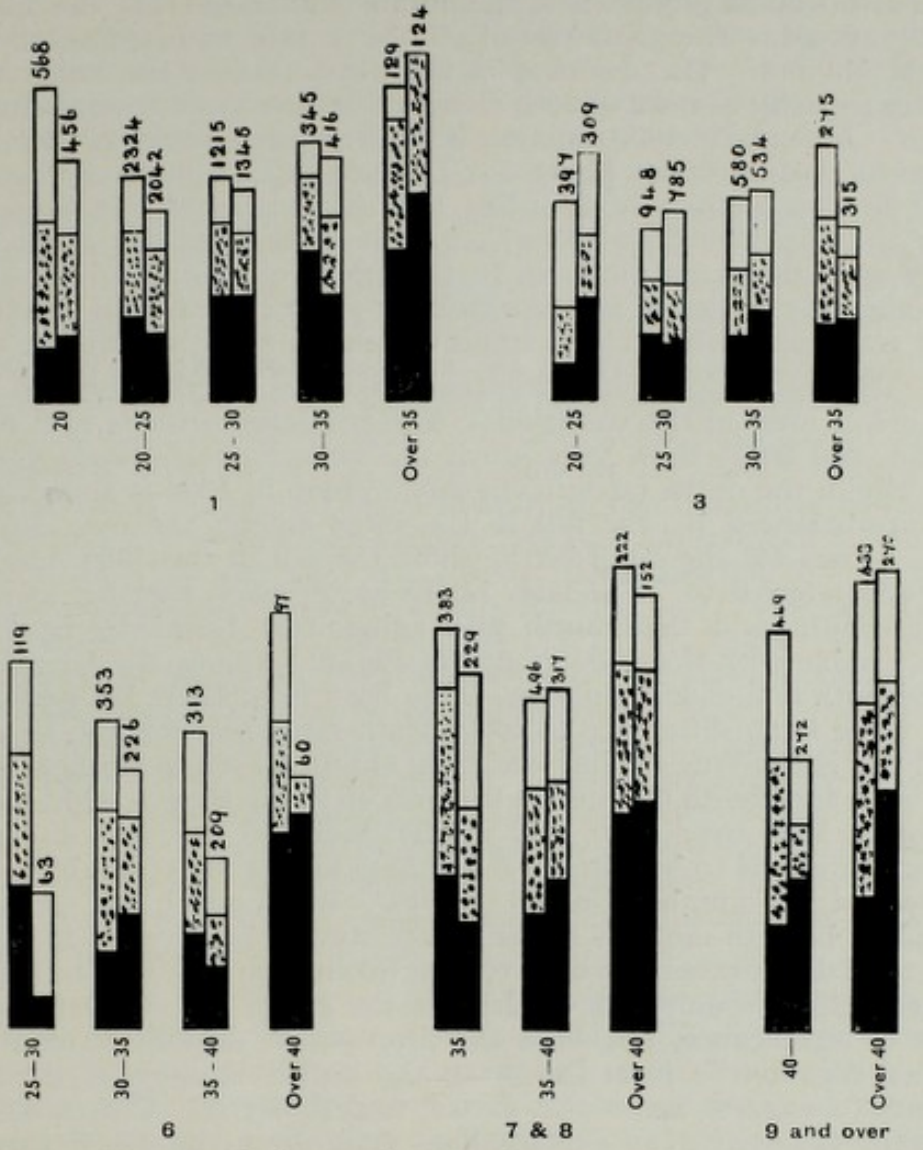

Fig. 6. The pairs of columns give rates in 1930 and 1936 as in Fig. 5. The figures immediately below each pair of columns are maternal ages. The figure below each group of columns is the birth rank of the child *e.g.* 1st 3rd 6th 7th and 8th and lastly 9th and subsequent children.

The death-rates were then analysed in groups by birth-rank and maternal age, and Fig. 6 shows the results for first, third, sixth, seventh and eighth, and ninth and subsequent births. Figures for second, fourth and fifth births are not given, the age groups among the second births being very similar for the two years; among fourth births the age groups in the two years were closely similar as regards still-birth and neo-natal death-rates, but at every age the rate from one month to one year was very much lower in 1936 than in 1930. On the other hand, among fifth births, all death-rates were higher in 1936 than in 1930 in each age group. Fig. 6 shows age groups and illustrates the kind of difference found. Among first births, total death-rates (to 1 year) are lower at all stages up to the 35 + group. This difference

is mainly due to differences in death-rates after one month, but it is probably only in the under 20 group where the difference is large and in the 20-25 group where the numbers are large that the difference is significant. The great rise of still-birth rate with age of mother is again obvious. The decrease in the death-rate in the under twenty group is partly associated with a change in the composition of the group itself. Among the 1930 children born to mothers under 20, 5·1% were born to mothers under 17, 14·3 to mothers of 17, 28·0 to mothers of 18 and 52·6 to mothers of 19. For 1936 the corresponding figures were 3·4%, 9·8%, 23·0% and 63·8%, *i.e.* the mothers of this group in this year were more mature than in the earlier year. The improvement among first children of mothers 20-25 however had no such explanation, and was presumably due to improvement in social conditions.

The figure for third children illustrates excellently the chance nature of most of the variations. The two larger groups with mothers 25-30, and 30-35 show very much the same figure for each year, and the rise in the death-rates in the 20-25 group in 1936 is almost exactly counterbalanced by the fall in the rates among the over 35 group. The figures for the sixth births show the fall in the 1936 death-rates already referred to. The later births are grouped together as seventh and eighth, and then ninth and subsequent births to make them comparable with the 1930 groups in Fig. 3. Among the largest group of seventh and eighth children, those born to mothers between 35 and 40, there is no difference in total death-rates between the two years, and this is also true of ninth and later children born to mothers over 40. Seventh and eighth children in the over 40 group show a slight improvement in 1936 over 1930, and in the under 35 group, a still greater improvement is to be noted. Both these figures are of doubtful significance on the numbers in the groups. When ninth and subsequent children born to mothers under 40 are studied however, it is seen that the total death-rate up to one year has fallen from 183/1000 to 124/1000. Since there are only 272 children in the group this difference is only just of significance, but since the drop occurs steadily in each group added together to form the total, the very steadiness of the change seems to suggest some real factor underlying it. Two possibilities present themselves as explanation. The group in which this great improvement has apparently taken place is just the one associated in the earlier study with a high abortion rate. If it is assumed that the economic depression of the early nineteen thirties had depressed social conditions and brought about deterioration in the physical condition of these mothers of large families, then the low death-rate might merely be associated with a high abortion rate, and might indicate a weeding-out of the unfit at the earlier stage. Since such abortions are not notifiable it is not possible to know if this is the cause of the low death-rate. An alternative hypothesis is that the improvement is due to improved services and greater forethought. Contraceptive advice is now available to mothers whose condition renders it desirable. It has been shown that it is just in this group that there are many women of poor health, who would be likely to seek such advice, and it may be that mothers who, under the 1930 conditions, would have borne delicate children, did not bear children in 1936 because of such advice. The children in this group in 1936 would then be borne preferentially by

the healthier mothers. If the improvement in this group is not merely a chance one, it seems that one of these explanations or a mixture of them is likely to account for the change. *From the detailed analysis of the groups it may then be seen that the greater part of the* **real** *improvement in child health as between* **1930** *and* **1936** *is to be associated with first children born to mothers under* 25. It is not possible to determine the social factor important in causing this real improvement.

It may however be noted that most of the improvement over the period studied was found in the one month to one year stage. This is in general agreement with the fact that during the period 1905-36, the death-rate among infants at this stage fell from 87/1000 to 29/1000, while deaths in the first month only fell from 40/1000 to 30/1000.

Finally it may be considered how far the results of this investigation agree with the results and opinions of other workers. The importance of social factors in determining child health will first be dealt with. The Registrar-General's special report showing the infant death-rate in different social classes, arranged broadly to pass according to social amenities from the professional classes in Class I to unskilled labourers in Class V for 1921 and **1931** has already been referred to. Figures given by Stevenson for the same classes for 1911 are (Table XXII) as follows: Class I, 76·4; II, 106·4; III, 112·7; IV, 121·5; V, 152·5. Since neither the figures for 1911, 1921 nor for 1931 give any indication as to relative rates of breeding in the different social classes, it is difficult to know how far the differences noted between the classes are due to social and how far to biological factors. *These figures however seem to confirm those of this report which show that even when biological factors are kept constant, there is an improvement in child health as measured by child death-rates if social amenities are improved.* It has however been indicated that different social amenities may vary in importance from place to place and from group to group.

In the report on "Poverty, Nutrition and Growth" [1926] Paton and Findlay cite a large amount of work (P. 116-123) all of which tends to show that the middle-class or generally better-off child is larger and healthier than the poorer child, but in much of this work definition of class is vague and no attempt is made to control other possible interfering factors. Broadly however all this supports the conclusions of this investigation, although most of the studies refer to growth and health of children rather than to death-rates. Paton and Findlay however themselves directed a very large investigation, and their main conclusions may be quoted. (*a*) *"No clear indication has been found that the nutrition of the child is directly associated with the income of the family, expressed as per person."* (*b*) *"It is curious to find that the correlations of weight and height to size of family and to air-space per person are all small and many of them insignificant."* Since the death-rates among children have been so clearly shown to vary with family income, the first conclusion seems startling. One sentence in the introduction to the investigation however seems to afford the key to the explanation: *"It does not touch the question which is at present under consideration—whether in the poorer classes there is any difference between the children of families with comparatively low and of those with comparatively high incomes, and whether there is any evidence that a*

moderate increase of income, such as is economically feasible, would ensure the better growth of the child." Study of the actual range of income in the families dealt with in Paton and Findlay's report, show that about 10% of them had less than 5/- per person per week, *i.e.* a family of mother, father and child in this group would have 15/- a week or less, while the 'average' family of three children and parents would have less than 25/- per week. Actually it seems probable that in this group many of the larger families would be found. Again 50-60% of the families had from 5/- to 10/- per person per week, *i.e.* for the two sizes of family quoted above, the maximum income would be 30/- and 50/- a week respectively. Only some 7-8% of the total had over 15/- per person per week. *i.e.* for a family of three, more than 45/- per week, and for five more than 75/- a week. All the areas investigated were slum areas. It is thus clear that most of the families studied belonged to the poorer-paid workers, and income *per person* was rather determined by the number of people to be maintained than by the industrial status of the wage-earners. It is fairly certain that all families would belong to social classes comparable with the M and R groups of the Durham investigation, and probably mainly to the lower-paid sections of these classes. All studies of the diet of the poor reveal the fact that this is a first charge on income, but 'man shall not live by bread alone', and as soon as hunger is satisfied, innumerable other more specifically human needs assert themselves, and improvement of diet in the sense of the inclusion of the expensive 'good' protein or vitamin-bearing foods does not occur *until a very considerable addition has been made to income*, *e.g.* Burns [1933] found that in 1000 families in County Durham, the whole-milk purchased per *person* per week decreased from 1·1 pints in familes of parents and one child with an average weekly income per person of 7/- to 0·4 pints in families of ten with average weekly income per person of 4/-. At all incomes, in the families investigated, the quantity of milk purchased per person was so hopelessly inadequate, that it would be foolish to expect measurable results from the variations in quantity. There is no reason to suppose that any considerable number of the families in the investigation by Paton and Findlay reached that stage of family income in which greater expenditure on diet became possible, (*i.e.* from the point of view of diet, all the families belonged to the one class), and the results do not show that income does not affect diet or nutrition, but merely answers the question "Whether in the *poorer* classes there is any difference between the children of families with comparatively low and of those with comparatively high income". The fact that within what is broadly one social class, and one set of external conditions (those usually known as slum conditions) the nutrition of the children as measured by weight was not influenced by the air-space in the home per person, is generally in agreement with the facts found in the Durham investigation, where it was impossible in the mining villages and small urban districts to relate 'rooms per person' or 'rooms per family' with death-rates, where the same size of family was considered. Both investigations seem to suggest that where 'quality of housing' and general social amenities are kept constant, quantitative overcrowding is unimportant. At first glance however, the fact that nutrition was unrelated to size of family would seem to be in direct contradiction to the results of the Durham

figures and might suggest that the nutritional state of survivors was not influenced by the same factors as influence the death-rates. Perusal of the details of Paton and Findlay's report show however that the influence of the numbers of the living members of the families was studied—not total number of births. In this case, all small-sized families would contain a considerable number in which total births had been much greater, but in which bad heredity, excessively rapid breeding, etc. had caused a high death-rate. It has been shown that these large rapidly-bred families have a high death-rate not only in early life but at later stages, *i.e.* they are presumably unhealthy, and their survivors would tend to lower the nutritional average of the smaller 'living' families. Examples of families which were not overcrowded, precisely because so many of the children had died, were given in the section of the report dealing with housing. One other example may be cited here from the Durham figures. In one family a third child was born in 1930 to a tuberculous mother. During the period 1930-1935, the mother and the two older children all died of tuberculosis, leaving the last child (already tuberculous) to share a four-roomed house with his father. A very considerable proportion of small, living, families are thus the relics of large families and the study of such families is beset by many complications. Of course such families will have the same income per head at any given moment as families with the same total income and total numbers, among whom no deaths have occurred, but since the health and nutrition of the children may be influenced by earlier periods of greater poverty when the family was larger, living families of given size are not very suitable units for study. These facts probably explain the apparent discrepancy between Paton and Findlay's conclusions on the influence of size of family on nutrition and the conclusions drawn from the Durham work, those of the Registrar-General's Special Report [1911], and of Dame Janet Campbell, already referred to.

Huntington [1938] quotes earlier work which seems to contradict the conclusions about death-rates and size of family. He describes studies by Ploetz on German noble families and American work on old New England families which showed no relation between the birth-rank of a child and infant and child death-rates, until the tenth and subsequent children. The death-rates he quotes are however all about three times the Durham figures, despite the relatively high social class of his subjects. The materials used were genealogical records of important families. All still-births would of course be absent, and probably many children who died in the neo-natal period. Moreover, as Huntington points out, the figures refer to a period when deliberate family limitation was probably minimal. Small families therefore contained many children of people too feeble to have more, *i.e.* the later born children in larger families were only produced by the most vigorous and healthy parents. Figures from such studies are clearly in no way comparable to those from any population where deliberate parenthood is the practice.

Contrary however to the figures quoted by Huntington, and supporting the conclusions of this investigation are the results of Gribbon [1922] from a study of Viennese children, of Agnew [1922]

from a study of Glasgow children, and of Hardy and Hoefer [1937] from a study of American school-children.

Gribbon studied Class 'C' among the children receiving a ration from the Friends' Relief Mission in Vienna. Class C were the children in the poorest physical condition of those receiving the relief ration. She concluded that *children of poor physique were found most commonly among the late children of large families.* Since the families had been fed for some time by outside agencies, this influence was not merely an economic one.

Agnew found the death-rate among children in Glasgow families increased with the position of the child in the family. She says *"In the large poor families—no figures are available for well-to-do families of similar size—probably from the fifth, and certainly from the seventh pregnancy, the wastage is so great as to indicate that—be the cause what it may—the additional members of the families are bought at a cost in human life and suffering which cannot be regarded as equitable, whether viewed from an economic or from a humanitarian standpoint."*

Hardy and Hoefer state *"In the case of the healthiest children, the chances were better than* 98 : 2 *that when the economic factor was controlled, more of them were first born than later born." "At the other extreme, only* 9% *of the healthy children were fifth or later born (inclusive or exclusive of miscarriages and still-births), as opposed to* 16% *of the fair health class, and* 24% *of the poor health class."*

The simple effect of 'biological' factors is indicated by Cox and Imboden's experiments [1936] with rats. They found that when rats produced successive litters on adequate diets, their fertility fell off rapidly after the first three or four matings, the number of young per litter was halved, and the proportion of those born alive which were reared to weaning fell from 96% to 60%.

In reviewing generally the influence of the factors studied on child health as measured by child death-rates, it is interesting to consider one further quotation from Paton and Findlay's study of child nutrition. They state *"When the correlations between maternal efficiency and weight and height of the child are studied, they are found to be the only really significant ones in the series."* Now their investigation had failed to demonstrate any correlation between child weight and height and income per person, diet, air-space per person, and artificial or breast-feeding, *within the limits of variation of these factors among the people they studied.* The general health of the mother influenced the child only in so far as it influenced maternal efficiency, *i.e.* the effect was a *social* rather than a biological one. It might seem from their results that any attempt at the improvement of child life by improvement in diet, housing, etc. was hopeless, but the experience of the last thirty years seems so completely to negative this, that some explanation of the apparent contradiction must be sought. To the present writer it seems that the *sine qua non* for all improvement in child health has been the drastic reduction in rate of breeding and consequently in size of family. This reduction has had three separate effects. First, it has meant that fewer unhealthy children have been born, since in the main, reduction in the birth-rate has been achieved by limiting reproduction to the period in which the mother was

biologically best fitted for it. Secondly, even where family income has remained constant, the available income per person has risen since there were fewer to share it. Where previously the living members of the family had remained few because of the high death-rate, illnesses and funerals had eaten up much of the money which in the later small families was to be available for the fewer born. But thirdly, and probably *much the most important effect of the reduction in births lies in the improvement in maternal health and efficiency.* During the recent concentration of interest on diet, the old idea that the addition of members to a family did not require a proportional increase in the money set aside for food has finally been abandoned, since the undesirability of increasing the cheap carbohydrate foods and decreasing the protective foods has been realized. A more realistic attitude to domestic problems generally may therefore not be despaired of. It is difficult to estimate the actual amount of work added to a household by the inclusion of an extra child, but this extra is only slight if the child is neglected, or if the performance of all duties is slackened a bit. It is true, of course, that one dish may hold vegetables for five instead of for four, and that the dish will only need to be taken out once, and washed and put away once, whether it is used for four or five, and that in almost every respect, the addition of another individual to the household will not add quite 100% of the work already caused by each of the other individuals, but such additional unit will however usually add about 80% of the work caused per unit. Why the energies of the mother and housewife should alone of all the world's workers be regarded as capable of infinite extension, it is difficult to see. A hypothetical example of the effect of increasing size of family on the care available per unit may perhaps usefully be cited. The mother of one child may probably be able to secure for 1/- the wool necessary to make the child a woollen suit, and she will probably have the time to do the knitting. But the mother of five children, or even three, may well find her time completely absorbed by necessary cooking, washing and mending, without any possibility of making any new clothes. For such a household to achieve the domestic comfort and general standards of the smaller one, it would be necessary to allow for each succeeding child not the pittance to cover raw food which is at present suggested in certain well-intentioned quarters, but a rapidly increasing sum to permit the purchase for the large family of *the services which the mother herself can render adequately to a small family.* Such services would not probably take the form of domestic help as understood by the middle classes, but would be first, ready-made clothing, and later, probably ready-prepared foods. Hence the wholly deserved popularity of the "fish and chip" shop. The failure to appreciate this fact means that all the schemes which have hitherto been put forward to encourage the production of larger and healthier families can just be dismissed as humorous. Actually it is probable that many women find themselves under-occupied before the birth of their first child, but thereafter each succeeding child calls for some domestic re-organization which cannot, for fully 90% of the homes of the country, be met by securing further domestic help. Domestic standards simply have to be lowered, and the point at which such lowering brings squalor or ill-health will depend on many factors, not least being the actual influence of child-bearing

on the health of the mother and the reaction of this again on the mother's domestic efficiency.

The influence of child-bearing on the mother's health will be dealt with in detail at a later stage of this report.

Conclusions.

If Table XXI is compared with Table XLV, the death-rates at different stages of first, second and third children may be studied in the different social groups. From this it may be seen that the second child has in general the best chance of all children, whatever the social group. Among Group R however there is no significant difference between the first three children, and it must be emphasised that the individual parity groups of the S classes are so small that the differences in death-rates between them are of doubtful significance. Tables XXI and XLV however show that the fall in death-rate between first and second children occurs in the crucial period round birth, and is represented by the difference between the figures for SB + NN for first and second births (Table XLVI). This difference, in every case, is greater than the difference between the total death-rates, and indicates that the reduction in death-rates round birth is not all gain, but is in part offset, as pointed out at an earlier stage, by an increase in later death-rates. This must either mean that the high death-rate in and around birth among first children is a weeding-out process, in large measure beneficial to the race, or it must mean that *under existing social circumstances*, one child per family will give the minimum post-natal death-rate. and is the maximum to be coped with satisfactorily. Even in Group S^{I} + S^{II} with the generally low death-rates of the whole social class, there is a considerable rise in the death-rates after one month among second children, to offset the enormous drop in still-birth and neo-natal deaths. It is probable that few of the women in this group would be able to afford anything much in the way of domestic help, and it is not possible to deduce from the figures any certain conclusion as to whether the later rise in death-rates among second children is due to an inevitable diminution of maternal care, or to the survival over the earlier periods of weedy specimens who would be killed off by the greater rigours of a first parturition.

Among third children, the lower rate of still-birth and neo-natal deaths as compared with first children is quite offset by the increase in later death-rates, but first, second and third children in each class compare very favourably with later children. It has already been seen that the excessively low post-natal death-rates found among the unvisited middle-class children is in large measure due to the fact that 92% of the births in this class are first, second or third. From Table XXI however it may be seen that in Group S^{I} + S^{II}, fourth, fifth and sixth children also show a death-rate which is remarkably low for this stage of family. The number in this group (193) is very small, and the significance of the figures derived from it therefore doubtful, but that the health of the children of these families is good is supported by the figures for death-rates among the previous children in the families, (Table XXXI), and *it seems reasonable to conclude that at a level of society marked by either* :—

(*a*) *That degree of education required for the 'black-coated' classes,*

(*b*) *That degree of responsibility necessary for supervision in industry.*

or (*c*) *That degree of initiative and that amount of capital necessary for even the smallest independent business.*

together with the amenities which can usually be commanded by people with the above qualifications, families of four, five and six may be reared with relatively low death-rates.

Restriction of families to first, second and third children intelligently bred at suitable rates by women of suitable age, with some fourth, fifth and sixth children born only into the healthier families would give a population from which many of the problems of infant welfare would have been eliminated, and the money, now spent on maintaining in indifferent health those large, rapidly-bred families which because of their initial biological handicap cannot be made really healthy, might be usefully employed in seeking a solution of the problems which still remain. It is clear for instance that in and around birth there is annually a colossal wastage of life, still-births and neonatal deaths eliminating some 40,000 potential lives. When one considers the attention devoted to non-pulmonary tuberculosis which annually removes less than one-tenth of such young lives, it seems very remarkable that so little attention is devoted to the major evil, even now where 'population' problems are being considerably aired. An occasional voice is heard in the wilderness, such as Dame Janet Campbell's "Finally, it seems evident that there is need for further study and investigation of infantile illness and disability, of the reasons for prematurity, of the causes of intra-natal death which are now inexplicable. The conditions of medical education and practice in this country have not hitherto been such as to encourage medical practitioners to give much time to enquiry or research into these problems."

There is however, urgent need for careful consideration of the problem presented to the community by the large rapidly-bred families. As has been seen, despite some reduction in infant and child death-rate in these families, death-rates still remain very high, and the records reveal a shockingly low standard of health.

"Although these efforts have had remarkable results they have failed to give the nation an acceptable measure of good health or satisfactorily to reduce the economic burden of sickness and accidents. Perhaps the most fundamental defect in the existing system is that it is overwhelmingly preoccupied with manifest and advanced diseases or disabilities and is more interested in enabling the sufferers to go on functioning in society somehow than in studying the nature of health and the means of producing and maintaining it. From this it naturally follows that millions of pounds are spent in looking after and trying to cure the victims of accidents and illnesses which need never have occurred if a fraction of this amount of intelligence and money had been devoted to tracing the social and economic causes of the trouble and making the necessary adjustments."

From "Britain's Health", page 205.

In his essay on Scientific Humanism [1941] Huxley writes as follows: "At the present moment we have no policy of values such as, at least in theory, the Middle Ages possessed. The world is but limited in size;

yet we permit this or that incomplete idea to go spreading patchily over its surface, almost without reference to what else it may make impossible." . . . . . "Let us take population. The value of human life becomes so absolute that it is murder to put away a deformed monster at birth, and criminal to suggest euthanasia ; and we push on with our reduction of infant mortality until we save an excess of cripples and defectives from which to breed. The enhanced control that is in our hands and the fact that much of the world is actually filling up are at last giving us pause. The Indian mortality rate could doubtless be reduced by half—but what would you do with the increased population ? Even if you bring huge areas of arid Indian land under irrigation and cultivation, it is only a matter of a generation or so before the new vacant space will be overrun by new population on the same level of prosperity, health and education as the old. Have you done any good by causing more babies to live and so creating greater population-pressure, or by opening up new land to be filled at once by the human flood ? Might it not have been better to have left the death side of nature's population-control to itself until we had some future policy for dealing simultaneously with birth ? or to have kept some open spaces in reserve until there was some better reason for filling them ? At the moment, most people do not even put such questions, much less try to answer them."

But it is not only in India that a population policy is imperative. In this country it is already broadly true that only those who are unable to look after themselves are increasing their numbers. All the others are slowly dying out. This is not a question of class. The capable miner is no longer more prolific than the wealthiest coal-owner. Our civilization is not apparently one in which those who can think are willing to reproduce, but their few offspring will have to bear the burden of an increasing proportion of the mentally and physically unfit. Yet these latter families are absorbing an enormous amount of the money and time spent on public health work, though only achieving such indifferent results. Only by the substitution of intelligent for casual breeding can this be remedied.

In his annual report for 1935, the Chief Medical Officer to the Ministry of Health writes : "We must not overlook the fact that, if the nation saves infant life on this scale, it must not be surprised if many weakly and perhaps even defective children are saved, which tend to increase the number of unfit. In other words, while it may be claimed that the protection and care of the newly born is advantageous and desirable, it brings with it some new problems and certainly brings new responsibility."

That the community must extend the maximum care possible to the unfortunates in its midst, who are inevitably born in the present state of knowledge would seem obvious. That no community can hope to survive which does not use such knowledge as it possesses to recruit its numbers mainly from the physically and mentally more vigorous sections of society would seem unfortunately less obvious to many.

CHAPTER XII.

SUMMARY OF PARTS I. AND II.

1. The death-rate among children after the first month of life is lowest among first children.

2. Death-rates during birth and in the first month of post-natal life are very much higher among first children than among seconds and thirds.

3. Total death-rates up to five years of age are very similar among first, second and third children, the lowest rates being found among second children.

4. After the third child there is a very rapid rise in death-rates.

5. These differences in death-rates according to birth-rank are found in *each of the social groups* into which the population studied is divided, although great difference is found in each birth-rank between the different social groups, *i.e. death-rates are determined by both biological and social factors.*

6. At all stages of family, and in all classes, births to older women are more frequently associated with still-births and neo-natal deaths.

7. Among those studied, the class with the lowest infant death-rates consisted of non-manual workers, independent farmers, business people and supervisors in industry. The children of this class had death-rates not differing significantly from those of the unvisited middle classes. In these classes with low total death-rates, there is a high still-birth and neo-natal death-rate, owing to the fact that first births form a large proportion of total births and that many of such first births are postponed to a maternal age associated with an extremely high still-birth and neo-natal death rate. Child deaths between one month and five years in these classes are very few, but where they occur they are caused by the same diseases as are found in the other classes, *i.e.* there is no evidence that these classes are in any way completely protected from certain diseases.

8. Among manual-workers, miners' children show a markedly higher death-rate at *each stage of family* than is found among other children, except in the late stages of the largest families. This seems to be possibly associated in part with the fact that miners suffer from the evils of rural life, (*e.g.* lack of readily available skilled services), poor sanitation, etc. as well as some of the evils of urban life. It is not however possible to demonstrate conclusively what is the cause of the higher death-rate among miners' children than among children of similarly-paid manual workers in the same administrative area.

9. When comparisons are limited to families in which the same number of conceptions had occurred, no relation can be demonstrated between the number of rooms per person or per family, and the child death-rates, *e.g.* first children who are as badly housed as seventh children have the death-rates of first children, and not the high death-rates of seventh children.

10. Even more important than size of family in determining infant death-rates, is rate of breeding. Children in families which are rapidly bred have the maximum death-rates at each birth-rank. In families which are large and rapidly-bred, the death-rates in the area studied show no improvement between 1911 and 1930 as compared with similar sized families, also rapidly bred, described in the Registrar-General's Special [1911] report dealing with families in England and Wales during the period 1891-1911.

Moderate-sized families (less than seven) which are slowly bred show however a considerable improvement over the earlier figures despite the fact that more than 50% of the Durham children are miners' children, who have been shown to have a specially high death-rate, while the figures for England and Wales for 1891-1911 must have been derived from families in which the middle-classes were much more heavily represented than in the Durham investigation. Clearly therefore, over the twenty years, a considerable bridging of the gap between the social classes has taken place. This has occurred in the families in which parenthood is deliberate, intelligent and responsible. These families are able to take advantage of the health, educational and social facilities offered them.

Tables XXI. — XLVII.,

pertaining to Part II.

In the following Tables:—

S = Middle class, unvisited by Health Visitors.

S' and S'' = Black-coated and independent workers

(See Text Page 97 *et seq*).

M = Miners.

R = Manual workers other than Miners.

TABLE XXI.

DEATH-RATES ACCORDING TO BIRTH-RANK AND SOCIAL GROUP.

M = Miners. R = Rest of manual workers. S' & S'' = Black-coated and independent workers.

Birth Rank	Social Group	No. in Group	% of respective Group	SB	IM		CM	TM
					NN	IM'		
1	M	2249	24·2	47·1	39·1	29·4	32·0	147·6
	R	1685	30·6	36·3	28·5	28·5	15·8	109·1
	S' + S''	434	40·9	46·1	34·5	13·9	6·9	101·4
2 & 3	M	3258	35·1	29·5	32·2	37·2	35·3	134·2
	R	1935	35·1	27·9	25·3	35·1	27·4	115·7
	S' + S''	389	36·6	18·0	25·7	18·0	25·8	87·5
4, 5 & 6	M	2423	26·1	34·3	44·2	48·2	42·5	169·2
	R	1256	22·8	48·6	34·2	42·2	26·3	151·3
	S' + S''	193	18·1	56·9	20·7	20·7	15·6	113·9
Over 6	M	1366	14·6	64·4	71·0	51·2	49·0	235·6
	R	636	11·5	64·5	70·7	47·3	26·7	209·2
	S' + S''	47	4·4	42·5	106·5	21·2	21·2	191·4
Total Legitimate and visited	M	9296		40·1	42·7	40·2	38·4	161·4
	R	5512		39·4	35·3	34·3	23·2	132·2
	S' + S''	1063		37·6	32·0	16·9	16·0	102·5
Unvisited	S 1930	474		44·3	21·1	8·4	16·9	90·7
	S 1931	465		34·5	25·8	12·9	10·7	83·9
	S 1936	373		29·5	21·4	8·1	—	—
Illegitimate		629		41·3	62·0	38·0	30·2	171·5

TABLE XXII.

INFANT DEATH-RATE ACCORDING TO SOCIAL CLASS.

	1911°	1921†	1931‡
Professional Classes—Class I. ...	76·4	38	33
Between I and III—Class II. ...	106·4	55	45
Skilled workers—Class III. ...	112·7	77	58
Between III and V—Class IV....	121·5	89	67
Unskilled workers—Class V. ...	152·5	97	77

° Taken from Paton and Findlay [1926] quoting Stevenson [1923].

† Taken from The Registrar-General's Decennial Supplement—England and Wales, 1921. Part II.

‡ Taken from The Registrar-General's Decennial Supplement—England and Wales, 1931. Part IIa. Occupational mortality.

In 1911 Class I contained many clerks, etc. who in 1931 were classed in Class III, and in 1911 Class I was approximately 10% of the whole as against 2% in 1931.

TABLE XXIII.

CLASSIFICATION OF 879 WORKERS OF GROUP R.

Probably relatively immune to unemployment		Much exposed to unemployment		Out of work or no information given
Personal service	12	Labourers	196	95
Amusements	13	Industry	202	—
Public Service	18	Transport	142	—
Navy, Army & R.A.F.	41	Crafts	70	
Land workers	56	Seamen	7	—
Trade	18	Others	9	—
Total	158		626	

TABLE XXIV.

PERCENTAGE DISTRIBUTION OF BIRTHS ACCORDING TO MOTHERS' AGE IN THE DIFFERENT SOCIAL GROUPS.

Social Group	Mother's Age under 20	20-25	25-30	30-35	35-40	Over 40	
S°	—	12·8	36·8	31·2	14·4	4·8	
S†	—	10·2	40·8	34·6	8·2	6·1	
S'	1·4	16·0	31·7	20·5	20·5	9·8	
					14·5		6·8
S''	3·9	23·0	33·3	23·7	11·1	4·9	
Total 16,500 ... (S' & S'' + M + R)	4·0	25·2	28·6	20·5	14·9	6·6	
Registrar-General's							
Professional, Class I (1930-32)	9·6		66·6		23·7		
Intermediate, Class II.	12·1		61·7		26·2		
Skilled workers Class III	23·3		57·1		19·6		
Intermediate, Class IV.	25·0		54·9		20·1		
Unskilled workers, Class V.	24·0		53·6		22·4		

° Calculated from the 125 women in this group in 1930 and 1936.

† Calculated from the 49 women in this group in 1930 only.

TABLE XXV.

PERCENTAGE DISTRIBUTION BY PARITY OF MOTHERS IN DIFFERENT SOCIAL CLASSES.

Social Group	Parity of Mothers 1	2 & 3	4, 5 & 6	Over 6
S°	51·7	40·0	7·9	0·4
†	53·6	36·8	8·8	0·8
S'	39·0	34·1	20·4	6·5
S''	42·1	38·2	16·6	3·0
R	30·6	35·1	22·9	11·5
M	24·2	35·1	26·1	14·6

° Calculated on the 267 women of known parity in this group in 1930 &1936

† Calculated on the 125 women of known age and parity in this group in 1930, and 1936.

TABLE XXVI.

PERCENTAGE AGE DISTRIBUTION OF 1st to 5th BIRTHS IN MANUAL WORKERS (GROUPS M. & R.)

Group	20	20-25	25-30	30-35	35-40	Over 40
R Manual workers not miners	3·3	28·7	35·9	21·1	8·8	2·1
M Miners	3·8	32·4	33·0	19·1	8·8	2·9

TABLE XXVII.

PERCENTAGE DISTRIBUTION OF FIRST BIRTHS BY MATERNAL AGE.

Group	under 20	20-25	25-30	30-35	35-40	over 40	All over 30
S	—	22·4	37·3	28·3	11·9	—	40·2
S'	3·6	31·9	34·8	18·8	8·7	2·2	29·7
S''	8·6	37·0	39·1	9·5	4·5	1·2	15·2
R	8·2	48·1	31·6	9·2	2·7	0·2	12·1
M	10·9	57·1	24·0	6·0	1·5	0·4	7·9

TABLE XXVIII.

BIRTH GROUPS ASSOCIATED WITH HIGH SB RATES EXPRESSED AS PERCENTAGE OF ALL BIRTHS IN EACH SOCIAL CLASS.

Social Group	All 1st births as percentage of total	(x) 1st births to women over 30 (percentage total births)	(y) 7th and later births (percentage total births)	(x + y)	SB rate in each social class per1000 first births to women over 30	SB rates in each social class per 1000 7th and later births	SB rate in each social class on all births
S = Middle class	51·7	20·8	0·4	21·2	—	—	36·6‡
S' Black-coated and independent workers	39·0	11·6 } 8·5	6·5 } 4·4	18·1 } 12·9	73 } 64	71° } 42	42·1 } 37·6
S'' Black-coated and independent workers	42·1	6·4 }	3·0 }	9·4 }	54 }	0* }	34·6 }
R = Manual workers not miners	30·6	3·7	11·5	15·2	53	64	39·4
M = Miners	24·2	1·9	14·6	16·5	75	64	40·1

° from 28 births. * from 19 births. ‡ Mean of 1930, 1931, and 1936.

TABLE XXIX.

DEATH RATES BY SOCIAL CLASS WHEN 1st, 2nd and 3rd BIRTHS IN M, R, and S' + S'' ARE COMPARED WITH ALL BIRTHS IN S.

Social Group	SB	NN	IM'	CM	TM
M—Miners	36·7	34·7	34·0	34·0	139·4
R—Other Manual workers	31·8	29·6	29·3	21·6	112·3
S' + S''—Black-coated	32·1	30·4	15·8	12·1	90·4
S (1930) Middle-class	44·3	21·1	8·4	16·9	90·7
(1931) ,,	34·5	25·8	12·9	10·7	83·9
(1936) ,,	29·5	21·4	8·1	—	—
S (Mean) ,,	36·6	22·9	9·9	(13·8°)	(87·3°)

° Mean of 1930 and 1931 only.

TABLE XXX.

PROPORTIONS OF TWINS IN DIFFERENT SOCIAL GROUPS.

	No. of sets of twins per 1000 births	per 1000 twin children born					Triplets
		SB	NN	IM'	CM	TM	
S	10·4	0	300	—	—	300	
S'	11·7	100	400	—	—	500	
S''	14·2	277	222	—	—	499	1 set 3 SB
Total 16,500 ...	15·6	99	259	56	27	441	
2 years' records from a "middle class" newspaper 1805 births	10·0	55·5	55·5°				

° Birth and death announced together in newspaper.

TABLE XXXI.

PREVIOUS CHILDREN.

d = deaths of children born alive before birth of last child.

Social Group	Birth rank of 1930 child	No. of previous children	Death-rates before the birth of the last child per 1000 pregnancies			
			SB	d.	MC	SB + d
S'	2—6	519	21·2	84·8	21·2	106·0
S''	2—6	699	22·9	104·4	15·7	127·3
Total 16,500 ...	2—6	22,829	28·5	124	15·6	152·5
S'	over 6	191	15·7	94·2	15·7	109·9
S''	,, 6	135	29·6	222	29·6	251·5
Total 16,500	,, 6	16045	34·9	191	37·4	225·9

TABLE XXXII.

PERCENTAGE OF FAMILIES IN EACH GROUP WHO OCCUPY HOUSES OF DIFFERENT SIZE.

No. of pregnancies in family	Number of Rooms per House						Total number of house holds in group
	1	2	3	4	5	over 5	
1	7·4	23·2	20·7	34·9	10·9	2·8	4674
2	5·1	28·0	21·9	33·5	9·7	1·9	3142
3	3·9	27·5	26·3	32·3	8·2	1·7	2340
4	2·5	24·2	28·9	32·7	9·6	2·2	1733
5	2·5	23·3	27·6	35·9	8·2	2·4	1235
6	1·9	20·1	28·2	37·0	10·0	2·9	915
7	2·0	17·5	27·3	40·6	11·5	1·0	684
7 & over	*1·2*	*16·7*	*24·4*	*43·5*	*12·8*	*1·3*	*2001*
8	1·4	15·6	24·7	43·1	13·4	1·8	441
9	0·9	24·2	20·9	38·1	13·8	2·2	320
10	—	14·7	20·6	51·8	11·9	0·9	218
11	—	13·2	28·7	43·4	14·0	0·7	136
12	1·2	11·6	22·1	53·5	10·4	1·1	86
13	—	8·8	22·8	49·1	19·3	—	57
Over 13	—	8·5	15·3	59·3	16·9	—	59
Total	*4·4*	*23·9*	*24·1*	*35·3*	*10·1*	*2·1*	*16040*

TABLE XXXIII.

ROOMS PER LIVING PERSON (R/P) VARIATION WITH SOCIAL GROUP AND SIZE OF FAMILY.

Group	No. of Pregnancies								Average for group
	1	2	3	4	5	6	7	8 & over 8	
S^{I} ...	1·51	1·27	1·08	0·97	0·79	0·88	0·67	0·60	1·22
S^{II} ...	1·06	0·91	0·79	0·68	0·61	0·51	0·49	0·40	0·90
Total 16,500	0·80	—	—	—	—	—	0·47	0·40	—

"Rooms per person" is measured by the number of rooms occupied by the number *alive* in the household.

No. of pregnancy refers to the pregnancy terminated in 1930.

TABLE XXXIV.

ROOMS PER PERSON (R/P)—VARIATION WITH PARENT'S AGE.

Position in family	Social Group	under 20	Age of mother 20-25	25-30	30-35	35-40	over 40	Unknown	Mean
1	S'	1·05	1·30	1·56	1·59	1·68	2·03	1·66	1·51
1	S''	0·80	0·94	1·17	1·09	1·25	1·44	1·19	1·06
1	Total 16,500	0·63	0·77	0·91	1·01	1·07	1·28	0·95	0·82
2	,,	—	—	0·74	—	—	—	—	—
4	,,	—	—	0·56	—	—	—	—	—
7	,,	—	—	0·46	0·47	0·46	0·44	0·48	0·47
10 & over10	,,	—	—	0·40	0·40	0·40	0·40	0·40	0·40

TABLE XXXV.

R/P FOR THE GROUPS IN WHICH DEATH OCCURRED AND THE MEAN FOR THE WHOLE GROUPS.

Birth-rank	1st					2nd	4th	7th All
Mother's age	20	20-25	25-30	30-35	35-40	25-30	25-30	ages
SB	·60	·95	1·30	1·10	1·45	0·85	0·77	0·57
NN	·70	·95	1·05	1·10	1·10	0·80	0·57	0·53
IM'	·60	·70	0·85	0·85	1·30	0·70	0·51	0·42
CM	·65	·60	0·90	1·30	1·50	0·70	0·58	0·49
SB*	·50	·70	0·90	0·80	1·05	0·65	0·58	0·47
NN*	·60	·70	0·80	0·80	0·85	—	—	—
Mean for group, alive and dead	·60	·75	1·00	1·00	1·05	0·75	0·56	0·47

SB* and NN* see text, page 115, par. 1.

TABLE XXXVI.

DEATH-RATES ACCORDING TO THE NUMBER OF ROOMS PER PERSON (R/P).

		R/P Uncorrected			R/P Corrected			
		Under ·6	·6-1 inclusive	over 1	under·6	·6-1 inclusive	over 1	Unknown
No.		671	1229	337	680	1240	317	87
per 1000	SB	34·3	39·0	65·3	38·2	46·0	31·6	11·3
	IM	53·7	58·6	86·0	61·8	59·7	66·3	124·3
	CM	32·8	26·9	11·8	32·2	26·6	12·6	—
	TM	120·8	124·5	163·1	132·2	132·3	110·5	135·6

TABLE XXXVII.

VARIATIONS OF DEATH-RATES WITH NUMBER OF ROOMS OCCUPIED PER FAMILY.

Birth rank	Age of mother	Rooms per family	Social Class	Number in Group	Average R/P for Group	SB	IM	CM	TM
1	20-25	2 or less	M	502	0·51	39·9	55·8	39·9	135·6
			R	256	—	23·5	70·7	7·8	102·0
	,,	3 or more	M	736	0·87	47·6	73·4	31·2	152·2
			R	495	—	36·4	48·5	12·1	97·0
1	25-30	2 or less	M	206	0·60	48·6	87·4	23·8	159·8
			R	135	—	29·4	51·5	7·4	88·3
	,,	3 or more	M	315	0·93	50·4	54·0	28·5	132·9
			R	358	—	58·6	41·9	19·5	120·0
1	Total 20-30	2 or less	M	708	0·55	42·4	65·0	35·3	142·7
			R	391	—	25·6	63·9	7·7	97·3
	,,	3 or more	M	1051	0·90	48·6	67·6	30·4	146·6
			R	853	—	45·8	45·8	15·3	106·9
6, 7, 8 & 9	All ages	2 or less	M	297	·25-·30	39·5	131·0	67·3	237·8
			R	209	—	71·6	105·3	23·9	200·8
	,,	3 or more	M	1294	·40-·50	54·9	104·0	42·5	201·4
			R	538	—	57·6	107·8	33·6	199·0

TABLE XXXVIII.

TOTAL DEATH-RATE AMONG FIRST CHILDREN UP TO 5 YEARS ACCORDING TO THE NUMBER OF ROOMS OCCUPIED PER PERSON.

(R/P corrected for still-births and neo-natal deaths).

Age of mother	No. of first children in homes R/P exceeds 1	Death-rate among first children where R/P exceeds 1	Death-rate among *all* first children to mothers of that age
20-25	317	110	129
25-30	296	111	124
30-35	107	121	127
Total 20-35	720	112	128

TABLE XXXIX.

PERCENTAGE OF DIFFERENT SOCIAL GROUPS OCCUPYING 2 ROOMS OR LESS.

Social Group.		Only one child born (mother aged 20-30)	6th to 9th child born. (all maternal ages)
Miners	M	40·2	18·7
Rest	R	31·1	28·0

TABLE XL.

PROPORTION OF CHILDREN BORN AT DIFFERENT STAGES OF THE FAMILY (1930).

Birth rank.	Illegitimate	All visited children
1st	79·0	29·8
2nd	10·1	20·1
3rd and later	10·9	50·4

TABLE XLI.

DEATH-RATES AMONG ILLEGITIMATE AND LEGITIMATE CHILDREN OF KNOWN BIOLOGICAL GROUPS.

Birth-rank	Mother's age	Social Group	SB	NN	IM[1]	CM	TM
1	Under 20	Illeg.	28·1	84·2	61·8	16·8	190·9
		M-miners	33·9	33·9	67·8	42·4	178·0
		R-other manual workers	15·6	62·5	62·5	23·4	164·0
1	20-25	Illeg.	44·7	34·8	29·9	34·8	144·2
		M	44·4	40·4	25·9	34·7	145·4
		R	32·0	27·7	28·3	10·6	98·6
1	Over 25	Illeg.	86·0	121·8	10·8	43·0	261·6
		M	56·2	38·9	24·8	22·0	141·9
		R	49·9	33·8	13·2	17·6	114·5
2	All ages	Illeg.	31·1	62·5	62·5	31·1	187·2
		M	26·8	31·7	37·3	34·0	129·8
		R	24·0	38·8	22·1	24·0	108·9

TABLE XLII.

PERCENTAGE DISTRIBUTION OF BIRTHS BY BIRTH-RANK OF CHILD AND AGE OF MOTHER.

Comparison of 1930 and 1936.

Birth-rank	1	2	3	4	5	6	7	8	9	10	11	12 and over 12
1930	29.5	20.1	14.3	10.5	7.5	5.6	4.1	2.8	2.0	1.4	0.8	1.3
1936	33.1	23.3	14.7	8.9	6.3	4.2	3.1	2.2	1.4	1.1	0.8	0.9

Age of mother	Under 20	20-25	25-30	30-35	35-40	Over 40
1930	4·0	25·2	28·6	20·7	14·9	6·6
1936	3·8	25·9	30·6	20·6	13·4	5·6

TABLE XLIII.

NUMBERS IN EACH AGE AND PARITY GROUP IN 1930 AND 1936.

Birth rank		under 20	20-25	25-30	30-35	35-40	over 40	All ages	All ages & birth ranks
1	1930	610	2503	1326	378	121	22	4960	16782
	1936	456	2051	1351	419	104	20	4401	13289
% *fall*		*25·3*	*17·9*					*11·3*	*20·8*
2	1930	54	1160	1362	552	194	44	3366	
	1936	50	1008	1263	569	180	32	3102	
% *fall*		*8*	*13·1*	*7·3*				*7·8*	
3	1930		426	1035	635	262	41	2399	
	1936		310	789	536	256	59	1950	
% *fall*			*27·2*	*23·8*	*15·6*			*18·7*	
4	1930		103	612	599	339	106	1759	
	1936		63	382	441	228	72	1186	
% *fall*			*38·9*	*37·6*	*26·4*	*32·8*	*32·1*	*32·6*	
5	1930		22	291	540	321	90	1264	
	1936		11	194	281	269	79	834	
% *fall*			*50*	*33·3*	*47·9*	*16·2*	*12·2*	*34·0*	
6	1930			127	373	335	104	939	
	1936			63	226	210	60	659	
% *fall*				*50·4*	*39·4*	*37·3*	*42·3*	*40·5*	
7	1930			58	211	307	117	693	
	1936			23	129	177	81	410	
% *fall*				*60·4*	*38·9*	*42·3*	*30·8*	*40·9*	
8	1930				136	221	121	478	
	1936				78	143	71	292	
% *fall*					*42·6*	*35·3*	*41·8*	*39·0*	
	1930				78	393	453	924	
	1936				68	215	272	555	
% *fall*					*12·8*	*45·3*	*40·0*	*39·9*	

TABLE XLIV.

DEATH-RATES IN 1936 AND 1930.

	Death-rate per 1000 births.			
	SB	NN	IM'	SB + NN + IM'
1930	39·8	41·2	35·8	116·8
1936	42·6	35·8	26·7	105·1
Figures calculated as though individual rates were as for 1930, but parity distribution of 1936 ...	*38·6*	*39·8*	*34·5*	*112·9*

TABLE XLV.

DEATH-RATE BY MOTHER'S PARITY AND SOCIAL GROUPS. (1930 BIRTHS).

Parity	Group	Number in Groups	SB	NN	IM'	CM	TM
2	M	1826	26·8	31·7	37·3	34·0	129·8
	R	1160	25·9	34·5	31·0	25·9	117·3
	S' + S''	255	15·7	19·6	19·6	15·7	70·6
3	M	1432	33·1	32·8	37·5	37·3	140·7
	R	775	31·0	11·6	41·3	29·7	113·6
	S' + S''	134	22·4	37·3	15·0	44·8	119·5

TABLE XLVI.

COMPARISON OF DEATH-RATES IN FIRST AND SECOND CHILDREN.

	SB + NN		Difference in SB + NN between 1st and 2nd births	Difference between TM for 1st and 2nd births
	1st	2nd		
Group M	86·2	58·5	27·7	+17·8
R	64·8	60·4	4·4	— 8·2
S' + S''	80·6	35·3	45·3	+30·8

TABLE XLVII

COMPARISON BETWEEN DEATH-RATES IN 1936 and 1930 AT DIFFERENT STAGES OF FAMILY.

1st Children

	SB	NN	IM¹	SB+NN	SB+NN+IM¹
1930	43·2	39·7	26·1	82·9	109·0
1936	41·1	36·8	20·2	77·9	98·1

2nd Children

SB	NN	IM¹	SB+NN	SB+NN+IM¹
25·7	33·9	32·7	59·6	92·3
28·4	33·8	26·8	62·2	89·0

3rd Children

	SB	NN	IM¹	SB+NN	SB+NN+IM¹
1930	31·8	28·4	35·2	60·2	95·4
1936	36·4	28·2	31·3	64·6	95·9

4th Children

SB	NN	IM¹	SB+NN	SB+NN+IM¹
34·6	35·2	49·6	69·8	119·4
39·6	36·3	26·1	75·9	102·0

5th Children

	SB	NN	IM¹	SB+NN	SB+NN+IM¹
1930	40·2	34·6	37·8	74·8	112·6
1936	64·7	45·5	27·6	110·2	137·8

6th Children

SB	N	IM¹	SB+NN	SB+NN+IM¹
48·5	58·3	43·1	106·8	149·9
44·7	28·6	25·1	73·3	98·4

7th Children

	SB	NN	IM¹	SB+NN	SB+NN+IM¹
1930	68·7	67·2	30·8	135·9	166·7
1936	82·9	61·0	43·9	143·9	187·8

8th-11th Children

SB	NN	IM¹	SB+NN	SB+NN+IM¹
58·0	72·6	49·4	130·6	180·0
64·5	33·5	39·8	98·0	137·8

12 and over 12 Children

	SB	NN	IM¹	SB+NN	SB+NN+IM¹
1930	75·5	89·6	98·4	165·1	263·5
1936	144·0	76·3	67·8	220·3	288·1

PART III.

BIOLOGICAL AND SOCIAL FACTORS INFLUENCING MATERNAL DEATHS AND DEATHS FROM OTHER CAUSES IN ACTIVELY REPRODUCING WOMEN.

CHAPTER XIII.

THE PROBLEM AND THE MATERIAL STUDIED.

Any investigation into the factors influencing deaths associated with motherhood immediately meets two difficulties not found at all in an investigation of the problems of infant and child death-rates. The first of these is an arithmetical difficulty. It has already been shown that about 90% of all children are born to mothers whose ages range from 20 to 40 years, while the number of women over 45 or under 15 years of age who bear children is negligible. It may be seen from Table I, (Part I) that the general death-rate [1931] of women ranges from 2·6/1000 at 15-25, to 4·5/1000 at 35-45 years of age in England and Wales as a whole, and from 3·8/1000 in the earlier group to 6·0/1000 at the later stage in the administrative county of Durham. The maternal death-rate for England and Wales has varied during the period 1930-36 from 4·71 to 5·69 per 1000 and averaged 5·3/1000. (These figures are on live plus still births). It has approximated to 6/1000 for the Durham area. and is fairly constantly about 10% above that of the country. This seems impressive, but if looked at from another point of view, it is seen that in the whole country 994·7 out of every 1000 women survive the ordeal of child-birth, while in Durham the figure is 994·1, a negligible difference. For the purpose of this investigation, it has been necessary to read the account given by mothers of something like 60,000 births, where the mother survived, and several hundred accounts, given by other people, where the mother died. The outstanding impression left by this study is the overwhelming importance of chance factors. That such chance factors may well conceal real changes in infant death-rates has already been indicated in considering the death-rate uuder 1 year of children born in 1936, although when dealing with figures of the order of 70/1000 or 80/1000 real changes might be expected to be clearly measurable. With figures of 3 or 4/1000, however, the study seems well-nigh hopeless at the outset. No one investigator or group of investigators can hope personally to study a sufficient number of *births* to get groups which will give a large enough number of maternal deaths to demonstrate the important causal factors. Any investigator must rely on records, and these are not at the present time universally compiled on any pre-arranged basis, and are not therefore readily comparable.

The problem presented is in fact very closely comparable to the problem of road accidents, where one accident involving a considerable number of people may play havoc with the mortality figures, without contributing anything to the knowledge of the means of preventing road deaths. If, for instance, the extremely morbid conditions are considered under which Caesarian operations are deemed necessary, it is found that the death-rate among the women concerned is 6·6% [Orley 1938]—a death-rate fifteen times the average for all births. Even so, this only means that out of every 1000 women who undergo this operation 934 survive, and 66 die, *i.e.* the odds in favour of living are enormously great, and it seems probable that the 66 deaths are determined by the *coincidence of a number of chance factors*, which vary from case to case.

Just as the road traffic problem can only be dealt with by studying the conditions which make for the accidents likely to cause death, irrespective of whether any given accident does so or not, so the causes of maternal mortality can only be rationally studied by considering total maternal morbidity, of which the maternal deaths must be regarded as particular, extreme, cases. Unfortunately, there is no adequate statistical record of maternal morbidity available for study. The question was therefore asked, how far mother and child might be regarded as a biological unit, and how far then the fate of the mother could be correlated with the factors known to influence the fate of the child.

From the records of County Durham for the years 1931-37 inclusive, it appeared that of 615 women whose deaths were classed as 'maternal deaths', 143 either had miscarriages or died undelivered. Of the remaining 472, 176 gave birth to still-born children, and of the 296 children born alive, 38 died during the first week. This gives a still-birth rate of 373/1000 and a death-rate under a week of 80/1000, the former being about 9 times and the latter 3 to 4 times the rate for all births. Taking the figures for England and Wales for 1934-1936 inclusive, from the reports of the Ministry of Health, for comparison, it appears that the still-birth rate among potentially viable children of mothers dying from puerperal causes is 325/1000—again 8 to 9 times the average rate. Death-rates for the children born alive to these women are not given. That there is an unmistakeable association between maternal deaths and still-births and neo-natal deaths among the children seems clear, and it is thus not unreasonable to regard mother and child as a biological unit for the investigation.

Unforunately there is a second, and perhaps more serious difficulty. This may be summed up in the question—'*When is a dead mother not a maternal mortality?*" If a child dies before he is a year old, his death is classed as an infant death, in the usually accepted classification. There are no two opinions on the subject. This is far from being the case with maternal deaths. There are a certain proportion of these deaths associated with conditions so narrowly determined by pregnancy and parturition that they would undoubtedly be classed as "maternal deaths" by all. There is a further proportion in which the final cause of death is disease in no way peculiar to the pregnant or parturient woman, but in which pregnancy and parturition have been considered as major factors in determining the fatal end of the disease. Study of the health records of many thousand mothers showed, however, that there were a very considerable number of deaths attributed by relatives to the stresses and strains of motherhood, which were not classed as maternal deaths by the doctors in attendance or by the health officials. Some such deaths actually occurred in the hospitals to which the women had been admitted for their confinement. It became increasingly clear, therefore, that a great divergence of opinion existed between the official and expert view of what constituted a maternal death, and the view of the ordinary man in the street, or more importantly, the woman in the home.

The Chief Medical Officer to the Ministry of Health in his Annual Report gives the maternal mortality figures in three sections—those

due to puerperal sepsis, and those to other puerperal conditions—which taken together form the *total puerperal mortality*, and "deaths of women not classed to pregnancy and child-bearing but returned as associated therewith." Total puerperal mortality plus the latter group give total maternal mortality. All the Durham figures refer to *total maternal mortality*. It has not proved possible to separate them into their component groups. It is to be expected that pregnant and parturient women will in general be subjected to the usual hazards of their age, sex, class and area, and that among them a death-rate will be found equal to that among the other women of their sex, class and area, from causes not associated with their physiological condition.

The expert attempts to separate deaths from maternal causes from deaths from other causes, but this could only be done if definite statistical evidence existed showing the relative death-rates from certain diseases in pregnant or parturient women on the one hand, and non-reproducing women on the other, with age, sex, class and environmental conditions kept constant in both groups. No such evidence exists, and it is obvious that there are a considerable number of deaths associated in time with child-birth, but not directly caused by it in which no two people would certainly agree as to whether child-birth should or should not be considered a causal factor. In the reports of some investigations, it would seem that the investigators class as maternal problems those with which the maternity services (of all kinds, including hospitals, specialist obstetricians, etc.) are designed to deal, and ignore altogether the possibility that pregnancy and parturition may accelerate other diseases or exacerbate other conditions, thus being an important indirect cause of death. These investigations do not therefore cover the whole problem, but really only show the extent to which existing services are adequate for strictly limited purposes.

That women themselves consider all deaths or illnesses *associated in time* with pregnancy or parturition as being probably causally related to these conditions is, however, socially of the greatest importance. It is essential to realize that *all the problems of childbirth can be eliminated by the simple process of avoiding childbirth.* This has occurred to an enormous extent, the actual numbers of women now dying from puerperal causes or from illness associated with pregnancy being only a fraction of what it was a few years ago. In the same way, although there is no difference in the death-rates of mothers per 1000 births in the different classes, the total death-rate per 1000 married women from puerperal causes in the wives of Classes I and II (the best-off classes) is only about 60% of that in Class V (unskilled workers), owing to the fact that the birth-rate in the latter class is so much higher than in the former. (Registrar-General 1931. Occupational Mortality.) **It is clear therefore that if the community wishes to survive, the problems of motherhood must be considered in the widest and not as at present in the narrowest sense.** The question to be posed is—"What is the total biological cost of mammalian reproduction to the female ? " On *a priori* grounds, there are three possibilities. It might be assumed that, apart from the specific and well recognised problems associated with reproduction, pregnancy and parturition are without influence on the health

of the female. Under these conditions, the death-rates among reproducing females would be expected to be the simple sum of the *normal* death-rates of women of their age, class and area, plus the *specific* death-rates associated with maternity. The second possibility is that reproduction might greatly accelerate and exacerbate other disease. (There is a common clinical opinion that this is true to some extent in the case of tuberculosis.) In this case, women passing through the reproductive cycle might have a higher death-rate from non-puerperal causes than non-reproducing women who are otherwise comparable. Thirdly, it is possible that the strains and stresses of pregnancy and parturition might act as a weeding-out process, causing latent disease to be revealed, and early pathological conditions to be more rapidly developed. By this means, defects of all kinds might be uncovered, and quite apart from purely obstetric difficulties, there might be a temporary rise in the death-rate due to this acceleration of pathological conditions. This however would mean an elimination of the "unfit" and would be followed by a lowering in the death-rate among the relatively healthy survivors.

An attempt was made to answer the question of the total biological cost of reproduction by a study of the death-rates of the women whose children came under the care of the maternity and child-welfare staffs. The investigation into maternal mortality rates therefore resolved itself into two parts.

(1) The study of the influence of mother's age, birth-rank of child and rate of breeding on 'maternal deaths', (taking these latter from the official lists), with consideration of relevant social factors.

(2) The study of the total death-rates among actively reproducing women over periods up to five years from the time when the birth of a child brought them on to the records.

Material used.

For the consideration of the factors influencing infant and child death-rates, a study was made, as already described, of the distribution of *births* according to the age and parity of the mother for the years 1930 and 1936, using for this purpose the records of health visitors.

Since, however, there are fewer than 100 'maternal deaths' in the area concerned each year, it was clear that the analysis of deaths even in two years would be too few to give reliable figures. It was, therefore, necessary to analyse the deaths occurring over several years. Each year, the County Medical Officer of Health has published in his report an analysis of maternal deaths by birth-rank of child and maternal age. Unfortunately these figures did not give an analysis of the influence of age when birth rank was constant, or of birth-rank when age was constant.

The analysis of the material was completed in the later part of 1937, and there were readily available detailed records relating to deaths in 1934, 1935, 1936, and the early part of 1937. It was decided, at the outset of the whole investigation, that if any records of deaths were in any way incomplete for various reasons, no further inquiries could be made concerning the dead woman or child. It was found in

fact that the records of the children in the earlier years did not give complete information about the mother. This is quite to be expected, since the first visit made by the health visitor at which most of the information relative to the mother is secured usually occurs at about the period when the mother is just able to receive visitors. But if the mother is dead or dying, then any information received must be given by others, and the health visitor must use her own judgment as to the desirability of getting such information. Actually in the case of women who die at the birth of a child which is not their first, the health visitor usually has the pertinent facts already recorded on the cards of earlier children. This is true even if the woman dies as the result of an abortion. The kind co-operation of the Superintendent Health Visitor and her staff secured from such other records the necessary information for 98% of all maternal deaths in 1930, and 1931. For 1932, records of the children gave details for the mothers in 74 out of 95 cases, and in 1933, 59 out of 75 cases. For reasons which will be clear later, the information regarding the others was not sought.

For the five years 1930, 1931, 1934, 1935 and 1936, there were 485 maternal deaths, and of these the age was always available, but only in 472 cases was age and parity known. The one or two cases in each year where information was not available as to parity seemed to be distributed between the socially well-placed on the one hand, and women in institutions, lodging-houses, etc. where any information was difficult to get. The ages of these women varied considerably, and there was no reason to suppose that they belonged predominantly to any one social or biological group.

The information secured from these records was checked against that given by the County Medical Officer of Health. His records of deaths were classified in the year in which the deaths occurred, while in the present investigation all classification was based on the year in which the child was born. Each year there were women who bore children late in the year, and died after the opening of the following year. The numbers per year in the two sets of records do not therefore exactly coincide, but the sum over several years is almost the same.

For the second part of the investigation the records of the children were studied for deaths occurring among mothers during the first five years of the children's lives. This was done for children born in 1930 and 1931, all of whose records were returned to the office by the end of 1936. It was early realized that the return to the office of records of children dying during the five years rendered the study incomplete, but it was considered that such information as could be secured was valuable (Chap. XVIII, page 169).

The following information was sought concerning the mothers' deaths during the period in which the children were visited.

Age of child at time of mother's death.

Age of any later children.

Age and parity of mother at the birth of *her last child.*

Cause of death. (This where stated was only the general cause as given by relatives, and not necessarily the certified cause of death.)

Late in 1937, the investigation was extended to cover the mothers of all the children born in the area from 1930 up to that time. Any records which had been returned to the Health office were examined as before. Most of the records (a total of 56,718) were however in the hands of the health visitors. The County Medical Officer of Health gave permission for information to be secured from these, and the Superintendent Health Visitor arranged for her staff to supply the aforementioned details of any deaths of mothers of children whom they were visiting. This was doubly useful in that it not only widened the scope of the investigation, but acted as a check on the original study of the 1930 and 1931 records. In these latter records there were only about 170 mothers' deaths in each set of records, apart from those initially classed as maternal deaths. Reading through records written in many hand-writings presents many difficulties, and it seemed possible that a few deaths might have been missed—and with a total figure as low as 170, this might be important. Each health visitor, however, at that time, held from 500 to 800 records, and the number of children being visited whose mothers were dead did not exceed 11 in any health visitor's list and only averaged 4. So that each health visitor was aware of the orphaned condition of these few children, and there was no chance of mothers' deaths being overlooked. As will be seen later, figures secured in this way for the mothers of children born in 1932, 1933, 1934, and so on to the end of the investigation, entirely confirmed the conclusions deduced from the study of the earlier years' records.

CHAPTER XIV.

THE INFLUENCE OF MATERNAL AGE AND PARITY, AND OF THE RATE OF BREEDING ON MATERNAL MORTALITY RATES.

Tables XLVIII and XLIX show the influence of maternal parity and age considered separately, on the maternal death-rate per 1000 births (live and still). Full details of the method by which these rates were calculated are given in Appendix 7. Here it may be stated that the number of deaths in each parity group was arrived at by taking the mean of the numbers given annually by the County Medical Officer of Health for the years 1930-1936 inclusive. The annual number of births was assumed to be equal to the mean of the numbers in the respective groups in 1930 and 1936. The total number for the seven years was, therefore, seven times this mean figure. This ignored the unvisited group in each year, but, since the parity was not known of unvisited mothers who died, (so that such mothers could not be included in their correct parity group, *i.e.* both births and deaths in this group were ignored), this seemed justifiable. No error was thereby introduced which could affect the validity of the conclusions drawn. In compiling Table XLVIII, 650 deaths of women of known parity were used to arrive at the figures relating death-rate to parity. (Pages 199—200).

For Table XLIX, the ages of 656 women who died were known. The rates were calculated as for the parity groups.

From Table XLVIII it appears that first births are associated with a relatively high maternal death-rate. The figure then drops for second and third births. For fourth, fifth and sixth births, the figure varies round that for the first, and for later births rises rapidly and averages nearly twice that for the firsts. The figure 6·2/1000 for women of all parities appearing in Table XLVIII is slightly higher than the figure 5·9/1000 which is the average for the maternal death-rates given by the County Medical Officer of Health in his reports for the years covered. This is due to the fact that in his tables, certain boroughs are included, which are not covered in this investigation, and which have had on the average, during the years considered, a maternal death-rate slightly below that of the Maternity and Child Welfare Unit of the County.

While from Table XLVIII it would appear that fewer maternal deaths are associated with second and third births (about 30% of the total), it must be noted that considerable irregularities occur in the relationship between parity and death-rates in both pregnancies, owing to the relatively small number of deaths, *e.g.* the death-rate associated with 8th births is less than that with seventh or even sixth births.

Table XLIX shows that the maternal death-rate in the small group of mothers under 20 is high compared with the larger 20-25 years group, even when averaged over the seven years. From twenty onwards the maternal death-rate rises steadily with age, although the difference between the 20-25 and the 25-30 age groups is negligible.

In view however of the fact that all the really interesting and significant biological factors influencing child health were elucidated by studying the influence of maternal age when parity was constant, it seemed desirable, despite the paucity of the figures to make a similar study of maternal deaths. For this were used 472 deaths where the woman's parity and age were known, and which occurred in the years 1930, 1931, 1934, 1935 and 1936. Table XLVIII shows that essentially similar conclusions as to the influence of parity on maternal death-rates may be drawn from studying the 472 cases as from the whole 650 of known parity.

Table LIII shows the maternal death-rate as deduced from the 472 cases in individual age and parity groups. None of these figures are of statistical significance because of the smallness of the numbers, but the trends indicated are probably of meaning.

From Table LI, where the figures are grouped into classes large enough for significance, certain facts stand out. (Page 201).

(1) **There are two peaks in the maternal death-rate,** one occurring in *association with first births to women over thirty,* and one associated *with all seventh* and later births.

(2) **The maternal death-rate rises with maternal age** at all stages of the family, but is almost precipitous in its rise for first births. The elderly primipara is a well-recognised problem, but what is not recognised is that **in this connection a woman is beginning to be elderly at 25.**

(3) **The two peaks in the maternal death-rate coincide with peaks in the still-birth rate and neo-natal death-rate.** The correspondence between the maternal death-rates, on the one hand, and the infant death-rates before, during or shortly after birth, on the other, is not direct and arithmetical, since the highest maternal death-rate occurred among women over thirty bearing their first child, while the highest infant death-rate around birth (SB + NN) occurs in the late born children of large families. Campbell's findings [1929] that the still-births and neo-natal deaths of first-born children are predominantly associated with birth injury probably throws some light on the problems relating to maternal deaths associated with first births. If, among first births, the 25-30 group is compared with the 20-25 group (Tables LIV and LV) it is seen that an increase of 13/1000 in the SB rate is only accompanied by an increase of 5/1000 in the SB + NN rate ; the *neo-natal* death-rate has fallen by an amount *which compensates* for much of the *rise in the still-birth rate.* This must mean that the ordeal of parturition becomes steadily more serious with increasing age of mother, and that the proportion of children dying *during birth,* therefore, steadily increases. But even with the younger mothers, many of the children are so weakened by birth that they are unable to survive, and the question resolves itself merely into whether the child will die during or shortly after birth. For the mother, it seems necessary to assume a steady and rapid decline in recuperative power as age advances. The unfitness of the female organism to achieve successfully *for the first time* the enormous structural and metabolic changes required in pregnancy and parturition after the age of thirty is reflected in the enormously increased maternal death-rate, and still-birth rate. For

second and third births, the maternal death-rate, the still-birth rate and the neo-natal death rate are all only 60-70% of those for first births. All these rates reach their very lowest figures for births to women between 20 and 30 years of age. The still-birth and neo-natal death-rates associated with second and third births to women between 30 and 35 years show no significant increase on those in the earlier age groups, but the *maternal* death-rate is nearly doubled. Here it is clear that although there is no significant increase in danger to the child, there is a considerable increase in danger to the mother. (Over the five years examined in detail there were between 10,000 and 11,000 second or third births in the 25-30 age group and 5000-6000 in the 30-35 group. There were exactly 34 deaths in each group). The fact that the recuperative power of the mother is markedly lessened with little change in risks to the child may be in part explained by the fact that many of the women who bear second or third children in the 30-35 period will have had their first children in the 25-30 stage, where the strain on the mother is already becoming considerable. **It is not unreasonable to suppose that the strain of child-birth is cumulative. Wherever, therefore, pregnancy occurs for the first time at an age when the maternal death-rate is already relatively high, all subsequent births will probably be attended by greater risks than where the first pregnancy and parturition is the relatively slighter ordeal of the younger woman.**

For fourth, fifth and sixth births at all ages, the maternal death-rate, the still-birth rate and the neo-natal death-rate are all very close to those for first births. In the 25-30 age group, still-birth rate, neo-natal rate and maternal death-rate are all relatively low, although reference to Fig. 3 (page 33) shows that the *total* death-rate up to five years of age for the children is not low.

First and second births to women under 20, and fourth, fifth and sixth births to women under 25 are curious in that they are associated with a *low still-birth rate, an exceedingly high neo-natal death-rate and a high maternal death-rate*—the only groups in which a really high maternal death-rate is found in young women. This is the group noted earlier in dealing with children (Table IX, Group a) in which reproduction begins in the immature female and is continued too rapidly for the healthy development of the mother. It seems possible that the smaller infants borne by these women present fewer actual obstetric difficulties, and that the structural adaptations necessary for pregnancy and parturition are more readily accomplished by the bodies of these younger women whose metabolism is, in any case, that of the growing organism. Hence the low still-birth rate, but the recuperative power of the mothers is small (high maternal mortality rate), and the children are relatively feeble, as indicated by the high neo-natal death-rate.

Neither the figures for second births to women under 20 nor those for fourth, fifth and sixth in the 20-25 group have any statistical significance, as the former group contained only 50 births in each of the years examined, while the mean for the two years for the latter group was 95 : *i.e.* over the period of the five years in which age and parity was known for the different groups, there were about 250 births and 2 deaths in the first group, and about 500 births and 5 deaths in the second group. First births to women under 20 were, however, more numerous, averaging 533 over the two years in which birth

distribution was known. In the five years examined in detail, deaths in this group numbered 2, 6, 3, 5 and 3 and totalled 19. Over all the seven years 1930-1936 inclusive, however, the parity was known of the women who died in this age group, and there was a total of 26 women who died with their first child. If, therefore, the information concerning all mothers under 20, and mothers under 25 bearing fourth, fifth or sixth children, (only 2 mothers had seventh pregnancies in this age group in 1930 and none in 1936) is related to the established facts concerning the fate of the children it seems safe to conclude, on biological grounds, that the high maternal death-rate is real, although it is not statistically established. The excessively high puerperal death-rate per 1000 married women of this age found in the Registrar General's records also supports this—*i.e.* 1·3/1000 as against 0·7/1000 in the much more fertile period between 20 and 25 years.

If the two relatively large groups of first births to women 20-25, and 25-30 respectively are studied, it is noted that births annually averaged 2,277 and 1,338 in them, *i.e.* the second group is only about 60% as large as the first. In the five years in which the deaths were studied, these numbered 9, 10, 7, 11, 7, in the first group, and 11, 9, 6, 9 and 11 in the second group, *i.e.* deaths were *always* about equal in the two groups despite the disparity in numbers of births.

It is clear, then, that as in the matter of still-birth rate, the age of the mother is a very important factor in determining maternal death-rate. The production of large families or the rapid breeding of small ones is associated with high maternal risks. The decrease in the size of family has not however been followed by a decrease in maternal death-rates per 1000 births (although of course it has been followed by an enormous decrease in the numbers of women dying in child-birth). The absence of a drop in the death-rate is due to the peculiar difficulties associated with first births, and the precipitous rise in death-rates among these with increased age of mother.

Since any decrease in average size of family always increases the proportion of first births, it is clear that a falling birth-rate will always be accompanied by an increase in the proportion of maternal deaths associated with first births. If the falling birth-rate were also accompanied by a decrease in the number of large families, there would be a corresponding decrease in the number of maternal deaths, but of course, the birth-rate may continue to fall long after all families of seven or more have ceased to exist. On the other hand, the birth-rate might fall by a limitation in the number of medium-sized families, while the large families remained as numerous as before. Here there would be no decrease in maternal deaths in the second peak group, to offset the increase in the proportion in the first peak, and a falling birth-rate might be accompanied by a rise in maternal death-rate. **Actually, however, it has not been merely the increase in the proportion of first births with the falling birth-rate that has been the main factor in maintaining the level of the maternal death-rate, but the tendency to postpone first births from the relatively safe younger age period, to the later ages attended by much greater risk,—a tendency already noted in considering still-births. Moreover, wherever first births are postponed, all subsequent births must occur at ages associated with maternal risks relatively high for the birth-rank of the child.**

CHAPTER XV.

THE INFLUENCE OF TWINNING ON MATERNAL DEATH-RATES.

During the years 1930-37, there were 712 maternal deaths in County Durham, of which details as to multiple births were available. Among the children born to these mothers, there were 24 sets of twins and 1 set of triplets, *i.e.* 3% of all the births were multiple births. But multiple births have been shown in this area to form about 1·5% of all births. Clearly then, the death-rate among mothers giving birth to twins, was about twice the usual rate for the area. This occurred with complete regularity year by year, and, when the fact is related to facts known about the infants, *i.e.* the high still-birth and neo-natal death-rates among twins, it would seem that despite the paucity of the figures, a real biological phenomenon is indicated (See Table XIX, page 84).

CHAPTER XVI.

THE INFLUENCE OF ILLEGITIMACY ON MATERNAL DEATH-RATES.

For the years 1933-36 inclusive, the Health Ministry's Reports give 7,434 maternal deaths in which the women's married state was known. 7·8% of the births were illegitimate. For 1931, the Registrar-General gives illegitimate births as 4·4% of all births. Clearly then maternal deaths occur associated with illegitimate births much more frequently than with legitimate births—in the ratio of 1·8 : 1.

This is probably partly accounted for by the age of the mother. First births to women under 20 form 37·3% of all illegitimate births according to the Durham 1930 figures. First births to women over 25 form 15·5% of all illegitimate births. These two groups with high maternal death-rates thus form 53% of all illegitimate births. Among legitimate births they form about 2·5% and 10%, *i.e.* only 12% altogether. This does not wholly explain the high death-rate associated with the unmarried mother, which must in part be accounted for by poverty, squalor and disease.

CHAPTER XVII.

ARE THE FIGURES DEDUCED FOR COUNTY DURHAM APPLICABLE TO OTHER AREAS?

In this area, as already pointed out, the maternal death-rate has been slightly but consistently (usually about 10 to 15%) above the rate for the whole country. (Table LVI). As has also been indicated, the general death-rate among women of child-bearing age (15-45) in this area is some 30% above that of the whole country. Further, the natural death-rate among women in this county is about 15% above that of the men of the same age, instead of being much the same, as in England and Wales as a whole. It is tempting to attribute both the high maternal death-rate and the high general death-rate among women to a harsh environment which bears more heavily on the female. The factor of migration cannot, however, wholly be ignored. In this county, in 1931, according to the census figures, males between 15 and 25 exceeded females by about 12,000, (*i.e.* a male excess of about 15%, although in the whole country, females at this age showed an excess of about 2%). For the whole reproductive period of 15-45, males outnumbered females by about 10,000. So presumably of the 12,000 or so women who leave the district to seek work elsewhere, a fairly large proportion return and marry in their native county. This exodus of an appreciable proportion of young women, usually the healthier and more enterprising, cannot fail to be of importance in determining female death-rates. The county is in fact steadily exporting an appreciable proportion of its healthier population. These facts must be borne in mind in any attempt to apply conclusions arrived at by studying such an area as this, to other districts with quite different conditions.

Such information as can be gathered however tends to show that the factors influencing maternal death-rate in this area, act similarly elsewhere.

1. Age distribution of births and maternal deaths in County Durham, and in England and Wales.

Table LII shows the distribution of births according to the age of the mother in Durham, and in England and Wales. The figures for Durham are the mean for 1930 and 1936. Those for England and Wales are deduced from the figures given in the Registrar-General's Special Report [1931] (Occupational mortality) for women who were returned in the census of that year as having a child under 1 year. (Page 201).

The figures for maternal deaths in County Durham refer to the 656 cases occurring in 1930–36 inclusive and also to the 472 deaths of women whose age and parity were known. It may be seen that as regards age the 472 are a fair sample of the 656.

(Those figures which were available for age and parity among women dying from maternal causes in Durham for 1932 and 1933 were

so very similar in distribution to the 472, that it was not considered necessary to undertake the tedious search required to complete the figures for these two years.)

The age distribution of maternal deaths in England and Wales is derived from two sources, and refers to two slightly different classes of death. The first refers to the distribution of deaths from strictly puerperal causes, and the figures are derived from the aforementioned supplement of the Registrar-General; these deaths occurred in the period 1930-32. The second group of deaths are those classed as "maternal mortalities" by the Ministry of Health, and the figures are derived from those deaths occurring in the period 1930-36, for which the Ministry's reports give the age of the mother. These deaths include not only puerperal deaths, which form about 80% of the whole, but deaths from other causes which are nevertheless attributed to maternity. It may be seen from Table LII that the age distribution of strictly puerperal deaths does not differ markedly from that of all maternal deaths. In County Durham the proportion of births in the different age groups differs from that in the whole country as would be expected from the different distribution of social classes in the two areas. **But the influence of maternal age on maternal death-rates is in the same direction and of much the same order in both areas.** The ratio of the proportion of maternal deaths to births in women under 25 in Durham is 20/29, *i.e.* 0·7; in England and Wales it is 17/22, *i.e.* 0·8. In women between 25 and 35 the respective ratios are 45/50, *i.e.* 0·9 and 51/56, *i.e.* 0·9. For women over 35 they are 35/20, *i.e.* 1·7 and 31/21, *i.e.* 1·5. Age would thus appear to be a slightly more important factor in this relatively small group of Durham deaths than in the larger group, but the influence of age is clearly essentially similar in both areas.

2. The distribution of maternal deaths in Durham and in England and Wales according to the parity of the mother.

Little information is available as to the distribution of births in the whole country according to the parity of the mother, but it is possible to arrive at an approximate estimate of certain figures. In Appendix 9 the estimates given by Campbell [1929] for the distribution of births at different levels of birth-rate are considered, and the evidence is adduced which indicates that during the years 1930-36, in which the average birth-rate for England and Wales was 14·8, the proportion of sixth and later births would not exceed 10%. In the Chief Medical Officer's reports the maternal deaths associated with such sixth and later births are given for the years 1933, 1935 and 1936 as 17·4%, 17·6% and 14·2% of all the maternal deaths in the respective years. The average proportion of such *deaths* is therefore 16·4% to compare with a proportion of *births* not exceeding 10%, *i.e.* **the high maternal death-rate found in Durham to be associated with these later births is common to the country as a whole.**

The proportion of maternal deaths associated with first births in England and Wales was 37·9%, 36·2%, 37·6%, 37·6% for the years 1933-1936 inclusive (Reports of the Chief Medical Officer to the Ministry of Health). There is no evidence as to the proportion of first *births*,

but in the area studied in Durham, the proportion rose from 29·5% with a birth-rate of 20·6/1000 to 33·1% with a birth-rate of 17·0/1000. In the U.S.A. [1934] a birth-rate of 17/1000 was associated with 33% of first births. (Bleyer, 1938). Among the middle class and non-manual workers in general in County Durham, the proportion of first births rose to 40-50% of all births. Since such classes form a very much smaller percentage of the population of this county, than of the whole country, it is reasonable to suppose that a birth-rate of 14·8/1000 in the latter is accompanied by a percentage of first births lying between 35 and 40. The mean figure for the proportion of maternal deaths associated with first births for the only years for which the figures were available, was 37·1%. **It may therefore be concluded that maternal deaths are distributed in the country in much the same way as in County Durham.**

First births form about 35-40% of all births and are associated with 37% of all maternal deaths. Sixth and later births form less than 10% of all births, but contribute 16% of all maternal deaths. In between lie the births associated with a maternal death-rate lower than that of firsts, and very much lower than that of the later births.

3. Age and parity distribution of maternal deaths from three maternity hospitals.

It was unfortunately not possible to get any information about the influence of age when parity was constant, and vice versa for the whole country. Some information was secured in the following way.

By courtesy of the obstetricians in charge, it was possible to secure details as to parity and age of all the women dying during several years between 1930 and 1936 in three large maternity hospitals, serving three considerable centres of population. Nothing was known of the distribution of births among these populations, of course, since a maternity hospital does not usually serve the middle classes who are predominantly found in towns, so that the birth-rate in the areas was no guide.

Table LII shows the age distribution of the 840 deaths for which age was known. Table LVII shows the age and parity distribution of these deaths (row b), and permits the distribution to be compared with that for the 472 Durham deaths (c), and Durham births (a). It may be noted that (b) and (c) are remarkably alike. First births among hospital cases contribute 37% of all maternal deaths, as compared with 32% in the Durham cases, while the share contributed by seventh and later births was 17% and 20% respectively. This might indicate either that first births were commoner among the population served by hospitals, or that the type of obstetric difficulty associated with first births is more likely to be treated in hospital. Table LVII shows quite clearly that the proportion of deaths among mothers bearing their first child after thirty, and among all mothers bearing their seventh or later child is greatly in excess of the proportion of births in these groups, *i.e. that these 'peak' periods for maternal deaths are not peculiar to Durham*, but are at any rate common to those sections of the population who are served by our voluntary hospitals.

4. Class Differences in the distribution of maternal deaths.

The *number* of women who die annually from causes related to maternity can be found from the death-rate *per* 1,000 *births*, and the number of births which occur. In County Durham, the death-rate attributed to maternity and the strictly puerperal death-rate *per* 1,000 *births* have each exceeded the rates in England and Wales, on the average for some years (Table LVI, page 203). From Table I, page 75, it may be seen that the *total* death-rate among women at the child-bearing ages in this County exceeded that of the whole country by 30%. The questions which naturally arise are "Are these excess death-rates due to the poverty of the people in County Durham? Does the same difference in death-rate appear when different social classes in the country as a whole, are compared?"

When allowance is made for the high degree of unemployment in County Durham during the period under consideration, it would seem fair to compare the population of the County economically with Class V in the Registrar-General's classification. Over the reproductive period, the death-rate among women in Class V is less than 20% in excess of that for all classes in the country. (Table LIX, page 205). If simple poverty be accepted as the sole or principal cause of the Durham death-rate which is 30% in excess of that of the whole country, it would be necessary to conclude that the total population of the County had a lower economic level than Class V, *i.e.* than unskilled workers. But Table I shows that the men in the County do not compare so unfavourably with the men in the whole country as do the women. Further, the children of the miners in the County do not compare unfavourably up to two years of age with the children of Class V. (Table LXX, page 214). (The infant death-rate among the children born in Durham in 1930, expressed on live births was 79/1000; the figure found for Class V [1930-32] was 77/1000). **One must, therefore, conclude that the high death-rate under consideration is due to causes peculiar to the women in the County.**

Table LXX also shows that the puerperal death-rate *per* 1000 *births* is very high among the miners' wives, while Table LVIII shows that there is no such excess rate in Class V, as compared with other classes. The high puerperal death-rate among miners' wives is, therefore, determined by local conditions and is not merely to be attributed to poverty.

Since the birth-rate in the mining community is very high and is fairly high in the County as a whole, it follows that deaths due to maternity form a considerably high proportion of all female deaths at the reproductive age. This is shown for different classes in Table LX (page 205). As, however, this excess of deaths directly attributed to maternity is not in itself enough to explain the total high female death-rate in County Durham, it seemed that light might be thrown on the problem by a study of the health of the women, as reflected in their general death-rates, over the period of five years during which they were visited after the birth of a child.

This problem will be discussed in the next chapter.

CHAPTER XVIII.

WHAT IS THE TOTAL BIOLOGICAL COST OF MOTHERHOOD?

The three possible effects of the reproductive cycle on health as measured by the death-rate among women, have already been indicated, i.e.,

(1) A simple summation of deaths due to the reproductive process and the ordinary death-rate for women of the age, class and area studied.

(2) The summation of the essentially 'maternal' death-rate and a general death-rate *indirectly* increased by *secondary* effects of the reproductive cycle.

(3) A weeding-out process whereby the unfit are killed by the reproductive cycle leaving a fitter residuum among which the death-rate is in consequence decreased. In this case, the total biological cost of motherhood might appear nil. (This is of course partly a question of terminology. Lives can never be saved in the sense that they are perpetuated indefinitely, but a woman who dies because of child-birth, some five or ten years before the defect which caused her death would have developed to that point, had child-birth not supervened, loses thereby some five or ten years of life.)

The death-rate over the five years per 1000 women at any age could only be calculated approximately, for the following reasons.

As will be seen, the time around birth is a peak period for all deaths—and not only for those attributed to child-birth. In the year 1930, where the greatest details were known, there were 17,049 women brought into the investigation by the birth of a child. Of these, 474 belonged to the unvisited classes or those only visited once or so. Maternal deaths, classified as such, occurring among these, would be noted, but no record was available of deaths from other causes. Moreover, when a child died and his record card was returned to the office, after the health visitor's final visit to inquire into the cause of death, no further record of the mother's health was made on that child's card. Of the 16,500 mothers of known parity, 656 gave birth to still-born children, and of the children born alive 678 died before the end of the first month. The health records of the 1,334 mothers of these children were therefore only known for a few weeks subsequent to the birth which brought them into the investigation. Before the end of the first year, a further 592 mothers were eliminated from the investigation by the death of the infants, and the return of the records to the health office. About 500-600 children, moreover, removed out of the area during the first year. Many of these removals occurred very soon after birth since they were due to the fact that the mother had come to stay with relatives for the birth of the child. Of the 16,500 records, there remained in the hands of the health visitors at the end of one year only about 14,000. During the next four years, about 1000 of these were returned because of the death or the removal of the child.

It is obviously only possible to determine the *range* of death-rate, the minimum being that calculated on the total number of women originally coming into the investigation, and the maximum being calculated on that number who were studied for five years. The death-rates at different ages were in fact calculated on (a) the number of women of that age who bore a child in 1930 and belonged to the visited group, and (b) the number of women still being visited at the end of five years. (Table LXIII). When actual comparisons of death-rates came to be made, a second difficulty became obvious. Women who were between 20 and 25 at the birth of the child were between 25 and 30 five years later. It is broadly true that women of 20-25 years of age in the whole community will have a mean age of 22½ years. If a group is studied however over a period of five years during which the mean age rises from 22½ to 27½ years approximately, then the mean age over the period will be about 25 years. This means that the death-rates over the five years in the age groups based on the *initial* age, should really be compared with a death-rate of women 2½ years older. To cite an example—The death-rates of women in the county in 1931, in the age groups 20-25, and 25-30 are known from numbers of deaths and the census figures. But the death-rates over five years among women who were 20-25 in 1930 would be expected to lie between these two figures since over the period studied, the women had passed from one group to the other.

The time distribution of mothers' deaths in relation to child-birth.

In the year 1930, there were 17,049 births studied. In the maternity and child welfare unit the number of births as deduced from the County Medical Officer of Health's reports for 1930 were 17,131 ; for 1931, 16,452 ; for 1932, 16,277.

The number of mothers *recorded* as dying before their children reached five years of age was, for those bearing children in 1930, 270 ; in 1931, 279 ; and in 1932, 281.

For these three years, the records were as complete as possible at the end of the investigation, which ended at the close of 1937. (The limitations of the records have been pointed out.) For later births, the records covered varying periods. Children born in 1933 would, at the end of 1937, lie between four and five years of age ; those born in 1934 between three and four years, etc. Table LXI shows the total number of deaths among the mothers who bore children in each year, and the numbers dying at various stages subsequent to birth. The column marked MM contains the numbers officially classified as maternal deaths. The other columns show the number of women dying under 1 year, from 1-2 years, etc. after the birth of the child. Some of these later deaths were maternal mortalities associated with later births, but Table LXI merely *shows their relation in time to the birth which brought the women into the investigation in the year marked in column* 1. The column marked "MM elsewhere" presented difficulties. It may be noted that in each year, in addition to the number of mothers whose deaths were classed as maternal mortalities, there was a fairly large number of women who died within three months of child-birth whose deaths were not officially attributed to it. Unfortunately, it was clear that relatives did so attribute it quite frequently, and described

the woman as having died after her last confinement. These cases seemed to be associated predominantly with tuberculosis, heart, kidney and respiratory disease. In nearly every year, however, there were a few cases where a child was being looked after by a relative because the mother had died in or near child-birth, where it was difficult to tell from the records whether the mother's death ought or ought not to be classed as a Durham death. There were some cases where the mother had clearly been resident, and had died, outside the county. Such cases should not be included. There were others where the mother died in hospital in the local boroughs, where it was difficult to know whether she had been resident in the county and had been admitted to the hospital when ill, and was therefore a 'county' death, or whether she had been resident in the borough. Prolonged search might have cleared up these details. The numbers were however small. Since there were a small number of births about which no details were forthcoming, and a larger number where mother and child left the area very shortly after the birth, it seemed probable that, just as some children were brought into the area to relatives because the mother died, so some would be taken out of the area for the same reason. If the mother's death were officially classified as a maternal death it would not escape recording. If it was attributable to other causes, however soon after childbirth it occurred, it might not be recorded, since the health visitor might be unable to make any contact with the family. It was argued that any deaths missed in this way (and this might occur at any stage in the five years, the mother's death being frequently the cause of the break-up of the household and the scattering of the children), might be compensated for by the inclusion of the deaths of mothers of children brought into the area, who are nevertheless classed separately as shown.

Table LXI shows that there is an enormous peak in the death-rate at childbirth. Taking the women who were studied for five years, *i.e.* those bearing children in 1930, 1931, and 1932, it may be seen that of the 270, 279 and 281 deaths in the respective groups, there were 97, 107 and 95 deaths due to childbirth, a total of 122, 124 and 128 respectively either due to childbirth or occurring within 3 months of it, 135, 129 and 130 at or within 6 months of childbirth, and 158, 153 and 147 at or within 12 months of childbirth. After this, the death-rate seemed to settle down to an annual figure of 20-40. Some of these latter deaths were however due to later childbirths. Table LXII shows the number of deaths related in time to the *last* childbirth. In the three completed groups, with total deaths of 270, 279 and 281 respectively, it is seen that deaths ascribed to maternity account for 131, 136 and 126 respectively (approximately 48%, 48% and 44%). Deaths occurring at or within three months of birth total 161, 162 and 165, and form nearly 60% of the total, while deaths occurring within one year of birth (including maternal mortalities) total 197, 196, and 192, and form approximately 70% of all the deaths.

The number of deaths occurring annually after the first year, among the women who did not have further children, was very small. In the 1930 group, it ranged from 10 to 33 and averaged 18. For the other two groups, the range was 13 to 27, and 16 to 28, with averages

of 20 and 22. If all deaths occurring in the last four years for each group are considered, irrespective of whether the deaths were related to later births or not, then the figures for the four years and the respective groups become :—range, 20-39, 28-35, and 25-43 ; average 28, 31 and 33 respectively.

Annual deaths to be expected in a female population of this size and age in this area.

It has been shown that :—

(*a*) One year after the birth of the 1930 children, the health visitors would still retain the record cards of about 14,000 children born in 1930.

(*b*) The death-rate among the mothers is enormously highest in the first year.

(*c*) In the course of all the following four years, about 1000 cards altogether would be returned to the office because the child had died or been removed before reaching the age of five.

It was, therefore, concluded that figures calculated on a mother-population of 14,000 would give a rough idea of the *minimum* number of deaths to be expected among women of child-bearing age. Actually, as 90% of the women were between 20 and 40 at the beginning of the investigation, it might have been better to have taken the death-rates for those ages, but the death-rates could only be calculated from the figures available for the periods 15-25, 25-35, 35-45. For the years 1930-31, and -32, the death-rates for women in County Durham between the ages 15 and 45, average 4·3, ranging from 4·2 to 4·5, if the rates are calculated on the assumption that the census distribution of 1931 can be applied to calculate death-rates in 1930 and 1932. If 14,000 women were to be subjected to conditions giving an average death-rate of 4·3/1000 for 5 years, some 60 or so deaths might be expected annually, with a total of 300 in the five years. Actually, the total in each group fall short of the 300 by 10-15% and the distribution is quite abnormal. In the last four years of each period there were not approximately 60 deaths per annum, but approximately 30, and if deaths associated with later childbirths were eliminated from these, the figure fell to about 20. Figure 7, page 173, shows the distribution of mother's deaths in *time* in relation to childbirth.

Tables LXI and LXII show that, in addition to the groups in which the mothers' records were studied for five years, the groups for which records were available only for a shorter period all showed the same drop in numbers of deaths after the first year. Clearly the phenomenon was real and not chance.

THE DISTRIBUTION OF MOTHERS' DEATHS IN TIME IN RELATION TO CHILD-BIRTH.

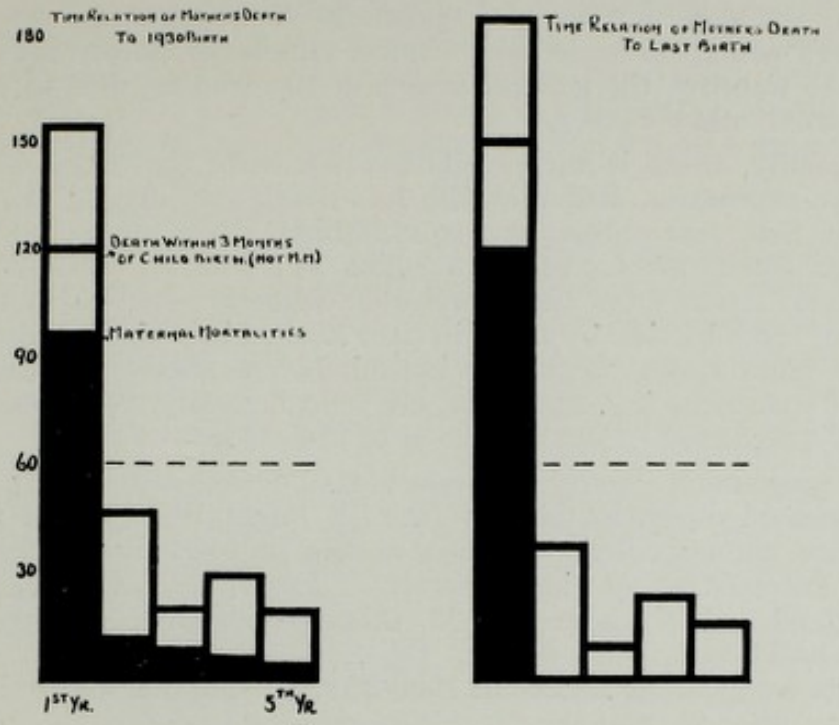

Fig. 7A. The black columns indicate the number of deaths classed as "maternal mortalities" in each year (from one to five) among women who bore a child in the area in 1930. The number of women who died from causes "other than maternal" within three months of their 1930 child birth or later up to five years from child-birth in 1930 is indicated by the framed part at the top of each column. From the numbers at the side one can get the numbers who died each year. The dotted line is placed horizontally at the level showing the "expected" average annual number of deaths of women of that age and class in this area.

Fig. 7B The facts in 7A are displayed to show the relationship of mothers' deaths to the last child-birth. The black column for the first year therefore contains all the "maternal mortalities" associated with the last child-birth no matter in what year they occurred. The upper framed portions of this column give respectively the deaths from all causes other than those classed as "maternal" occurring within three months and within a year of child-birth. The four remaining columns indicate the number of deaths among the women studied which took place during the subsequent years.

Does this mean that the effect of childbirth is mainly a weeding-out of the unfit?

The simplest explanation of the observed facts seemed to be that childbirth merely weeds out the weak, and that, when such are removed from any group, the death-rate from all causes becomes low. On this interpretation maternity would be less a *cause* than an *occasion* of death,

and many if not most of the women who now die in childbirth would presumably die fairly early from some other strain unless excessively carefully protected from the stresses and struggles of existence.

There are, however, other two possibilities. One is that the great care and attention bestowed on women and children by our social services, although not as yet successful in eliminating the special difficulties which occur in and around childbirth, nevertheless serve greatly to improve the general health of the women, and to diminish deaths from other causes.

Secondly, there is the possibility that only the fittest people at any time reproduce, and that the low death-rate among the women after the first year subsequent to childbirth really measures the *true death-rate among these women*, to which is added an extra danger in maternity. Apart from the exercise of deliberate self-restraint in the matter of reproduction by those in poor health, it is obvious that many diseases must make pregnancy improbable at least, and that some forms of treatment (*e.g.* sanatoria, etc.) must greatly reduce the probability of pregnancy in certain states of ill-health.

If pregnancy greatly increased the death-rate among women who appeared otherwise healthy, then it might be expected that the death-rate among married women at the reproductive period would greatly exceed that of single women. But Table LXIV shows that for England and Wales in 1930-32, this was not true, although it was true ten and twenty years earlier. On the contrary, the total death-rate for single women was higher in 1930-32 than that for married women at all ages after 25, and the death-rate not due to puerperal causes was higher at all ages after 20. This might mean that either :—

(*a*) It is the less fit women who remain unmarried. This is doubtless in part true.

(*b*) The conditions that society has now created for the married woman are markedly better than for the unmarried woman.

(*c*) Marriage *per se* makes for good health.

It is obviously impossible to measure the biological cost of reproduction if no light can be thrown on these questions. Some light is thrown on the influence of social conditions by the fact that the death-rate among widows and divorced women is higher at all ages than in married or even single women. Since these women do not belong to the physically unfit who are prevented from marrying by their unfitness, it seems necessary to attribute their high death-rate to bad social conditions. This may indicate that, except for the very young worker who forms the greater part of the total body of female employees, conditions of employment for women are bad generally. Since, however, widows who have to return to paid employment after a period away from such work clearly labour under handicaps not felt by spinsters who have remained steadily in such employment, and since, moreover, widows frequently have domestic ties which entail their attempting to do the jobs of two people, it is not at all certain that their high death-rate demonstrates that the conditions of women's employment is the main reason for the excess death-rate in spinsters and widows as compared with married women.

No evidence concerning the health records of unmarried women in County Durham was available, but an attempt was made to study the question of whether the low non-puerperal death-rate among the mothers was due to weeding-out, to deliberate self-selection on the part of the mothers before reproduction was undertaken, or to relatively good conditions once the actual difficulties of childbirth and the months immediately following it were surmounted. For this purpose the deaths occurring among the mothers from *tuberculosis* were noted, and the date of these deaths in relation to childbirth. Secondly, the deaths among the fathers were considered. The results were as follows.

Deaths from Tuberculosis.

In Appendix 8 is set out the deaths from tuberculosis in County Durham among women of the age under consideration, over a period of years, and evidence is adduced to show that the tuberculosis death-rate per 1000 such women is 1·2 approximately. If it be assumed, as indicated before, that it is a safe approximation to regard the groups of women bearing children in 1930, 1931, 1932 as equalling about 14,000 at risk for 5 years, then it is clear that among such women, about 17 deaths ought to have occurred annually from tuberculosis, or 85 throughout the five year period. In the later groups (births in 1933, etc.), with total births numbering about 14,000, it may be shown that the 11,000 or so women still being visited at the end of 1 year, probably give the fairest figure for the group. Among these, 13 deaths would be expected annually from tuberculosis, if their rate was merely that of their sex, age and area. Table LXV, page 209, shows the total number of deaths from tuberculosis found.

(As there were a considerable number of mothers' deaths in which cause of death was not stated, it seemed possible that some of these might be due to tuberculosis. Through the County Medical Officer of Health's kindness it was possible to find out from the official list of deaths from tuberculosis, whether any of the women who had died from unspecified causes appeared on the list. There were only two such cases. As there were a total of nearly 250 deaths from tuberculosis, this seemed again to indicate that the conclusions drawn from the health visitors' records were fundamentally valid.)

It may be noted that in no group does the number of deaths from tuberculosis approach the expected figure. This is the more remarkable since there seems to be a general clinical opinion that pregnancy and parturition greatly accelerate tuberculosis. It is, however, obvious that apart from any biological effect tuberculosis may have in preventing pregnancy, or from any deliberate avoidance of pregnancy by women who are or think themselves liable to develop tuberculosis in its severer forms, there must be considerable prevention of pregnancy among the tuberculous by the simple segregation so often involved in the treatment of the disease. Clearly therefore those who become pregnant are not, in this respect, a random sample of the population, but *are definitely drawn from those least likely to die of tuberculosis.* Deaths from tuberculosis are not evenly distributed throughout the years, but like deaths from all causes are commonest shortly after childbirth. The 1930, 1931, 1932, and 1933 groups show 52, 47, 51

and 37 (in 4 years) tuberculosis deaths respectively. Of these 22, 18, 14 and 15 occurred in the first year after childbirth, 6, 4, 5, and 8 occurring within 3 months. In the other years, there occurred an average of 7 to 9 such deaths. These figures are very few, but they are consistent, and indicate clearly how the association of the acceleration of tuberculosis with pregnancy and parturition grew up. (Perhaps two examples may illustrate this. One girl bore her first child at 20, and then 13 months later when still only 21, her second. Ten months later she died from pulmonary tuberculosis, never having been fit from the birth of the second child. A little later the second child also died from tuberculosis. In another case, a girl had her second pregnancy at 19, her third at 21, and her fourth at 23. At the birth of the latter the mother herself died, her death being attributed to childbirth and phthisis. The second and third children were alive at the end of the investigation. There were a considerable number of such cases, and the impression they make on an investigator is wholly out of proportion to their frequency.) **There would seem to be no doubt that deaths from tuberculosis are not more common among actively reproducing women than in other women of their age, but are quite markedly fewer. This is due to the fact that women likely to die from tuberculosis are relatively unlikely to bear children.**

Is this true also of other chronic diseases?

There appeared to be no direct way of answering this question, but it was thought possible that the death-rate among fathers might be useful in arriving at a tentative conclusion. This was determined for the two groups in which children were born in 1930, and 1931, since all the records of these were readily available.

Deaths among fathers.

The records of deaths of fathers are subject to the same limitations as those already described for deaths of mothers. It was improbable however that anything so important to the child's health and well-being as the father's death would not be included on the record. As has already been noted, the unexpectedly low figures for mothers' deaths for the 1930 and 1931 groups were amply confirmed by the figures given by the health visitors for all the cases with whom they were still in contact in the later group years. Extraordinarily low though they are, there is no reason to doubt the accuracy of the figures found for the fathers' deaths, *i.e.* 149 and 190 for the 1930 and 1931 groups, respectively. The total death-rate for men of this age, in this area, averaged 4·4 for the years 1930-32. (Since early marriage for both sexes is here the custom, there is rarely much difference in the age of husband and wife.) If the groups may again be taken to approximate 14,000 at risk for 5 years, it is clear that the total deaths expected among the fathers would be 308. Of these, about 20% would be due to accident. Again it is obvious that the fathers under consideration are in no way a random sample of the men of their age, but *for biological or social reasons, those likely to die are largely excluded from the group who are actively reproducing.* The mean of 149 and 190, *i.e.* 170 is not much more than half what would have been expected if the men had been a random sample of the men of their age. It has already been

shown that non-puerperal deaths among their wives were only at about half the expected rate.

This does not mean that those men and women who die from certain diseases (probably those of a chronic nature) have refrained altogether from reproduction. It probably merely means that when the disease which will cause their ultimate death has already impaired their health somewhat, they are less likely for biological and social reasons to reproduce further. In any 5 years, only about 2% of those at the reproductive age will die. That reproduction is much commoner among the remaining 98% calls for no comment.

Nevertheless, the fact that the actively reproducing section of the population contains a smaller proportion of those of their age who are likely to die than is found among all those of their age, means that it is not possible to measure the total biological cost of reproduction simply by comparing the total death-rates of women who are reproducing with those of the same age, class, etc. who are not.

It is of interest to note that the death-rate from all causes among fathers of seventh and subsequent children was 2·6 times that of fathers of first children. This is not however a measure of the toll of paternity. It merely reflects the fact that fathers of seventh or later children are usually considerably older than the fathers of first children.

Can the true biological cost of reproduction be measured?

The true biological cost of reproduction clearly does not consist of deaths from puerperal causes, or even those "maternal deaths" at present attributed to maternity although the causes are not strictly puerperal. To these must also be added deaths from other causes which would not have happened at that time if pregnancy had not occurred. (It has already been pointed out that deaths cannot be prevented but merely delayed. If however pregnancy causes a woman to die at 35 of nephritis, who might otherwise have lived several years more, it is justifiable to include this acceleration of death in the total cost of reproduction.)

In estimating the total biological cost of reproduction moreover, the ill-health caused thereby which does not result in death, ought to be included. Unfortunately there is no means at present of measuring such ill-health. That it is believed to be considerable may be deduced from the following quotation from the British Medical Journal. *"This loss by death, however, is in some ways not the gravest consequence of child-bearing, for we have come to realise that, for each mother so lost, there are many more whose health is in varying degrees chronically undermined by the damage they have sustained in childbed."* Young [1928].

If deaths, which can be measured, are considered, and if the groups investigated in detail over five years are studied, it may be noted :—

(*a*) That the total deaths over the five years in the three groups who entered the investigation in 1930, 1931 and 1932, were 270, 279, 281 respectively.

(*b*)) That actual 'maternal' deaths in these groups accounted for 131, 136, and 126 of these respectively.

(*c*) That in addition to 'maternal' deaths there were 66, 60 and 66 deaths respectively in the first year after the birth.

(*d*) That after the first year, deaths not associated with a birth averaged about 20 annually.

(*e*) That for the two groups of fathers whose children were born in 1930 and 1931 respectively, the average annual number of deaths was 30 and 38 during the five years studied. (Since in this area, at this age, at least 20-25% of all male deaths are due to accident, while the accident rate among women is negligible, the *natural* deaths among the men were probably about 24 and 30, but the cause of death in the case of the father was rarely stated.)

It is, therefore, quite clear that in addition to the 131, 136 and 126 deaths officially attributed to maternity, somewhere in the region of 40 to 46 of the 66, 60 and 66 respectively occurring in the first year after childbirth, must also be included to get the "true" biological cost of motherhood, since presumably without pregnancy the women would no more have shown the peak in non-puerperal deaths in the first year, than did the fathers. The true biological cost of motherhood would, therefore, be represented by about 177, 176 and 176 in the three groups, *i.e.* motherhood would be the underlying cause of about 66% of all deaths in actively reproducing women. In this area at this time about 17% of the women of child-bearing age actually bore a child in any year.

It has been shown that :—

(1) The death-rate in the actively reproducing group is made up of a high rate of deaths directly or indirectly due to maternity, and a low rate of deaths from other causes, because actively reproducing women are a 'self-selected' sample.

(2) The death-rate from non-puerperal causes must be higher among non-reproducing women than among reproducing women by just the amount to which the reproducing group is selected for fitness. (It is not intended here to imply that this selection is wholly deliberate.)

It would be expected then that a group of married women living under similar social conditions to a group of single women would have a death-rate *exceeding that of the single women* by an amount which could be determined by :—

(*a*) The total biological cost of reproduction under the given social conditions.

(*b*) The proportion of women bearing children in any year.

(*c*) The counterbalancing tendency for the less fit women to remain single.

It has not proved possible to get information about the single women of County Durham, but the figures for men of the same age as the women are shown in Table I. It may be noted that in this area, despite the heavy loss among men due to accidents in mining and in heavy industry in general, the *total death-rate* of the women *equals* that of the men and the natural death-rate of the women *considerably exceeds that of the men*. (Table I, Part I, page 75).

Death-rates among men and women in various occupational groups.

Table LXVI built up from the Registrar-General's report on Occupational Mortality [1931] shows that this is common to all mining communities in England and Wales, and that almost up to the end of the reproductive period, **it is more dangerous to be a miner's wife than to be a miner.** It is curious to note from the Registrar-General's figures for the whole country that this excess death-rate among females is more marked in the skilled mining classes (hewers) whom he classes in Social Class III, than in the less skilled groups whom he puts in Class IV. It would not, therefore, appear to be mainly a question of poverty. (Table LXVI, page 210).

Up to the age of 35, the hewer's wives have a higher total death-rate than hewers. They even have a higher death-rate from causes other than accident, suicide, or puerperal causes, *i.e.* from all those causes which might be expected to affect the sexes equally. Between 35 and 45 their total death-rate is slightly below that of their husbands, but their natural death-rate greatly exceeds that of the latter. Their death-rate from natural causes other than puerperal causes (T-A-P) at this stage roughly equals that of the husbands. After 45 the male death-rates rise more steeply than those of the female.

The relationship between the death-rates of the two sexes among other mine workers, differs somewhat from that among hewers. Other workers below ground have a *natural* death-rate closely similar to that of hewers, but a lower accident rate. Their wives have a lower death-rate at all stages than the wives of hewers. Workers above ground on the other hand have a higher death-rate at all stages, and a very much higher *natural* death-rate than hewers. This would seem to indicate that underground workers in the mine are recruited mainly from the physically fittest applicants, while above-ground workers include an undue proportion of the less fit. Their wives on the other hand have death-rates which are below those of the hewers' wives at the earlier age periods, but rise towards their level at later ages. The death-rates among the men are broadly what might be expected on the basis of industrial selection of men fitted for their jobs. At first sight the death-rates among the women appear to be related to no definite factor. The death-rate due to puerperal causes was however calculated in each group, and this sheds considerable light on the problem. It is then clear from comparison with the figures for the miners' group with that of the different "Social Classes" (I-V) as given by the Registrar-General (Table LX) that the puerperal death-rate per 1000 married women is enormously greater among hewers' wives than among any of the other groups, very considerably exceeding that of Groups IV and V. This excess is greatest in the under 25 group, where the excess in total female death-rate is most marked. The excessively high puerperal death-rate in the immature mothers under 20 has already been noted. Among hewers' wives this figure rises to 2·6/1000 (Table LXVI) a figure exceeding the *total death-rate* of single women of this age, even in Class V, and while the total numbers of married women of this age are few, so that too much weight cannot be attached to the exact figure, **all the evidence goes to support the conclusions drawn from the study of infant health, that too early marriage and breeding are definitely to**

be deprecated. (The death-rate among the wives of hewers in the under 20 group is the same in 1930-32 as was the rate for all married women of that age in 1910-12.) In the 20-35 years group, a large and important one, hewers' wives again show puerperal death-rates roughly twice that of the whole community (Table LXVI). Moreover the non-puerperal death-rate is also very high at all these stages, being in many cases equal to the *total* death-rate of the males. It has been shown that among the actively reproducing women in County Durham, out of a total of about 280 deaths, about 135 were classed as 'maternal mortalities'. During the years 1930-36, the average 'maternal mortality' rate for the administrative county including certain small boroughs was 5·7/1000, (expressed on live and still-births, and deduced from the County Medical Officer of Health's records). The average figure for deaths from strictly puerperal causes was 4·9/1000 (expressed on the same basis and taken from the annual reports of the Chief Medical Officer of the Ministry of Health). It may therefore be calculated that 135 maternal mortalities would include on the average about 114 deaths from strictly puerperal causes. But it has also been shown that in addition to the 135 deaths attributed to motherhood, *there were about* 40 *more which probably would not have happened if no pregnancy had occurred.* For every 114 deaths from strictly puerperal causes, there are then (under the conditions prevailing in this county) at least a further 60 deaths which may be indirectly attributed to maternity (20 officially attributed to maternity and 40 not so attributed). Moreover, it would seem probable that the extremely rapid breeding necessary to give a puerperal death-rate of 1·6 per 1000 married women between the ages of 20 and 25 might actually be associated with a very much higher death-rate among women from causes indirectly attributable to maternity. Such rapid breeding has been shown to produce a very high infant death-rate, abortion rate, etc. and probably a high specifically maternal death-rate. The maternal deaths from strictly puerperal causes among hewers' wives may be calculated from the Registrar-General's figures to be 5 per 1000 total births, to set against an average of 4/1000. The excessive puerperal death-rate among these women (180 against 100) is therefore more largely determined by the fact that they are highly prolific than that the death-rate per 1000 births is excessive, since that is only up by 25%. It has been shown that in Durham the distribution of births in 1930 was such as to correspond to an average family of 2 in the unvisited classes, 4 among the miners, and 3 among the rest of the manual workers. (These figures only include actually fertile families—no information was forthcoming as to the number of childless families.) From the Registrar-General's figures for 1930-32, it may be deduced that the number of children born per annum per 100 married women between the ages 15 and 45 were :—Classes I and II—9, Classes III and IV—12, Class V—15, hewers 18 and farmers 13. (Table LXVII). Again, the birth-rate among the hewers is seen to be about twice that in the middle-classes. It is obvious that the very high total death-rate among young wives of hewers, (20-25) at 5·8/1000,—nearly twice that of other women of what is usually called the same social class—must be largely put down to the effects of *very early marriage and excessively rapid breeding.*

If however Class V and hewers are compared, the two classes with most nearly comparable size of family, it is seen that the puerperal

death-rate among hewers' wives is even much greater than in Class V. This is to be related to the facts that births to women between 15 and 45 in Class V are to those in the mining group as 1·5 to 1·8, and that the maternal death-rate in the two classes from strictly puerperal causes are 4/1000 and 5/1000 respectively. Also it has already been indicated that a slightly larger proportion of miners' children are born to mothers under 25.

The relatively high death-rate among miners' wives from *puerperal* causes might mean either :—

(*a*) That the geographical distribution of mining communities complicated the problem of adequate health services of all kinds. This has already been shown to be probably the case in relation to still-births among miners' children, or

(*b*) That the miners' high birth-rate was brought about by a relatively large proportion of rapidly-bred families in a community of otherwise small families, while the high birth-rate in the Class V was associated with a larger number of moderate-sized families with very few really large ones. As there is no evidence in relation to the size of family in Class V, the influence of these two factors cannot be decided.

It is, however, not only true to say that it is safer to be a miner than a miner's wife, but with equal truth it may be said that it is safer to be a farmer than a farmer's wife. (Table LXVI). This fact is interesting since farmers show exceedingly low death-rates at all stages, and the farming community is, in this respect, a complete contrast to the mining community. Both among farmers and their wives, deaths from causes other than accidents, old age, or puerperal causes are relatively low. But at the reproductive stage the puerperal death-rate among women is high enough to more than counterbalance the higher accident rate among men, and **there is no evidence at all that the relatively good health among the women, as indicated by the low general death-rate, has any influence towards decreasing the puerperal death-rate.** On the other hand in the case of farmers' wives, a fairly high puerperal death-rate is not associated, as in the case of the miners' wives, with a high non-puerperal death-rate. It seems to the present writer that **it is precisely in relation to those deaths which are *indirectly* due to maternity that environment is likely to play a major part.**

A study of the death-rates, etc. among the farming community excellently illustrates the complexity of the whole problem. The Registrar-General classes farmers in Class II. Their children, with an infant death-rate of 46/1000 fit excellently into this class (infant death-rate 45/1000). As is true for the rest of Class II, the neo-natal death-rate among farmers' children at 29/1000 shows no significant improvement on that for Classes III, IV and V, all the advantage being in the later stages of infancy. Although it has been shown that bad biological groups still show a high death-rate at all stages, even where environmental improvement has enabled better biological groups to survive, it has also been indicated that environmental changes have caused the average infant death-rate of the year 1900 to be found only in the *worst biological* and *social* groups of 1930.

It would appear from the Registrar-General's figures that the birth-rate in the farming community is nearer that of Classes III and IV, but the tendency to postpone marriage typical of Classes I and II is found here and may be deduced from the small proportion of married women in the under 25 group (Table LXVII). The result is that after 20, (before which births are negligible in this section of the community) there are in each age group more *first* births than in Classes III and IV. Hence relative to these classes, the *puerperal* death-rate per 1000 births will be higher. But since there are more births per 1000 married women among the farming community than in the rest of Class II, the puerperal death-rate per 1000 married women is high as compared with that also. *The good environment which however favours the survival of the infant after the first month, also decreases the deaths of mothers from non-puerperal causes.* It is unfortunate that no study of the health of middle-class mothers can be made to compare with the one described here (for a mainly working class population) to determine how far the increase in non-puerperal deaths due to child-birth, which was estimated in this study to equal about 40 out of 280 deaths, is really a product only of bad environment. This is the conclusion the present writer would draw from the facts adduced.

Death-rates among married and single women in various occupational groups.

There are two further pieces of evidence in support of this conclusion. Table LXVIII gives the death-rates of married and single women in Classes II-V. Class I is excluded, because half the single women in Class I (an extremely small number in any case) were nuns. Without the nuns, the groups were too small to have significance, and the death-rates of the nuns were so unlike those of other women of the class (particularly in relation to respiratory diseases) that it seemed best to exclude the whole group from consideration.

Study of Class II shows that the death-rate due neither to accident nor to specifically puerperal causes is the same in *married and single women* between the ages of 20 and 35. Afterwards the rate in single women falls below that for married women. The Registrar-General considers that the latter fact may be due to the retirement from paid work of some women because of ill-health, and their being subsequently described for death-registration purposes as 'unoccupied.' The single women of Class II consist as to about one-half of teachers, and the other half of school matrons, welfare workers, shopkeepers, the subordinate medical services and a number of other occupations in each of which only a few women are found. Taken as a whole, however, the class consists of women who have deliberately adopted a profession or occupation, have spent time and money in preparing for it, and presumably propose seriously to practise it. Most of the jobs have fairly clearly defined ranges of remuneration and conditions of work. The occupations of men in Class II cover much the same range as those of the women in the class, except that business managers and owners probably include some men receiving very much higher incomes than those reached by the women.

It would therefore seem that where single women are not selectively drawn from the physically less fit of their class, and where conditions of

employment give them as good environment as the married women of their class, the general death-rate of single and married women is closely similar. For married women, however, there must be *added* to this death-rate common to all women of the class, the *death-rate from specifically puerperal causes.* There is not, however, in this class any indication of deaths from non-puerperal causes being increased by the processes of pregnancy and parturition.

In Classes III, IV and V a high puerperal death-rate in women under 20, is accompanied by what is, compared with single women of their class, a relatively high non-puerperal death-rate. Here it seems as though motherhood in unfavourable conditions has again increased the general death-rate. In the age group 20-25, the death-rate due neither to accident nor childbirth is the same for both single and married women in Class III, as is the case between 20 and 35 years in Class II. In Classes IV and V, however, even in the 20-25 age group, and in Classes III, IV and V at all later ages, the death-rate associated neither with accident nor childbirth is greater among single than among married women (Tuberculosis appears to account for much of the difference). Actually, apart from the 25-35 age group in Class III (a large and important group) the *total* death-rate among single women is greater than among married women, despite the specific child-bearing dangers of the latter. This difference is not explained by the accident rate. This high death-rate among single women might mean either that :—

(*a*) Married women are differentially chosen from the healthier women. This must be in part true since some forms of disease and infirmity must form an effective marriage bar.—and/or

(*b*) Social conditions are more favourable to married than to single women.

Since there are these differences in age groups and social classes, the generalization that single women have a higher death-rate than married women may be misleading. Marriage *qua* marriage is clearly only important in so far as it leads to potential puerperal risks. Table LXIV shows that the advantage enjoyed by the married woman over the single one represents a relatively new state of affairs. In the years 1910-12, and 1920-22 the death-rate among married women was clearly in excess of that among single women. Since, at those times, the birth-rate was much higher than in 1930, and, therefore, the puerperal death-rate must have contributed a much larger part of the total death-rate in women, and since, as has been seen for County Durham and for all miners in England and Wales, a high birth-rate, under some social conditions, is associated not only with a high puerperal death-rate per 1000 married women, but also with an increased death-rate from causes other than child-birth, it may reasonably be inferred that **a considerable portion of the improvement in the death-rate in married women in the twenty years between 1910 and 1930 is due to the reduction in the birth-rate.** During that period the death-rate in single women between 30 and 35 fell only from 4·3/1000 to 3·6/1000. For married women, it fell from 4·6/1000 to 3·2/1000. It must be borne in mind, of course, that reduction in the birth-rate not only reduces the direct risk from child-birth and the indirect risks which appear to accompany child-birth under poor social conditions, but under existing economic

arrangements, each child added to a family impoverishes further the existing members. Reduction in family size has therefore been an enormous social advantage to the mother, and hence arises some of the great improvement in the health of women. There has been no corresponding reduction in the difficulties to be faced by single women, nor any corresponding improvement in their average financial position.

Death-rates among men and women in different countries.

The importance of social factors in determining the magnitude of the total biological cost of reproduction as distinct from merely the puerperal death-rate may be deduced not only from studying the death-rates among men, married and single women, at different times and in different classes, but also by examining the death-rates among men and women at different ages, in different countries, under widely different environments. These figures are given for certain years in the Statistical Year Book of the League of Nations. [1937/38]. There it may be seen (Table LXIX) that in countries like India and Japan, the death-rate for the female, between the ages of 5 and 40, is always clearly higher than for the male. Between the ages of 15 and 40 this excess reaches the proportion of 20%. Chile also shows an excess in the female death-rate between the ages of 10 and 35, particularly between 15 and 20. Among European states, Bulgaria shows a steady and considerable excess in the female death-rate between 5 and 40, reaching a figure of 25% in the 15-20 age group. Ireland and Poland show female death-rates in excess of the male between the ages 5 and 55 and 5 and 45 respectively. Hungary shows a smaller excess over the age period 5 to 35.

In the shorter periods, 25-45, Denmark, Holland and Canada show female death-rates slightly but steadily in excess of the male.

During the period of maximum reproduction, in most other countries than those mentioned above, the female death-rate closely approaches that of the male, although it would seem quite safe to assume that in all countries, (as has been shown for this country), deaths from accident and violence generally form a very much larger proportion of the total male deaths than of the female deaths. The extent to which this is true in primitive peasant communities cannot be stated. It seems reasonable to assume that the excess natural death-rate among women during the reproductive period is *directly and indirectly due to reproduction*, as has in fact been shown for the wives of farmers, miners and Social Class II generally, for England and Wales.

The figures for death-rates among men and women in Hungary are of special interest, in view of the description of the health of a peasant population in Hungary given in the League of Nations report. (Oct. 1937, Vol. VI, No. 5). It is alleged that among the peasant women, maternal mortality reaches the low figure of 1/1000. This apparently refers only to women who are (*a*) delivered and (*b*) die within ten days of delivery. It is clearly in no sort of way comparable to the figures of maternal mortality in this country, in which more than 10% of maternal deaths occur before delivery, and a very considerable proportion after more than ten days. It is obvious that comparison of figures alleged to pertain to 'maternal mortality' cannot be made between areas which do not have much the same cultures

and standards. The women of Hungary have a death-rate [1930-32] closely similar to that of *miners' wives in England and Wales* at the same time. The birth-rate in the two populations (Hungary and British miners) is high compared with that for England and Wales as a whole. The infant death-rate is much higher in Hungary than in the mining population of England and Wales, which can probably be largely attributed to the social services in the latter country. It might, therefore, be argued that the excess death-rate in the female was merely due to some 'social' circumstance, which bears on all the population, but bears more heavily on the female. However, the excess is found between the ages of 5 and 35 when in England it has been shown that the *natural* death-rate of the female is slightly in excess of that of the male. Between 35 and 40 the relationship between the death-rates changes, and after 40 the male rate markedly exceeds the female, due, perhaps partly, to the weeding out of the weaker females. The age relationship seems to indicate without question that the excess is due to the strain set up in the female by the whole sex cycle. Whether 'maternal mortality' as measured by the deaths within ten days of childbirth of women who are delivered of viable children is or is not low would seem therefore to be relatively unimportant. It is clear *that the total cost of reproduction is very high.* It is not, after all, fundamentally more attractive to the female concerned to die three or six months after childbirth from pneumonia which would not have been contracted if pregnancy had been avoided, than to die of post-partum hemorrhage a few hours after delivery.

Table LXIX gives the death-rates of females at different stages between 5 and 50, in different countries. It may be noted that in the Asiatic countries (of which Japan is given as an example), the female death-rate is excessively high as judged by European or British Empire standards (white populations). In Bulgaria, Hungary and Ireland, the death-rate among females during the reproductive period is from 30% to 100% higher than among females in England and Wales at the same age. Among the women of Canada, Denmark and Holland, at the reproductive stage at which they show a death-rate in excess of the male rate, the female rate is not particularly high, as compared with England and Wales, Norway, etc.

Just as in the case of miners it was found that an excess female death-rate occurred when reproduction was at its maximum, *although the death-rate was high in both sexes*, while in the case of farmers, a low general death-rate in both sexes plus the puerperal death-rate in the female gave the female an excess over the male, with a *relatively low death-rate in both sexes*, so in countries like Japan, India and Chile, and to a lesser extent Bulgaria, Hungary, Poland and Ireland, a *high* death-rate among both sexes is accompanied by an excess in the *female* death-rate over the male death-rate during the sexually active periods, a relationship which is reversed at the later stages. In Canada, Denmark and Holland, on the other hand, the female death-rate does not compare very unfavourably over the reproductive period with that in other countries of similar culture, but the low *death-rate among the men*, presumably indicating good environmental conditions favouring a low general death-rate in both sexes, makes the women with their

special, additional puerperal death-rate have a higher total rate than the men.

The high death-rate among women under primitive conditions need call for little comment. At no other stage either in nature or in agriculture has any species been made to attempt what primitive mankind has always essayed, *i.e. to combine in one organism the functions of the milk cow and the draught ox.*

The health (as measured by death-rates) of the women of most of the industrial countries is, however, somewhat surprising, since despite the specific puerperal risks the death-rate among married women is less than among men.

This would appear to be due to the facts that :—

(*a*) The accident rate among males is always higher than among females after the age of 5.

(*b*) Married women are to some extent chosen from the more healthy women, and breeding is undoubtedly influenced by the health of both sexes. So that in our civilization, the strain of general ill-health and pregnancy are less likely to occur together.

(*c*) In domestic life, women would appear to be protected from some of the difficulties which beset those engaged in "gainful occupations".

The conclusion seems inevitable that our civilization has aimed less at grappling with the particular physiological problems raised by the sex cycle in the female than at compensating her for any disadvantages she may suffer by protecting her from other dangers. This process has its weaknesses.

CHAPTER XIX.

THE INFLUENCE OF SOCIAL POSITION ON MATERNAL MORTALITY.

Before considering the little evidence available on this question it seems desirable to consider in what way social position might influence maternal mortality.

(1) Presumably certain social classes might produce women who were fitter mammals, with superior general health, and therefore more suited to undergo the 'natural' process of reproduction. These classes might owe their superiority to inheritance, or to environment. They might be found among those markedly blessed with the goods of this world, or among the relatively poor who happened to have achieved some idyllic, 'natural' surroundings which made for fitness.

(2) On the other hand, it might be considered, that while birth, like death, is a perfectly natural process, it is a highly complicated one, at so many stages verging on or reaching the pathological, that if reproduction was to be brought into line with the rest of civilized life, the fullest scientific understanding and control of the processes would be necessary. The questions must then be asked, "Does this understanding exist?" and "Is such knowledge and skill as does exist equally available to everyone?" It may immediately be said that over the whole subject of mammalian reproduction, there is still an impenetrable or unpenetrated veil of ignorance. A few rents may have appeared during the last few years in that part of the veil which covers non-human mammalian reproduction, but all that passes for knowledge on the subject of human reproduction is the crudest empiricism, safest where it is frank empiricism, and dangerous when shrouded in scientific terminology.

If, then, it is accepted that science has not yet been called in to study the subject, what is the degree of availability of such empirical knowledge as exists? Broadly the practice of obstetrics is left as to 50%-70% in the hands of midwives, who have received a brief training in the elements of their job. It must be remembered that much if not most of the midwifery in maternity hospitals is left to the nurses. The midwifery practice not undertaken by nurses is carried out by doctors, but, even if the training of the latter were much more scientific, thorough and relevant than it is (and even if anyone had the scientific knowledge about reproduction which they now certainly have not), it is clear that a system which leaves the medical practitioner largely to deal with complicated midwifery, without any reasonable experience of non-complicated midwifery is not quite perfect.

The services of really experienced, highly skilled specialist obstetticians are available to the plutocrat and to the moribund.

(3) It is not impossible to imagine a condition in which women of the prosperous classes apparently enjoyed extremely good health, because they were sheltered from almost all adverse conditions, but whose latent weaknesses would display themselves when they reached their first hurdle in pregnancy and parturition.

(4) The reproductive habits of different social classes might differ in such a way as to produce quite different biological problems associated with maternity in the different classes.

For the years 1933-1936, the annual report of the Chief Medical Officer to the Ministry of Health has included an analysis of the social position of women whose deaths were attributed to childbirth. Of 7,531 women, 3·1% belonged to the well-to-do, 50·9% to the comfortable classes, and 46% to the poor and destitute. From this, some workers have deduced that class is unimportant in relation to maternal deaths. This would only be true if it were accepted that the poor and destitute normally produce 46% of the children born in any year. It has been shown that in County Durham, during the period investigated, on the average from 20-25% of the families into which children were born were deemed to need 'milk assistance'. Clearly these families should be classed as poor. Whether there would be a further 20% or so to be classed as poor, but not poor enough for milk assistance seems doubtful. *This moreover is in an area which has been economically stricken for many years, and which even when relatively prosperous would have comparatively few of the middle-classes who collect in towns.* Obviously, without some definition of comfort and poverty, the above figures are valueless. They certainly show that poverty is not the only factor and may not even be the main factor in determining maternal death-rates. The Registrar-General [1931] gives figures (Table LVIII) for maternal deaths from *puerperal causes* only, in his five social classes. It is clear that the steady improvement in infant and child mortality in passing from Class V to Class I (Table LXX) has no parallel whatsoever in maternal deaths. (Tables LVIII and LXX, pages 204 and 214).

Table LXXI shows the proportion in the different classes, of men, of women between 15 and 45, and of births. Classes I and II together constituted 16·4% of adult men. Titmuss [1938] adduced figures to show that among families in Great Britain, the main income earner received £10 per week or more in 5·3% of all families. In a further 21·3%, he received between £4 and £10 per week. It seems reasonable to assume that this 26% of all men supporting families would include the 16% of men in Classes I and II, the remainder probably being found among the clerical, supervisory and highly-skilled workers of Class III. If however it is true that people with incomes of £500–£1000 per annum must be regarded when sick as poor (*loc sit*), and needing the help of the community, it would seem that the number of people able at their own expense to avail themselves freely of all the advantages of modern science must be negligible. Broadly Classes I and II constitute the unvisited classes or those only visited once, but there is no definite line of demarcation, and while few members of these classes probably suffer from actual want, it is obvious that many are by no means affluent, and probably very few would describe themselves as well-to-do. If this 16% of the population who produce 12% of the births (Table LXXI) were those classed as well-to-do, then one might conclude that as these only gave 3% of the maternal deaths, childbirth was much safer in this class than in the poorer classes. This is completely negatived by the figures of the Registrar-General, because although these latter only refer to maternal deaths from *puerperal* causes, no possible distribution of maternal deaths due to other causes could give such a small

proportion of total maternal deaths as 3% in Classes I and II. It is clear that the Ministry of Health's classification has little relationship to that of the Registrar-General. From the small number of men classified by the latter as unoccupied, it is clear that the unemployed who may be said to have had a normal occupation are classed as belonging to that occupation. So that Class III may contain many men who are living in great poverty, due to prolonged unemployment. Grade of occupation can, therefore, only be regarded as being an extremely rough measure of the amenities to be commanded by an individual. The influence of the size and rate of breeding of the family on the mother's health, and on the income per head has already been discussed in relation to child health, and social advantages.

The effect of class differences on the health of married women may perhaps be most clearly demonstrated by a study of Tables LXXII and LXXIII which include facts from classes as defined by the Registrar-General, and from the Durham investigation. Table LXXII shows the steady increase in all ages in the death-rates of women as 'class' changes from I to V. It also however shows that this is only a broad generalization, since the wives of hewers (Class III) have easily the highest death-rate among those shown, exceeding that of other mine-workers placed in Class IV, while the wives of agricultural labourers (Class IV) compare very favourably with Class II.

Table LXXIII shows the death-rates among these women from causes other than violence or puerperal causes. Again, there is the increase from Class I to Class V. Again, the wives of hewers (Class III) show the worst figures, while agricultural labourers in Class IV compare not unfavourably with Class II. The difference in the total natural death-rate between Classes IV and V lies mainly in the non-puerperal death-rate. The excess in Class V would seem to occur in deaths from respiratory, heart and kidney disease just those diseases in which a peak is found to follow childbirth in the Durham investigation. It is probable that this is an indirect effect of a high birth-rate under poor social conditions. (Table LXXIII, page 216).

Table LXVII shows the number of children born per annum to 100 married women between the ages of 15 and 45 in each class, the proportion of married women between 15 and 45 who are under 25, the proportion of all puerperal deaths occurring among women under 25, and the death-rate from strictly puerperal causes, as deduced from the Registrar-General's figures (Special Report 1931 Occupational Mortality) This table demonstrates excellently the social and biological complexities of "class" influence. While, broadly speaking, fertility increases in passing from Class I to Class V, the most fertile section are the hewers in Class III. Farmers in Class II have the fertility of Class III or IV, and do not differ significantly in this way from agricultural labourers. On the other hand, as regards *age* of marriage, farmers are typical of Class II, *i.e.* there is considerable postponement of marriage. Most of the children of farmers, as of Class I and II must, therefore, be born to older women. To this may be attributed the relatively high puerperal death-rate among farmers' wives. Agricultural labourers with the highest proportion of wives under 25, and the highest proportion of total puerperal deaths to women under 25, nevertheless show a relatively

low total puerperal death-rate, **because the proportion of older women having children is the most important factor in determining the total puerperal death-rate.**

Table LXX shows the strictly puerperal death-rate for the different social classes as given by the Registrar-General, and also the neo-natal death-rate and the death-rate between one month and 12, and between 1 and 2 years in each class. The neo-natal and infant death-rate for miners' children in County Durham is also included. Reference to Table XXI gives the still-birth rate, the neo-natal death-rate and infant and child death-rates in the different social groups in County Durham. The tables XXI, LXX and LXXII bring out clearly certain facts in relation to health and social position. They demonstrate that after the first month or so, environment plays an enormous part in determining death-rates. As among women, so among children, the death-rates follow the classification from I to V, if total averages for the classes are taken. There are significant exceptions. The children of mine-workers have a very high death-rate, from birth to two years old (Registrar-General's figures), Table LXXII, or from before birth to five years old (Table XXI), Durham investigation. This may be related to the high death-rate of their mothers.

The children of farmers fall into their own social group, Class II. Those of agricultural workers show a marked superiority to the rest of Class IV. Now in the period 1905-1936 (from the annual report of the Chief Medical Officer to the Ministry of Health 1936), there has been a fall from 87/1000 to 29/1000 in infant deaths between 1 month and 1 year. In the same period, infant deaths in the first month have only fallen from 40/1000 to 30/1000. Throughout the period of official notification of still-births (since 1915) the figure has remained fairly constant at just over 30/1000 (Campbell 1929). During the seven years 1930-36 inclusive, the still-birth rate only varied from 40 to 41/1000. (Health Ministry's reports).

In the course of thirty years there has been a fall of 58/1000 in the death-rate among babies between the ages of 1 month and 1 year. Reference to Table LXX shows that in the period 1930-32, there is a fall in infant death-rate at this age of 33/1000 from Class V in which it is highest to Class I in which it is lowest. During the same thirty years there has been a fall in death-rates at later ages, comparable to the decrease from Class V to Class I in women for the years 1930-32. (Tables LXVIII and LXIV). *Total* deaths from puerperal causes during the thirty years have enormously decreased with the fall in the birth-rate. But the fall in still-birth rate, in neo-natal death-rates, and in maternal deaths per 1000 births has been negligible. (Owing to the modern treatment of puerperal sepsis, there has been a fall in maternal death-rates since 1936).

It has already been seen that the fall in the infant death-rate between one month and one year has been in large measure associated with the fall in birth-rate, which in the main has resulted in fewer births occurring in the worst biological groups in each social class. Accompanying this tendency to limit births to the age of greatest vigour, there has been a large number of social changes, broadly to be described

as an improvement in the standard of living. One of the most important of these changes has been the increase in available maternal care, due to family reduction. **Fitter mothers are able to give the fewer individuals in their family more attention. The mothers are also enabled to profit more easily by the health and educational services offered.**

A brief survey of the kinds of diseases which have decreased enormously shows that they are those which may be classed as "crowd" diseases, *e.g.* diseases caused by infecting organisms, whether those organisms have or have not been identified. Study of the death-rates in different classes indicates that the reduction in death-rate with improved social position arises mainly from avoidance of these diseases. This must mean, that in the course of time, the social amenities and the knowledge necessary to secure protection from these diseases is gradually being spread through all classes. Protection from these diseases is dependent on many factors. Some of these are external to the individual, and of these probably the most important are all those conditions usually grouped under sanitation, on the one hand, and avoidance of probable personal sources of infection on the other. Sanitation in rural areas is still usually primitive, yet it has been seen that despite a 50% excess of fertility among farmers above the rest of their social class, the children of farmers compare very well as to death-rates with those of the other members of the group (Table LXX). Farmers and their wives also show death-rates from causes other than accident or child-birth which compare extremely well with their class and sex. Agricultural labourers are placed in Class IV, and their children with a death-rate of 27/1000 between 1 month and 12 months, and 9·7/1000 between 1 year and 2 years, compare most favourably with the rest of Class IV for which the similar figures are 35/1000 and 15·7/1000. Agricultural labourers and their wives have also low death-rates compared with the rest of Class IV. **It seems certain that here the main factor is sparsity of population and limitation of human contacts.**

There are some factors in protection from certain diseases which are more peculiar to the individual. Perhaps one of the most important of these is the stability of body temperature, itself largely dependent on the availability of an adequate supply of suitable clothing. Equally important is the health of the tissues. It is now known that the maintenance of a healthy skin and lining membranes is in part at any rate, determined by the inclusion in the diet and utilisation of certain vitamins. The healthy skin or membrane is much more resistant to the attack of invading organisms, and certain diseases of the respiratory and digestive tracts have been shown to be much rarer in adequately fed animals than in others whose diet was known to be deficient in certain respects. It seems probable that, for many rural populations, the evils inherent in poor sanitation are more than compensated for by low density of population, and more varied foods. **Thus, given certain fortunate conditions in environment, there may be a low incidence of certain diseases not only among the financially more fortunate section of the community, but also among certain groups with low monetary incomes.**

There are however certain diseases which show little or no class difference in the level of death-rate, *e.g.* influenza, and septic infections. The absence of class difference in the incidence of death from puerperal causes is thus not unique. Many writers seem to express surprise that the concentration of attention on the subject of mortality and morbidity due to maternity should have had no measurable effect on the maternal death-rate up to 1936—since then the maternal death-rate has fallen—while the infant death-rate has been rapidly reduced. This attitude seems to assume that there were common causes underlying maternal and infant death-rates, so that measures which reduce the one ought to reduce the other. All the figures which have been secured in the study forming the basis of the present report however seem to show that mother and child may reasonably be regarded as a biological unit to the end of a few weeks after birth—one month is a convenient but wholly arbitrary period to take. It has also been shown that not only does maternal mortality per 1000 births vary little with time or class, but that this is also true of still-births and neo-natal deaths, *i.e. during the stage of development in which mother and child may be studied as one, there has been little improvement in the health of either in so far as health is measured by death-rate, during the period of extensive development of health services, nor is there any clear indication of class advantages.* This might seem staggering, but is it, in fact, unique? Comparison with the incidence of and death-rate due to tuberculosis may here prove useful. The following extract taken from the British Medical Journal, Oct. 8, 1938, p. 753, is illuminating on this question.

"In an interesting analysis of the present trend of case fatality rates in tuberculosis Drolet shows that the ratio of deaths to new cases of tuberculosis reported in various communities has varied little in the past twenty years, a period during which the incidence and mortality of the disease have been declining steadily. Similarly, no variation was found in this ratio when it was calculated on the basis of the new cases reported and the survivors two years after notification, the period during which most of the deaths occur. Since the ratio of deaths to cases is comparatively high in children under 5, low in the age-period 5 to 15, and then rises steadily with age, the possible influence of a change in the age distribution of the populations had to be eliminated. Drolet shows that the difference between the age of patients or age at death now and formerly are not great enough to modify materially the fatality rates of the communities investigated. Persons dying from tuberculosis now are, on an average, slightly older than formerly. Passing to the influence of treatment on the fatality rates, Drolet finds that the mortality ratio to the total discharges among cases treated in sanatorium or hospital since 1910 has tended to fall in New York. In England on the other hand, the mortality ratio in 'approved residential institutions' was 11 per cent. in 1927, and has risen steadily to 19 in 1936. The proportion of all tuberculosis cases 'isolated' in hospitals is several times greater now than it was some time ago; in the United States it has risen from 4 per cent. in 1915 to 25 in 1934; and in England, from 8 per cent. in 1921 to 17 in 1934. This he considers the most important factor in the fall in the tuberculosis mortality. Finally, Drolet says that sanatorium or surgical treatment of pulmonary tuberculosis would seem so far to have had little effect upon the case

fatality rates of the entire tuberculous population in the communities he has studied. But this finding in regard to the surgical treatment (including artificial pneumothorax) of pulmonary tuberculosis in no way detracts from the value of collapse therapy, for correctly applied collapse therapy is still too recent a measure to allow of the study of its influence on case fatality."

It would seem that just as maternal deaths due to child-birth have decreased in *number*, with the fall of the birth-rate, although there has been no decrease in the *rate per* 1000 *births*, so there has been a tremendous decrease in deaths from tuberculosis because of the tremendous decrease in incidence of the disease, without any fall in the death-rate among those who have contracted the disease, despite the enormous sums spent in research and treatment. The parallel seems very striking. It may, of course, be argued that pregnancy and parturition are physiological processes not to be compared with a disease such as tuberculosis. Moreover, there is no numerical comparison between the 4 maternal deaths per 1000 births, and the 11% mortality ratio given by Drolet for tuberculous cases in institutions. But it does seem true that in the population there are individuals ill-fitted to withstand certain adverse conditions. Some may be ill-fitted to withstand *any* adverse conditions. Others may be peculiarly susceptible to some *special* conditions. And neither for the relatively large proportion who are unable to cope with tuberculosis once they have contracted it, nor for the much smaller proportion who are unfit for the strains of pregnancy and parturition has science yet been able to do much. Pregnancy can be, of course as it is, avoided. On a large scale, that spells race-suicide.

It may logically be argued that if there is no improvement in death-rate despite great devotion of money and time to services designed to improve the situation, then one of three things must be true.

(1) The services may be useless. This would appear to suggest a very remarkable degree of ineptitude in those responsible for them.

(2) The services may be valuable in limiting morbidity among those who survive, so that maternal deaths *indirectly* caused by pregnancy and childbirth, and not at present classed as related to these conditions may be reduced. It has already been noted that the death-rates among single and married women in the Registrar-General's Social Class II shows that the death-rate among married women in this class is almost exactly that of single women, plus deaths due to strictly puerperal causes. In County Durham, on the other hand, it has been shown that in the first year after child-birth, the death-rate from puerperal causes is greatly increased. This seems to indicate *class differences in maternal morbidity*, but no opportunity has presented itself of studying an adequate number of middle-class women.

(3) The services may in fact be achieving their end, but there may be at work factors of steadily increasing magnitude, which cause the problem and the attempts to solve it to increase *pari passu*. The position may in fact be described in the words of the Red Queen to Alice. "Now here, you see, it takes all the running you can do to keep in the same place."

CHAPTER XX.

THE PROBLEM AS IT REMAINS.

It has already been noted that maternal death-rate, still-birth rate and neo-natal death-rate are predominantly influenced by maternal age, all these death-rates being moreover excessively high when older women are bearing their first, or seventh or subsequent child. It has also been shown that great changes are taking place in the marriage and reproductive habits of the community, many of the poorer classes now postponing marriage or reproduction in a way which twenty years ago was characteristic only of the professional classes.

Evidence has already been adduced (Table XXIV) in dealing with still-births in different classes, to show that the age distribution or mothers in the Registrar-General's Social Classes I and II is similar to that of the middle class (Group S) in County Durham, while for Classes III, IV and V it is similar to that of Group S^{I} and S^{II}, R and M taken together, *i.e.* the rest of the community. Table LXXIV shows what proportion of births in each age group will belong to the relatively dangerous biological groups in each social class. Very high maternal death-rates, still-birth and neo-natal rates in Classes I and II or Group S are mainly found in association with first births, since fourth and subsequent births are relatively few in these classes. But first births form 95% of all births between 20-25, 55% of all between 25 and 35, and 33% of all over 35 in these middle or upper class families. In the other classes, however, the peak death-rates associated with late births in large families become important. Table LXXIV shows that the proportion of first births with high maternal and intra-natal infant death-rates form only 60% of births to mothers of 20-25 in the less fortunate classes, to compare with 95% among business and professional people. In the 25-35 group, (the largest group) only 26% of births belong to the groups with high death-rates in Classes III to V, as against 55% in Classes I and II. Among women of over 35, 48% of all births are in the dangerous groups in the lower classes, and only 33% among those who are better off. But if the figure derived from the small number of maternal deaths among women of 35 or more who were bearing their first child in the Durham study has any real validity, then these 33% *of births are associated with the very highest risks.*

While therefore the changes in family size and rate of reproduction have in the main worked to produce healthier children, this has only been true of those who survive the first month or so. The position as regards the children who die ante-natally, intra-natally or neo-natally, and as regards maternal deaths has remained apparently unchanged.

It has already been emphasized that the average infant death-rate of the year 1900 was found only in the worst biological groups in County Durham in 1930, and that therefore social changes must have greatly decreased the death-rate in the different biological groups. It has already been suggested that these social changes and the specific services set up to deal with the health problems of mothers and children are probably largely responsible for the noted, and notable decrease in

infant and child death-rates after the first month, and for the improvement in maternal health which has caused the decrease in non-puerperal deaths associated in time with childbirth. Yet despite this visible success in these stages, infant death-rates before the end of the first month, and maternal death-rates have remained remarkably steady. (This was true up to the end of 1936—the period largely covered by this investigation. Since then there has been a steady fall in the death-rate attributed to puerperal causes.) The relative stability in maternal death-rates, and in ante-natal, natal and neo-natal death-rates among children, during a period in which other infant death-rates were falling rapidly, together with the relative stability of these death-rates as social position improves, although later death-rates fall rapidly with each increase in social amenities, strongly suggest that different factors control death-rates at the two different stages—that the problems are fundamentally different biologically. It is difficult to avoid the conclusion that many misfits are conceived but fortunately die off at this early stage. It is, however, probable that some who die at this stage are potentially healthy, but are killed off by chance ante-natal, natal and neo-natal conditions. The problem would appear to be to differentiate between these groups, and as far as possible to avoid the conception of the former group and to control favourably the conditions of the latter. Increasing maternal age seems to favour the production of the unfit, and to complicate parturition. Both aspects of this problem require careful study in relation to the woman's general health and her environment. The fact however that there is no tendency for maternal mortality to rise in the wealthier classes, (although the women are "unweeded" and births are more frequently found in the dangerous biological groups) probably indicates that skill is just about keeping pace with the extra demands on it. The low neo-natal death-rate in Class I may also indicate the availability there of greater skill, but as children in Class I form less than 2% of all children, it is clear that what has been achieved in this line is quantitatively negligible.

The problem of senescence is of course a large part of the whole problem of health. The increasing death-rate in childbirth with increasing age of mother is paralleled by the increase in death-rate among those contracting any disease. No evidence exists to show whether the ova themselves are directly influenced by senescence, or whether the adverse factors only make themselves felt after maturation or fertilisation. Bleyer [1938] showed clearly that mongolism in infants is directly related to the age of the mother. A woman over 45 is fifty times more likely to have a mongoloid child than one of 15 to 20 years. At 40-45, the ratio is 25 to 1 falling to 4 to 1 at 30-35. He also showed that many women bore normal children after the birth of a mongol. It might be possible to explain this fact by assuming that the mongoloid infant was subjected, as a foetus, to faulty intra-uterine conditions, which did not re-appear in the later pregnancy, but, on the whole, it would seem easier to assume that the initial defect lay in the fertilised ovum itself. Nothing whatsoever seems to be known as yet as to what determines which of the ova shall mature under the influence of the hormones which bring about ovulation. Equally little seems to be known as to whether the intra-natal difficulties associated with first births among ageing women are primarily muscular, nervous or hormonal

in origin. It is difficult to see how adequate steps can be taken to cope with any problem where the fundamental scientific knowledge is as completely absent as is the case in relation to human reproduction. It has already been shown that among women bearing their first child the increase in still-birth rate with age of mother between 20-35 is compensated for by a decrease in later infant and child deaths, and that the decrease in still-birth rate associated with second or third births as compared with first births is largely offset by an increase in later death-rates. This may mean either that parents who marry late are significantly better off than those who marry early, so that once their children are born alive, they enjoy social amenities similar to the 'S' groups, and show the low death-rate found in those groups. On this assumption, it would be necessary to suppose that the birth of even a second child into the average household sufficiently depressed the standard of living and the available care to influence the death-rates of second children.

There remains the possibility that among any given number of children conceived, there will be a certain small proportion of weaklings, whose weaknesses may be strictly hereditary and carried genetically, or may be related to poor intra-uterine conditions due to maternal ill-health. At present these children may die in or shortly after birth ; the older the mother, the more likely is it that death will be intra-natal. Actually it is these children, for whom science and skill have so far done nothing, who present to the community in an acute form the problem of "to try or not to try". Are they, or are they not those who, if not better dead, are certainly better never born ?

In his book "Heredity and Politics", J. B. S. Haldane writes, "The death-rate among potters [1921] from bronchitis is still eight times that of the general population. . . . . The majority of potters do not die of bronchitis. It is quite possible that if we really understood the causation of this disease, we should find that only a fraction of potters are of a constitution which renders them liable to it. If so, we could eliminate potter's bronchitis by rejecting entrants into the pottery industry who are congenitally disposed to it." If much greater knowledge concerning reproduction were available, it might be possible to discourage attempted reproduction in those likely to produce still-born children, or weaklings who would die in the first month. The argument for such discouragement would be even stronger if the mother were known to be likely to lose her life. Since the peak maternal death-rate in the figures given (Table LI) was found to be 23/1000 for primiparae over 35, it is evident that in this, the worst group, 977/1000 women survive. Very much further knowledge is obviously necessary before discouragement of reproduction could be undertaken intelligently. It may be pointed out that in County Durham, during the period investigated, the distribution of births suggested an average of 3 children per fertile family. If the families had actually consisted of three children each, born to mothers between 20 and 30, with existing services and despite poverty, the maternal death-rate would only have been 3·5/1000 instead of 6·3/1000 as found. Clearly the maternal death-rate could be greatly reduced by a change in marriage and reproductive habits. Whether this would necessarily be accompanied by a fall in total female death-

rate is less certain. The difficulty of accepting the low maternal mortality figure attributed to Hungarian peasant women, together with the excess of total female deaths over male deaths during the reproductive period has already been pointed out. Social Class V in England and Wales also presents difficulties. Here a relatively high fertility rate is associated with a low maternal death-rate, but a high total female death-rate. It may well be asked whether, when conditions are bad, a latent weakness which is only uncovered by pregnancy and parturition in more protected classes, may not be exposed by a number of different factors. Two interesting cases may be cited here. The first was a woman who fell and scratched her knee a day or two before giving birth to her child. Five days later she died of septicaemia, the site of infection being the knee. Another was a woman suffering from a septic infection of the ear. Three days after childbirth she died of septicaemia, of non-puerperal origin. Neither of these cases were called maternal mortalities, but it is difficult to believe that pregnancy and parturition had not in fact contributed to their deaths, if only by lowering resistance to infection. It seems inevitable that where pregnancy and parturition form one of many difficulties to be surmounted by women, the maternal death-rate may well be classed as low. *In the more protected clasess, it is the greatest single adverse factor in the health of women.* The position is thus very complicated and deserves a degree and kind of attention which it does not receive. Paton and Findlay (*ibid*) quote the conclusions of Karn and Pearson from a study of mothers and children attending an infant clinic. "A study of the relation to Baby's health of Mother's health before pregnancy, during pregnancy and after confinement indicates that the first is the most important, and suggests that we are dealing with a true hereditary factor." They continue, "**Mother's health has something like twice the influence of crowding, clothing, cleanliness, feeding or economic conditions on the baby's health.**"

It is clearly necessary that over large tracts of the problem, mother and child must be regarded as a biological unit. It is however equally clear that pregnancy and parturition cannot be isolated from the rest of a woman's life. **It is a mistake to lose sight of the woman in the mother.** Many women are more in need of ante-conceptional than ante-natal advice, and any service that proposes to care for maternity must not relinquish responsibility at the end of ten days after childbirth, but must be responsible for the woman's health throughout the entire reproductive period.

A quantitative estimate of the extent of the problem to be considered may be made from the following facts. In 1936, there were in England and Wales 25,045 still-births. 18,159 deaths of infants under 1 month, and 2,966 deaths of mothers attributed to maternity. There were thus 46,170 deaths resulting mainly from the problems associated with mammalian reproduction. Natural abortions representing another part of the same problem may be conservatively estimated at a further 20,000 to 30,000, making a total loss of life or potential life of 66,000 to 76,000. One may compare this with the fact that in the same year there were 28,268 deaths from tuberculosis, and 56,354 from cancer.

In studying the infant death-rates in County Durham in 1930 and 1936, it was shown that all the fall in still-birth and neo-natal

death-rate was due to the fall in the birth-rate, and other evidence has been adduced to show that the fall in the death-rate of married women is also primarily associated with the falling birth-rate. **In other words we are largely improving the health of the individual by the process of exterminating the race.** It seems that a more rational community might well spend at least half as much money and time as is now spent on cancer research, on research into the problem of human reproduction. It would be wholly unfortunate if the success achieved in certain directions should blind us to those problems which remain unsolved.

The following quotation indicates how the problems appear to an American thinker.

"The approaching limit of population will modify not only the output of medical graduates, but will tend to change very definitely the nature of medical service. There are going to be fewer children born, and fewer will die in childhood. The babies that do appear will be important to society out of all proportion to their numbers. Problems of nutrition and infectious disease in the young, and of degenerative diseases in the old, are likely to be the focus of the medical practitioner's concern after a generation or two.

But there is something else to be weighed. The biological sciences have not yet discharged their full debt to progress. We look with satisfaction at the widening borders of medical knowledge ; it is easy to become complacent about the rapid advances of our science, about the conquest of preventable diseases and the lengthening span of life. But look at the other side of the shield. More than half of the institutional beds in the United States are now permanently occupied by individuals who are gross biological deficits, as far as society is concerned. The burden of financial care for these dependents is slowly but surely strangling the productive fraction of society that pays for their maintenance. For the time being we look upon this as another uncomfortable burr of taxation under the saddle that the solid citizen wears, but in the end, of course, it is basically a problem of human biology, which must be solved either by the calm wisdom of foresight or under pressure of despair. The planning of a population made as free from the menace of biological incompetents as our tested knowledge can make it lies far ahead, perhaps, but in that direction a step will be taken one day that will endow our race with unimagined powers and opportunities. . . . . It is enough for my purpose to indicate these needs and to point out again that the medical problems of the future will be of social rather than individual concern, and will have to do with maintenance rather than with repair."

[Henry S. Houghton, Director of University Clinics, University of Chicago. 1934.].

TABLE XLVIII.

MATERNAL DEATH-RATE ACCORDING TO MOTHER'S PARITY.

* = No. of births estimated as *seven* times the mean for the years 1930 and 1936.

† = No. of births estimated as *five* times the mean for the years 1930 and 1936.

Mother's Parity	1	2	3	4	5	6	7	8	9	10 & over 10	7 & over 7	All
*No. of births used for calculation of rates. 1930-36 inclusive	32,763	22,638	15,221	10,307	7,343	5,243	3,860	2,695	1,848	3,328	11,732	105,246
No. of deaths used for calculation of rates. 1930-36 inclusive.	213	95	58	64	40	46	41	19	24	50	134	650
Death-rate per 1000 births.	6·5	4·2	3·8	6·2	5·4	8·8	10·6	7·1	10·3	15·0	10·6	6·2
					6·6							
†Death-rate per 1000 births from 472 deaths in 1930, 31, 34, 35 and 36	6·5	4·0	4·7	6·0	7·3	7·7				17·2	11·1	6·3
					6·8							

TABLE XLIX.

MATERNAL DEATHS (per 1000 births) IN RELATION TO MATERNAL AGE.

No. of births estimated as seven times the mean for the years 1930 and 1936.

Maternal age	under 20	20-25	25-30	30-35	35-40	over 40	All
No. of births 1930—1936 inclusive	4,095	26,800	31,066	21,871	14,962	6,454	105,248
No. of deaths 1930—1936 inclusive	28	104	137	157	152	78	656
Death-rate per 1000 births	6·8	3·9	4·4	7·2	10·1	12·1	6·2

TABLE L.

ACTUAL NUMBER OF MATERNAL DEATHS (in brackets) IN THE DIFFERENT AGE AND PARITY GROUPS IN THE YEARS 1930, 1931, 1934, 1935 and 1936.

ESTIMATED NUMBER OF BIRTHS IN THE SAME GROUPS FOR THE SAME YEARS, CALCULATED AS FIVE TIMES THE MEAN NUMBER IN THE GROUPS FOR 1930 and 1936.

MATERNAL AGE.

Parity	under 20	20-25	25-30	30-35	35-40	over 40	Total
1	2665 (19)	11385 (44)	6692·5 (46)	1992·5 (27)	562·5 (15)*	105	23402·5 (151)
2 & 3	260 (2)	7260 (23)	11122·5 (34)	5730 (34)	2230 (15)	440 (7)	27042·5 (115)
4, 5 & 6		497·5 (5)	4172·5 (19)	6150 (37)	4255 (37)	1277·5 (13)	16352·5 (111)
7 and over 7			202·5 (2)	1750 (15)	3640 (42)	2787·5 (36)	8380 (95)
Total ...							75177 (472)

* All over 35.

TABLE LI.

MATERNAL DEATH-RATE PER 1000 BIRTHS IN PARITY AND AGE GROUPS (DEATHS IN 1930, 31, 34, 35 and 36).

Parity	under 20	20-25	25-30	30-35	35-40	over 40	Total
1	7·1	3·9	6·9	15·8* 13·6	22·5 †	—	6·5
2 & 3		3·2	3·1	5·9	8·2† 6·7	15·9	4·25
4, 5 & 6			4·6	6·0	9·0† 8·7	10·2	6·8
7 & over 7				8·8 ‡	11·5	12·9	11·1
Total ...							6·3

* All over 30 † All over 35 ‡ All under 35

TABLE LII.

PERCENTAGE DISTRIBUTION OF BIRTHS AND MATERNAL DEATHS ACCORDING TO AGE OF MOTHER.

Area	Birth or death	Time	Age of mother in years		
			under 25	25-35	over 35
Durham	Births	Mean of 1930-36	29·4	50·2	20·3
England and Wales	,,	1931*	22·3	56·6	21·1
Durham	Deaths	1930-36 (656)	20·0	44·8	35·1
,, ...	,,	1930, 1931, 1934, 1935, 1936 (472)	19·7	45·3	35·0
England and Wales	,,	(1930, 31, 32 * Puerperal Causes only)	15·4	51·9	32·6
,,	,,	1930-36. All maternal deaths †	17·6	51·1	31·2
Hospitals	,,	840 cases. 1930-36	19·0	50·2	30·9

* Figures deduced from the Registrar-General's Special Report 1931.

† Figures from the Annual Report of the Chief Medical Officer to the Ministry of Health.

Figures in brackets are actual number of deaths.

TABLE LIII.

MATERNAL DEATH-RATES PER 1000 LIVE BIRTHS IN INDIVIDUAL AGE AND PARITY GROUPS.

(Mean for five years).

Parity	Maternal Age in years					
	under 20	20-25	25-30	30-35	35-40	over 40
1	7·1	3·9	6·9	(*15·8) 13·6	†22·5	
2	7·4	2·9	3·7	6·4	† 6·6	
3		4·5	2·5	6·1	†10·2	
4		10·1	3·0	6·1	†10·1	
5			6·5	6·7	† 9·4	
6			10·9	6·2	† 8·8	
7				‡ 9·8	7·8	12·6
8				‡ 4·0	10·3	8·8
9					7·3	17·6
10					16·6	9·4
11					17·9	19·0
12 & over 12					33·1	14·2

* All over 30 † All over 35 ‡ All under 35

TABLE LIV.

STILL-BIRTH RATE PER 1000 BIRTHS IN THE DIFFERENT MATERNAL AGE AND PARITY GROUPS.

(Mean of 1930 and 1936).

Parity	Age Group				All ages
	under 20	20-25	25-30	30-35	
1 ...	28	36	49	65	42
2 ...	20	23	23	31	27
3 ...	—	33	29	39	34
4, 5 & 6 ...	—	26	34	41	43
7 and over 7 ...	—	—	—	—	70

TABLE LV.

STILL-BIRTH PLUS NEO-NATAL DEATH-RATE PER 1000 BIRTHS IN THE DIFFERENT MATERNAL AGE AND PARITY GROUPS.

(Mean of 1930 and 1936).

Parity	Age Group				All ages
	under 20	20-25	25-30	30-35	
1	82	75	80	104	80
2	80	58	55	65	61
3	—	60	55	65	62
4, 5 & 6	—	84	66	81	83
7 and over 7	—	—	—	—	130

TABLE LVI.

MATERNAL DEATH RATES PER 1000 LIVE AND STILL BIRTHS.

P.D. = death-rate from strictly puerperal causes.
M.M. = total death-rate attributed to maternity.

	England and Wales*		Durham County†	
	P.D.	M.M.	P.D.	M.M.
1930	4·22	5·36	4·64	5·56
1931	3·95	5·32	5·02	6·18
1932	4·04	5·15	4·36	5·27
1933	4·32	5·69	4·67	4·90
1934	4·41	5·61	4·52	5·75
1935	3·94	5·08	5·46	6·54
1936	3·65	4·71	5·60	6·46
Average ...	4·07	5·27	4·89	5·81

*Taken from the reports of the Chief Medical Officer to the Ministry of Health
†Taken from the reports of the County Medical Officer of Health.

TABLE LVII.

DISTRIBUTION OF BIRTHS AND MATERNAL DEATHS ACCORDING TO THE PARITY AND AGE OF THE MOTHER.

(Expressed as a percentage of the total).

a = mean of births in 1930 and 1936 in Durham.
b = 840 deaths from three maternity hospitals.
c = 472 deaths in 1930, 1931, 1934, 1935 and 1936 in Durham.

Parity		Age of Mother						All
		under 20	20-25	25-30	30-35	35-40	over 40	
1	a	3·6	15·2	8·9	2·6	0·9*		31·2
	b	3·1	11·1	12·8	6·8	3·5*		37·3
	c	4·0	9·3	9·7	5·7	3·2*		32·0
2 & 3	a	0·3	9·7	14·8	7·6	3·5*		35·9
	b	—	3·9	7·3	5·9	5·2*		22·3
	c	0·4	4·9	7·2	7·2	4·7*		24·4
4, 5 & 6	a	—	0·7	5·5	8·1	5·6	1·7	21·7
	b	—	0·8	6·1	7·7	5·9	3·0	23·5
	c	—	1·1	4·0	7·8	7·8	2·8	23·5
7 and over 7	a	—	—	—	2·6	4·9	3·7	11·2
	b	—	—	—	3·6	7·2	6·2	17·0
	c	—	—	—	3·6	8·9	7·6	20·1

* All over 35.

TABLE LVIII.

PUERPERAL DEATH-RATE per 1000 births according to social class and age (England and Wales) (1930-32) together with total *maternal death rate* per 1000 births in County Durham (1930-1936).

Social Class	Age			All
	Under 35	25-35	35 and over	
All	2·87	3·81	6·21	4·13*
I	—	3·43	6·30	4·01
II	3·37	4·04	6·09	4·52
III	2·93	3·86	6·09	4·11
IV	2·98	3·70	6·81	4·16
V	2·44	3·62	5·97	3·89
All Classes in County Durham 1930-36 (*Total maternal death-rate*)	4·4	5·8	11·2	6·2

* Compare *puerperal* death-rate with a *total maternal* death-rate of 5·28/1000

TABLE LIX.

COMPARISON OF DEATH-RATES PER 1000 MARRIED WOMEN IN THE DIFFERENT SOCIAL CLASSES.

(Standard death-rate throughout the community = 100)

Class	Age				
	20-25	25-35	35-45	45-55	55-65
I ...	81	71	78	81	83
II ...	80	81	84	89	93
III ...	101	98	98	99	101
IV ...	102	102	103	103	102
V ...	104	119	119	111	111

TABLE LX.

PUERPERAL DEATH-RATES PER 1000 MARRIED WOMEN IN DIFFERENT SOCIAL CLASSES AND AT DIFFERENT AGES.

(deduced from the Registrar-General's figures 1931).

Social Class		Age		
		16-25	25-35	over 35
	I ... R.G. ...	0·5	0·5	0·2
	II ... ,, ...	0·7	0·6	0·2
	III ... ,, ...	0·8	0·5	0·3
	IV ... ,, ...	0·85	0·6	0·5
	V ... ,, ...	0·7	0·6	0·5
Husband's Occupation.	Hewers	1·7	1·0	0·65
	Other workers below ground	0·9	0·7	0·6
	Miners above ground	0·9	0·9	0·6
	Farmers	1·1	0·8	0·5
	Agricultural labourers	0·9	0·6	0·45

TABLE LXI

TIME RELATION OF MOTHERS' DEATHS TO THE BIRTH WHICH BROUGHT THE MOTHER INTO THE INVESTIGATION.

Year of Birth which brought the mother into the investigation	Total deaths in 5 years	Maternal mortalities in 1st year	Maternal mortalities (M.M.) elsewhere	Deaths under 1 year	Deaths between 1 & 2 years	Deaths between 2 & 3 years	Deaths between 3 & 4 years	Deaths between 4 & 5 years	Deaths under 3 mths. Not M.M.	Deaths under 6 mths. Not M.M.
1930	270	97	—	61	39	21	32	20	25	38
1931	279	107	3	46	34	35	26	28	17	22
1932	281	95	1	52	29	26	43	35	33	35
1933	207‡	75	2	52	24	22	27°	5°	32	37
1934	195†	88	1	43	22	32°	9°		18	26
1935	167*	99	3	43	18°	4°			18	23
1936	136/	94	5	32°	5°				14	19

‡ = 4-5 years. † = 3-4 years. * = 2-3 years. / = 1-2 years. ° = incomplete period.

TABLE LXII

TIME RELATION OF MOTHERS' DEATHS TO THE LAST BIRTH.

Year in which mother came into investigation	Total No. of deaths	Total Maternal mortalities (all years) MM	Maternal mortalities elsewhere	Number of Deaths						
				in 1st year Not MM	in 1-2 years	in 2-3 years	in 3-4 years	in 4-5 years	in first 3 mths. not MM	in first 6 mths. not MM
1930	270	131	—	66	33	10	18	12	30	44
1931	279	136	4	60	27	23	13	16	26	32
1932	281	126	2	66	28	16	22	21	39	44
1933	207†	99	4	59	17	12	11	5†	34	40
1934	195†	105	2	45	20	19	4†		23	31

† Incomplete period

TABLE LXIII.

DEATH-RATES AMONG ACTIVELY REPRODUCING WOMEN IN COUNTY DURHAM, calculated by studying each group for five years.

Year in which women entered investigation	Death-rates per annum per 1000 women in investigation. Age of women at beginning of investigation				Death-rates per 1000 women in County Durham (1931)*		
		15-25	25-35	over 35	15-25	25-35	over 35
1930	Rate on initial No.	2·6	2·9	5·4	3·8	3·9	6·0
	Rate on final No.	3·0	3·4	6·6			
1931	Rate on initial No.	2·5	3·8	4·0			
	Rate on final No.	2·9	4·4	4·9			
1932	Rate on initial No.	2·7	3·4	5·1			
	Rate on final No.	3·2	3·9	6·3			

* Deduced from the Registrar General's figures.

TABLE LXIV.

DEATH-RATES PER 1000 WOMEN AMONG MARRIED, SINGLE AND DIVORCED WOMEN AT DIFFERENT PERIODS.

(From the Registrar-General's figures).

DEATH-RATES PER 1000 WOMEN.

Age	1910-1912		1920-1922		1930-1932		
	Single	Married	Single	Married	Single	Married	Widowed or Divorced
15—	2·6	6·2	2·6	4·3	2·3	3·8	—
20—	2·9	3·9	3·1	3·7	2·7	3·0	4·3
25—	3·3	3·9	3·5	3·8	3·2	3·0	4·1
30—	4·3	4·6	4·0	4·1	3·6	3·2	4·6
35—	5·3	5·9	4·7	4·9	4·1	3·9	4·7
40—	6·9	7·2	6·1	5·6	5·5	4·7	5·5
45—	9·6	9·2	8·3	7·2	7·5	6·4	8·0
50—55	12·7	12·4	11·4	10·1	9·9	9·1	11·0

TABLE LXV.

TIME-RELATION OF MOTHER'S DEATH FROM TUBERCULOSIS TO THE LAST BIRTH.

Year in which woman entered investigation	Total deaths from T.B	Period elapsing between last birth and mother's death.								
		1 mth	1-3 mths	3-6 mths	6-12 mth	1 yr	1-2 yrs	2-3 yrs	3-4 yrs	4-5 yrs
1930	52	1	5	4	12	22	18	2	6	4
1931	47	2	2	2	12	18	9	7	4	9
1932	51	3	2	3	6	14	13	10	7	7
1933	37*	5	3	1	6	15	8	5	6	3*

* 4 yrs for those born late in 1933, 5 yrs for those born early in 1933.

TABLE LXVI

DEATH-RATES PER 1000 AMONG MINERS AND FARMERS AND THEIR WIVES AT DIFFERENT AGES.

(deduced from the Registrar-General's figures 1931).

M—Male. W—Wife. T—Total death-rate. A—Accident death-rate. P—Puerperal death-rate.

Occupational Group		Age									
		15—20		20—25		25—35		35—45		45—55	
		M.	W.	M.	W.	M.	W.	M.	W.	M.	W.
Hewers, R.G.'s Class III	T	3·6	6·8	3·7	5·8	4·0	4·9	6·5	5·9	12·2	9·5
	T–A–P	2·5	4·2	2·6	4·0	2·8	3·8	5·2	5·2	10·6	9·3
	P	—	2·6	—	1·6	—	1·0	—	0·65	—	?
Workers below ground not Hewers R.G.'s Class IV	T	3·2	?	3·6	3·6	4·2	3·4	5·8	5·0	9·8	8·4
	T–A–P	2·2	?	2·8	2·6	3·0	2·7	4·6	4·3	8·2	8·3
	P	—	—	—	0·95	—	0·73	—	0·6	—	?
Workers above ground Class IV. R.G.	T	3·7	?	4·8	4·1	5·5	4·6	7·6	5·6	11·9	8·9
	T–A–P	3·2	?	4·3	3·0	4·7	3·6	6·5	4·9	11·1	8·7
	P	—	—	—	0·9	—	0·9	—	0·55	—	—
Farmers Class II	T	1·4	—	2·3	2·5	2·5	2·7	3·6	3·9	7·9	6·7
	T–A–P	1·2	—	1·7	1·3	2·0	1·8	3·0	3·3	6·9	6·5
	P	—	—	—	1·1	—	0·8	—	0·5	—	—

TABLE LXVII

THE RELATION BETWEEN SOCIAL OR OCCUPATIONAL GROUP AND

(1) The number of children born per year per 100 married women between 15 and 45.
(2) The percentage of married women between 15 and 45 who are under 25.
(3) The puerperal death-rate.
(4) The percentage of all puerperal deaths found among women under 25.

Social Class	No. of married women between 15-45	No. of children	Children per 100 married women	Percentage of all married women between 15 and 45 who are under 25	Puerperal death-rate per 1000 births	Percentage of total puerperal death-rate occurring under 25 among women
I	116,528	10,974	9·4	4·4	4·0	6·1
II	676,128	60,804	9·0	5·2	4·5	9·0
III	2479,340	298,166	12·1	8·6	4·1	16·5
IV	849,600	113,319	13·3	11·7	4·1	17·8
V	781,615	119,856	15·5	12·2	3·9	14·9
Farmers	91,330	11,884	13·0	5·7	5·0	9·6
Agricul. Labs.	146,695	20,654	14·1	13·5	4·2	22·2
Hewers	206,545	38,066	18·4	10·0	5·0	18·5
All Miners not Hewers	114,716	19,077	16·7	11·7	4·7	20·8

Deduced from the Registrar-General's Special Report 1931 (Occupational Mortality).

TABLE LXVIII.

DEATH-RATES PER 1000 MARRIED AND SINGLE WOMEN ACCORDING TO THE SOCIAL CLASS AND THE AGE OF THE WOMAN.

(deduced from the Registrar-General's figures).

T = Total death-rate A = Accident death-rate. P = Puerperal death-rate. M = Married. S = Single.

Social Class.		Age											
		16—20		20—25		25—35		35—45		45—55		55—65	
		M.	S.	M.	S.	M.	S.	M.	S.	M.	S.	M.	S.
II	T	—	2·3	2·4	1·7	2·5	1·9	3·6	3·0	6·9	5·4	15·2	11·5
	T–A	—	2·2	2·3	1·5	2·4	1·8	3·4	2·8	6·6	5·2	14·9	11·2
	T–A–P	—	—	1·6	—	1·8	—	3·2	—	6·6	—	—	—
III	T	3·4	1·7	3·0	2·3	3·0	2·9	4·2	4·4	7·6	8·7	16·5	19·2
	T–A	3·3	1·6	2·9	2·2	2·9	2·7	4·0	4·2	7·4	8·4	16·2	18·7
	T–A–P	2·2	—	2·1	—	2·4	—	3·7	—	7·4		—	—
IV	T	4·4	2·3	3·0	2·7	3·2	3·4	4·4	4·8	7·9	8·6	16·8	19·3
	T–A	4·4	2·2	3·0	2·6	3·1	3·2	4·3	4·6	7·7	8·1	16·5	18·9
	T–A–P	2·7	—	2·2	—	2·5	—	3·8	—	7·7	—		—
V	T	4·1	2·2	3·1	2·8	3·7	3·2	5·1	5·6	8·5	11·3	18·2	20·7
	T–A	4·1	2·0	3·0	2·7	3·6	3·0	4·9	5·4	8·3	10·7	17·9	20·0
	T–A–P	2·4	—	2·4	—	3·0	—	4·4	—	8·3	—	—	—

TABLE LXIX.

DEATH-RATES PER 1000 IN THE TWO SEXES AT DIFFERENT AGES IN DIFFERENT COUNTRIES (1930-32 except where other dates are given).

Country	Sex	Age								
		5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50
England	M	2·3	1·5	2·5	3·3	3·3	3·6	4·8	6·4	9·3
and Wales	F	2·0	1·4	2·3	2·8	3·1	3·3	3·9	4·9	6·7
Scotland	M	2·7	1·7	2·6	3·4	3·6	4·2	5·8	7·6	10·1
	F	2·3	1·6	**2·6**	3·1	3·5	**4·2**	5·0	6·0	8·0
Norway	M	1·5	1·6	2·9	4·9	5·2	4·9	5·3	5·8	7·4
	F	1·1	1·3	2·8	3·9	4·4	4·3	4·6	5·1	6·2
Sweden	M	1·7	1·5	2·9	4·0	4·0	4·1	4·5	5·6	7·5
	F	1·4	**1·5**	**3·0**	3·9	3·8	4·0	4·3	5·2	6·7
Australia	M	1·5	1·2	1·8	2·4	2·5	3·0	3·9	5·3	7·8
(1932-34)	F	1·2	0·9	1·4	2·1	**2·6**	**3·0**	3·7	4·4	6·1
New Zealand	M	1·4	0·9	1·6	2·4	2·2	2·3	3·4	4·6	6·7
(1935-36)	F	1·1	0·7	1·0	1·9	2·1	**2·7**	2·9	4·1	5·5
Canada	M	2·2	1·6	2·5	3·3	3·4	3·5	4·4	5·4	7·2
	F	1·7	1·5	2·4	**3·3**	**3·8**	**4·1**	**4·8**	**5·5**	6·8
Denmark	M	1·3	1·1	2·1	3·1	2·7	2·9	3·6	4·8	6·5
	F	1·1	0·9	2·0	2·6	**3·2**	**3·2**	**4·2**	**5·2**	**6·7**
Holland	M	1·6	1·1	1·8	2·4	2·3	2·5	3·0	3·9	5·6
	F	1·3	1·0	1·7	2·1	**2·4**	**2·9**	**3·5**	**4·4**	**5·9**
Ireland	M	2·5	1·6	2·8	4·2	4·3	5·1	5·7	6·9	8·7
	F	2·4	**1·9**	**3·3**	**4·4**	**4·8**	**6·2**	**6·6**	**7·2**	**9·2**
Hungary	M	3·6	2·7	4·1	6·0	5·7	5·8	6·9	8·4	10·7
	F	**3·6**	**3·0**	**4·6**	**6·1**	**6·0**	**5·8**	6·4	6·9	8·5
Bulgaria	M	3·8	2·4	4·4	5·2	4·8	4·5	5·2	6·6	8·9
(1933-36)	F	**4·0**	**2·8**	**5·2**	**6·5**	**6·1**	**5·6**	**5·9**	6·5	7·2
Japan	M	4·3	2·7	7·4	9·3	7·9	7·2	8·1	10·4	14·5
(1929-31)	F	**4·6**	**3·8**	**8·8**	**10·2**	**9·1**	**8·9**	**9·5**	10·0	10·9
Chile	M	4·1	3·2	6·6	9·4	9·5	10·6	11·7	14·4	18·7
	F	3·9	**3·7**	**7·3**	**9·5**	**9·5**	**11·1**	11·1	12·6	14·0
Poland	M	3·5	2·4	3·7	5·0	4·9	5·3	6·1	7·9	11·1
(1933-34)	F	**3·5**	**2·6**	3·6	4·6	**5·1**	**5·8**	**6·5**	7·2	8·5
British India	M	10·0	6·3	8·9	9·5		12·6		18·7	
	F	9·9	**6·3**	**10·6**	**11·9**		**13·3**		16·3	

The figures are given in heavy type where the female death rate equals or exceeds that for the male.

(Taken from the League of Nations Statistical Year Book 1937/38 and 1938/39)

TABLE LXX.

PUERPERAL DEATH-RATE AMONG MOTHERS AND DEATH-RATES UNDER 1 MONTH, between 1 month and 12 months and between 1 year and 2 years, in different Social Classes and Occupational Groups (from the Registrar-General's figures).

Social Class	All per 1000 Births			
	Puerperal Death-rate	Neo-natal Death-rate	Death-rate between 1 and 12 mons.	Death-rate between 1 and 2 years.
All (England and Wales) (1930-32)	4·1	30·1	31·4	14·5
I ...	4·0	21·7	11·0	4·5
II ...	4·5	27·2	17·8	7·3
III ...	4·1	29·4	28·1	12·6
IV ...	4·1	31·9	34·9	15·7
V ...	3·9	32·5	44·5	23·0
Farmers (Class II)	5·0	29·3	17·1	6·8
Agricultural Labourers (Class IV) ...	4·2	31·7	26·6	9·7
Hewers. (Class III)	5·0	38·0	43·5	22·6
Miners (above and below ground) (Class IV) ...	4·7	40·0	42·8	20·0
Miners (County Durham) 1930)*	—	42·7	40·2	—

* From the investigation reported here.

TABLE LXXI.

DISTRIBUTION OF CLASSES IN THE POPULATION, IN THE POTENTIALLY REPRODUCING POPULATION AND AMONG BIRTHS.

(Deduced from the Registrar-General's figures 1931).

Class	% distribution of men	% distribution of women between 15 and 45	% distribution of births
I	2·5	2·4	1·8
II	13·9	13·8	10·0
III	48·5	50.4	49.4
IV	17.6	17·3	18·8
V	16·3	15·9	19·8
Unoccupied	1·4	0·3	0·1

TABLE LXXII.

DEATH-RATES PER 1000 MARRIED WOMEN AT DIFFERENT AGES ACCORDING TO SOCIAL CLASS OF HUSBAND.

	Age				
	15-20	20-25	25-35	35-40	45-55
Class I. R.G. ...	—	2·4	2·2	3·3	6·2
Class II. R.G. ...	—	2·4	2·5	3·6	6·9
Farmers. Class II.	—	2·5	2·7	3·9	6·7
Class III. R.G. ...	3·4	3·0	3·0	4·2	7·6
Hewers. Class III	6·8	5·8	4·9	5·9	9·5
Class IV. R.G. ...	4·4	3·0	3·2	4·4	7·9
Miners below ground. Class IV.	—	3·6	3·4	5·0	8·4
Miners above ground. Class IV.	—	4·1	4·6	5·6	8·9
Agricultural Labourers. Class IV.	—	2·7	2·7	3·8	6·7
Class V. R.G. ...	4·1	3·1	3·7	5·1	8·5

TABLE LXXIII.

DEATH-RATES PER 1000 MARRIED WOMEN FROM OTHER THAN PUERPERAL CAUSES OR ACCIDENT, SHOWING THE RELATION TO AGE AND CLASS.

(Deduced from the Registrar-General's figures 1931).

Social Class	Age				
	15-20	20-25	25-35	35-45	45-55
I.	—	1·7	1·5	2·9	5·9
II. ...	—	1·6	1·8	3·2	6·6
Farmers ...	—	1·3	1·8	3·3	6·5
III. ...	2·2	2·1	2·4	3·7	7·4
Hewers. III. ...	4·2	4·0	3·8	5·2	9·3
IV. ...	2·7	2·2	2·5	3·8	7·7
Miners below ground. IV. ...	—	2·6	2·7	4·3	8·3
Miners above ground. IV. ...	—	3·0	3·6	4·9	8·7
Agricultural Labourers. IV.	—	1·7	2·1	3·3	6·6
V.... ...	2·4	2·4	3·0	4·4	8·3

TABLE LXXIV.

PERCENTAGE OF FIRST BIRTHS AND SEVENTH AND LATER BIRTHS (i.e. DANGEROUS BIRTHS) OCCURRING AT EACH AGE GROUP OF MOTHER IN DIFFERENT SOCIAL CLASSES.

Proportion of "Dangerous" Births in each Group as percentage of all Births in the Group. (on Durham figures).

Social Group		Mother's Age.			
		Under 20	20-25	25-35	Over 35
S. ...	1st births	—	95	55	33
	7th or later births	—	—	—	—
Total 16,500 births	1st births	95	59	20·0	3·9
	7th or later births	—	—	6·0	45·8

PART IV.

APPENDICES AND REFERENCES.

APPENDIX 1.

1. A comparison of figures deduced from the Health Visitors' records with the relevant figures given by the County Medical Officer of Health.

Certain areas included in the reports of the County Medical Officer did not fall into this investigation, as they did not come under the care of the health visiting staff of the Administrative County. All the following figures therefore relate only to that portion of the County (more than 90%) which belonged to the County Maternity and Child-Welfare Unit. The number of live births in 1930 reported for this area by the Medical Officer of Health was 16,377, and the still-births 754. The live births, of which some records were secured from the Health Visitors, (including those removing into the area after birth) numbered 16,366, and the still-births 683. The numbers coming into the neighbourhood from elsewhere were not investigated, since it would have necessitated too lengthy an examination of each card, but, in an area such as this with a population which is slowly decreasing, (despite a birth-rate which should give a considerable natural increase), it seems safe to consider that they formed only a small proportion of the total.

The still-births recorded on health visitors' cards comprised only 90% of those recorded in the Medical Officer's report. The missing 10% were equally distributed between the rural and urban areas. No other information was forthcoming concerning them.

Children born in 1930, and dying under 1 year of age would die either in 1930 or 1931. It was, therefore, concluded that the infant mortality for the children born in 1930 ought to approximate to the mean of the figures for 1930 and 1931 as given by the Medical Officer.

The following table allows the necessary comparisons to be made.

	Infant mortality rate per 1000 *live* births from M.O.H.'s report.			Infant mortality rate per 1000 *live* births for children born in 1930.
	1930	1931	Mean	H.V. records.
Rural areas.....	69·6	84·4	77·0	78·4
Urban areas ...	77·0	84·2	80·6	79·4
Total	73·2	84·3	78·7	78·9

Clearly, the infant death-rate, as deduced from the records studied, agrees very closely with the figures from the official report.

The number of children born in 1930 who died between the ages of 1 year and 5 years (called here the child mortality CM), was 530, which ought to approximate to the yearly average of the numbers dying at this age during the years 1931-35. This average was 493, *i.e.* about 10% lower than the figure found. Since deaths at this age varied greatly from year to year (*e.g.* in one area the variation was from 55 to 99, and in another from 18 to 56), it is clear that such figures represent the closest agreement that could be expected. It seems possible to conclude that the figures deduced from the health visitors' records are fundamentally valid.

2. The consistency of the statements made in the records themselves.

The questions asked were, "Did the parity stated for the mother agree with the number of pregnancies under the heading previous children alive, dead, still-born, and miscarriages?" Also, "Did the number of children alive agree with the number of children in the house"? The latter test could only apply to small families, since children of twelve years and over in the big families were classed as adults and were therefore indistinguishable from lodgers, etc. Moreover, the test was only applicable where the family were not sharing rooms with other families.

For the small families, the results were entirely satisfactory. *e.g.* in the 3,300 second pregnancies described, no information was given about the first pregnancy in 12 cases, 22 cases of twins were reported among first pregnancies, while in 9 other cases two previous children were described and the number of children living in the house suggested that these 9 cases had also been twins. (No special space is allotted on the record cards for multiple births occurring in previous pregnancies.) In three records only were two previous children claimed, while the number of children in the house indicated that the newly-born child had been counted as a previous child, although it was pointed out that in practice this error is frequently made by mothers, and has to be carefully guarded against by the health visitors in compiling their records. In 4 cases, where the house was shared, it was not possible to conclude whether the new baby had been included wrongly, or whether the first had been a twin pregnancy. However, 31 to 35 sets of twins in 3,300 first births would agree quite well with the distribution of twin births found in this investigation. The records for small families appeared to be correct therefore to 1%—a very high standard of accuracy. In the larger families, the standard reached was not so good. In the 684 families, in which a seventh child came into this investigation, there were 17 cases in which the records of previous pregnancies were incomplete, 22 families in which twins were recorded (24 sets of twins), fourteen families in which the total children recorded, and the number of occupants of the house indicated that a previous pregnancy had resulted in twins (in two cases two sets of twins), ten families in which the previous children exceeded six, but in which it was not possible to deduce whether these were twins or whether a mistake had been made, and only four where the new baby had probably been counted as a previous child. If all these excess births were twin pregnancies, then the distribution of twins among the previous children would be approximately 1 in 80, which is about the average for the country, and rather less than was found among the 16,500 children intensively studied in this investigation. In these families to which the seventh children belonged, the records were consistent within 5%, and the probable accuracy was even higher than this. In the sixty families with thirteen children, there were records of nine sets of twins among the earlier children, and excess children, which were probably twins in four other families. Thirteen sets of twins in the 700-800 children of these families would agree again quite well with the rather high rate of twinning found in this investigation in the larger families.

APPENDIX 2.

DEATH-RATE PER 1000 CHILDREN BORN ALIVE.

All marriage ages of wife.

Size of family	Duration of marriage in years.								
	0-5	5-10	10-15	15-20	20-25	25-30	30-40	40-50	50-60
1	62	70	94	109	122	135	166	217	268
2	106	94	110	125	140	151	179	233	299
3	172	126	136	149	162	173	191	243	286
4	263	163	153	166	176	184	204	248	298
5	283	205	170	176	189	195	212	254	296
6		262	196	187	199	205	220	257	298
7		301	226	196	206	212	227	259	307
8		335	268	217	214	222	236	266	301
9		304	311	243	225	229	243	271	303
10			360	278	246	247	259	284	320
11			393	307	267	258	269	292	332
12			450	349	300	288	297	319	354
13			493	386	331	306	321	345	381
14				431	364	337	346	368	402
15				483	394	369	369	386	423
16				499	436	405	416	434	455
17					465	444	456	470	450
18					486	471	475	491	549
19						506	511	542	
20						559	549	594	
21							583		
22							596		

Reproduced from the Census of England and Wales, 1911. Vol. XIII. Part II. Fertility of Marriage. By permission of the Controller of H.M. Stationery Office.

APPENDIX 3.

COMPARISON BETWEEN THE DEATH-RATES IN THE PREVIOUS CHILDREN BORN ALIVE IN THE DURHAM INVESTIGATION WITH FAMILIES OF SIMILAR SIZE BRED AT THE SAME RATE IN THE 1911 REPORT (Appendix 2). (See Text Page 49 *et seq*).

1930 pregnancy = 2nd. Previous pregnancies 1.

Mother's age 20-25. Previous children born alive = ·96. Death-rate 116/1000.

M.A. = Mother's age at marriage. D.M. = Duration of marriage.

Cf. 1911 report.	M.A.	D.M.	Death-rate per 1000 in families of 1.	Comparable Durham figure.
	20-25	0-5	62	116
	15-20	5-10	90	

Mother's age 25-30. Prev. children born alive = ·97. Death-rate = 66·4.

Cf. 1911 report.	M.A.	D.M.	Death-rate per 1000 in families of 1.	Comparable Durham figure.
	25-30	0-5	63	66
	20-25	5-10	68	
	15-20	10-15	52	

1930 pregnancy = 3rd. Previous pregnancies 2.

Mother's age 20-25. Previous children born alive = 1·9. Death-rate = 173/1000.

Cf. 1911 report.	M.A.	D.M.	Death-rate per 1000 in families of 2.	Comparable Durham figure.
	20-25	0-5	107	173/1000
	15-20	5-10	104	

Mother's age 25-30. Children born alive = 1·9. Death-rate = 105/1000.

Cf. 1911 report.	M.A.	D.M.	Death-rate per 1000 (assuming 2 per family)	Comparable Durham figure.
	25-30	0-5	94	105
	20-25	5-10	93	
	15-20	10-15	124	

It is therefore impossible to demonstrate in these families any improvement in death-rates over the twenty years.

APPENDIX 3—*continued.*

1930 pregnancy = 4th. Previous pregnancies 3.

Mother's age 20-25. Children born alive per family = 2·8. Death-rate = 149.

Cf. 1911 report	M.A.	D.M.	Death-rate in families of 3.	Comparable Durham figure.
	20-25	0-5	176	149
	15-20	5-10	144	

Mother's age 25-30. Children born alive = 2·8. Death-rate = 140/1000.

Cf. 1911 report	M.A.	D.M.	Death-rate in families of 3.	Comparable Durham figure.
	25-30	0-5	145	
	20-25	5-10	125	140
	15-20	10-15	144	

Mother's age 35-40 Children born alive = 2·9. Death-rate = 109/1000.

Cf. 1911 report.	M.A.	D.M.	Death-rate in families of 3.	Comparable Durham figure.
	35-40	0-5	176	
	30-35	5-10	150	
	25-30	10-15	129	109
	20-25	15-20	143	
	15-20	20-25	169	

It seems probable here that in the relatively slowly bred group where there were only three previous children when the mother had attained the age of 35, that an improvement had occurred over the twenty years, but it cannot be regarded as proved.

1930 pregnancy = 5th. Previous pregnancies 4.

Mother's age 25-30. Prev. children born alive = 3·8. Death-rate = 172/100

Cf. 1911 report.	M.A.	D.M.	Death-rate per family of 4.	Comparable Durham figure.
	25-30	0-5	217	
	20-25	5-10	162	172
	15-20	10-15	158	

Mother's age 35-40. Prev. Children born alive = 3·9. Death-rate = 121/1000.

Cf. 1911 report.	M.A.	D.M.	Death-rate in families of 4.	Comparable Durham figure.
	35-40	0-5	188	
	30-35	5-10	182	
	25-30	10-15	150	121
	20-25	15-20	162	
	15-20	20-25	179	

Again it seems possible that where the rate of breeding has been slow, there has been a real improvement over the twenty years.

APPENDIX 3—*continued.*

1930 pregnancy = 7th. Previous pregnancies = 6.

Mother's age under 30. Prev. Children born alive = 5·4. Death-rate = 242/1000.

Cf. 1911 report.	M.A.	D.M.	Death-rate in families of 5	Death-rate in families of 6	Comparable Durham figure.
	20-25	5-10	203	263	
	15-20	10-15	180	209	242

Mother's age over 40. Prev. Children born alive = 5·8. Death-rate = 139/1000.

Cf. 1911 report.	M.A.	D.M.	Death-rate in families of 6.	Comparable Durham figure.
	35-40	5-10	231	
	30-35	10-15	213	
	25-30	15-20	187	139
	20-25	20-25	193	
	15-20	25-30	208	

Again the more slowly bred show a probable improvement.

1930 pregnancy = 8th. Previous pregnancies = 7.

Mother's age under 35. Prev. Children born alive = 6·4. Death-rate 237/1000.

Cf. 1911 report.	M.A.	D.M.	Death-rate in families of 6	Death-rate in families of 7	Comparable Durham figure.
	25-30	5-10	237	268	
	20-25	10-15	193	222	237
	15-20	15-20	188	199	

Mother's age over 40. Prev. Children born alive = 6·6. Death-rate 164/1000

Cf. 1911 report.	M.A.	D.M.	Death-rate in families of 6	Death-rate in families of 7	Comparable Durham figure.
	30-35	10-15	213	247	
	25-30	15-20	187	197	164
	20-25	20-25	193	201	
	15-20	25-30	208	214	

Again there is an improvement in the slowly bred families.

APPENDIX 3—*continued.*

1930 pregnancy = 9th. Previous pregnancies = 8.

Mother's age under 35. Prev. Children born alive = 7·7. Death-rate 253/1000.

Cf. 1911 report.	M.A.	D.M.	Death-rate in families of 7	Death-rate in families of 8	Comparable Durham figure.
	20-25	10-15	222	266	
	15-20	15-20	199	219	253

Mother's age over 40. Prev. Children born alive = 8·4. Death-rate = 170/1000.

Cf. 1911 report.	M.A.	D.M.	Death-rate in families of 8	Death-rate in families of 9	Comparable Durham figure.
	25-30	15-20	222	247	
	20-25	20-25	209	219	170
	15-20	25-30	221	226	

Once more the improvement in the slowly bred families manifests itself.

1930 pregnancy = 11th. Previous pregnancies = 10.

Mother's age under 40. Prev. Children born alive = 8·8. Death-rate = 231/1000.

Cf. 1911 report.	M.A.	D.M.	Death-rate in families of 9.	Comparable Durham figure.
	25-30	10-15	288	
	20-25	15-20	238	231
	15-20	20-25	226	

Mother's age over 40. Prev. Children born alive = 9·7. Death-rate = 222/1000.

Cf. 1911 report.	M.A.	D.M.	Death-rate in families of 9	Death-rate in families of 10	Comparable Durham figure.
	25-30	15-20	247	281	
	20-25	20-25	219	241	222
	15-20	25-30	226	244	

Here the difference between 1900-11, and 1920-30 is less obvious in the slowly bred, particularly when it is realised that women married at 15-25 probably contribute most in this size of family.

APPENDIX 3—*continued.*

1930 pregnancy = 12th. Previous pregnancies = 11.

Mother's age under 40. Prev. Children born alive = 9·4. Death-rate = 304/1000.

Cf. 1911 report.	M.A.	D.M.	Death-rate in families of 9	Death-rate in families of 10	Comparable Durham figure.
	25-30	10-15	288	338	
	20-25	15-20	238	271	304
	15-20	20-25	226	244	

Mother's age over 40. Prev. Children born alive = 10·1. Death rate = 246/1000.

Cf. 1911 report.	M.A.	D.M.	Death-rate in families of 10	Comparable Durham figure.
	25-30	15-20	281	
	20-25	20-25	241	246
	15-20	25-30	244	

Here it is difficult to demonstrate any improvement.

1930 pregnancy = 13th. Previous pregnancies = 12.

Mother's age under 40. Prev. Children born alive = 9·8. Death-rate = 307.

Cf. 1911 report.	M.A.	D.M.	Death-rate in families of 9	Death-rate in families of 10	Comparable Durham figure.
	25-30	10-15	288	338	
	20-25	15-20	238	271	307

Mother's age over 40 Prev. Children born alive = 11·1. Death-rate = 279.

Cf. 1911 report.	M.A.	D.M.	Death-rate in families of 11	Comparable Durham figure.
	25-30	15-20	308	
	20-25	20-25	261	279
	15-20	25-30	254	

Once more it is not possible to demonstrate any improvement in the death-rates in the period covered, when families of the same size bred at the same rates are compared.

APPENDIX 4.

OCCUPATIONS OF THE 879 MEN IN GROUP R WHOSE WIVES WERE LESS THAN 25 IN 1930, AND WHOSE FIRST CHILD WAS BORN IN THAT YEAR.

Crafts.

Joiner	23
Blacksmith	12
Mason	5
Slater	1
Painter	7
Printer	4
Shoemaker	1
Plumber	9
Plasterer	3
Brushmaker	1
Miller	1
Bookbinder	1
Photographer's assistant	1
Paper hanger	1
Total	70

Industry.

Only Employer's name given	51
Rope yard	1
Chemical worker	4
Plater	4
Blastfurnace	2
Brick works	27
Fitter	28
Quarry	12
Mechanic	21
Moulder and Steel worker	19
Coke ovens	9
Shipyard	12
Rivetter	8
Holder up	1
Waggon Repairer	1
Lime Kiln	1
Weaver	1
	202

Trade.

Clerk and shop assistant	16
Barman	2
	18
Navy, Army & R.A.F.	41
Farm labourer, Gardener, etc.	56
Personal Service.	
Window Cleaner	1
Mental Nurse	3
Chauffeur	4
Groom	1
Footman	1
Gamekeeper	1
Waiter	1
Total	12
Seaman	7
Sundry workers	9

Public Employees.

Rural or urban district employees	11
Postmen	3
Police	3
Warder	1
	18

Amusements.

Boxer	1
Billiards	2
Footballer	5
Cinema operator	3
Groundsman	2
Total	13

Labourers	196
Transport workers	142
Out of work or no statement	95

APPENDIX 5.

COMPARISON OF THE DEATH-RATES IN THE SAME BIOLOGICAL GROUPS IN SOCIAL GROUPS M AND R.

Mothers' Parity	Mothers' age	No. in group	Social group	SB	NN	IM'	CM	TM
1	under 20	236	M	33·9	33·9	67·8	42·4	178·0
		128	R	15·6	62·5	62·5	23·4	164·0
1	20-25	1238	M	44·4	40·4	25·9	34·7	145·4
		751	R	32·0	28·3	27·7	10·6	98·6
1	25-30	521	M	49·9	38·4	28·8	26·9	144·0
		493	R	50·6	26·7	17·9	16·3	111·5
1	30-35	130	M	92·3	38·5	15·4	0	146·2
		143	R	48·9	27·8	14·2	21·0	111·9
2	20-25	700	M	21·4	37·2	41·5	44·3	144·4
		314	R	16·0	41·0	29·1	35·0	121·1
	25-30	669	M	23·9	26·9	31·4	25·4	107·6
		457	R	28·4	39·4	26·2	28·4	122·4
	30-35	235	M	38·3	34·1	34·0	42·5	148·9
		203	R	24·6	35·0	34·0	19·7	113·3
3	under 25	261	M	3·8	30·7	53·6	53·6	141·7
		119	R	50·4	10·1	40·3	25·3	126·1
	25-30	600	M	36·6	26·6	26·7	36·6	126·5
		309	R	19·4	16·2	25·8	35·6	97·0
	30-35	350	M	40·0	25·7	37·1	31·4	134·2
		184	R	32·6	21·7	32·6	10·9	97·8
	35-40	133	M	22·6	60·0	22·7	30·1	135·4
		77	R	26·0	39·0	39·0	65·0	169·0
4	25-30	368	M	29·9	24·5	76·0	47·4	177·8
		182	R	22·0	38·5	49·5	22·0	132·0
	30-35	323	M	34·1	43·4	40·2	49·5	167·2
		184	R	27·2	16·3	43·5	21·8	108·8
	35-40	185	M	48·6	70·2	16·3	10·8	145·9
		103	R	68·0	0	19·4	19·4	106·8
5	All ages	774	M	37·5	34·9	43·9	46·5	162·8
		401	R	47·4	22·4	39·9	32·4	142·2
					NN + IM'			
6	All ages	609	M	41·1	102·0		42·7	185·8
		282	R	56·7	110·0		21·3	188·0
7	All ages	451	M	75·4	93·1		48·8	217·3
		205	R	53·6	92·7		34·2	180·5
8	All ages	317	M	53·6	113·5		47·3	214·4
		136	R	117·7	125·0		14·7	257·4
9	All ages	214	M	32·7	154·2		56·1	243·0
		109	R	55·0	110·1		27·5	192·6

Of the remaining biological groups in which the numbers did not fall below 50 nor exceed 100, there were 6 groups in which the total death rates for Groups M and R were almost exactly equal, one group in which the death-rate for Group M was clearly less than for Group R, and 7 groups in which the rates for Group M definitely exceeded those for Group R.

APPENDIX 6.

DESCRIPTION OF FAMILIES REQUIRING SPECIAL ASSISTANCE.

MC = miscarriage. SB = still-birth. NN = died within first month of life.

Mother's Parity	Mother's Age	Result of previous pregnancies			Result of last pregnancy	Comments by H.V.
		Alive	Dead	MC		
2	19	—	1 NN	—	Twins—both NN	Mother suffering from (Venereal disease) V. D.
2	25	—	spina bifida	—	S.B.—hydrocephalic	—
2	27	1 healthy	—	—	NN—deformed	Mother took in washing till end of 5th month of pregnancy.
3	22	2 in fair health	—	—	NN	—
3	22	1 in fair health	1 SB	—	SB	Mother only in fair health.
3	23	—	2 SB	—	SB	Mother not V.D. Receiving free milk.
3	23	1	1 NN	—	NN	Father abuses mother.
3	25	2 rachitic	—	—	Twins—1 NN, 1 alive but rachitic	Mother anaemic. First child born 25/9/33. Twins born 22/9/35 (3rd preg.)
3	26	1 unable to walk at nearly 3 years	1 SB	—	Died at less than 1 year	Mother eclamptic.
3	27	—	2	—	Alive but kept in hospital	Mother had sleepy sickness seven years before, unable to feed herself.
4	22	3 all healthy	—	—	Deformed—died at 2 months	Mother's mother only 45.
4	22	2—1 delicate	1 NN	—	Cleft-palate and hare-lip. Died under anaesthetic.	—

APPENDIX 6—*continued.*

Mother's Parity	Mother's Age	Result of previous pregnancies			Result of last pregnancy	Comments by H.V.
		Alive	Dead	MC		
4	22	—	1 NN, 2 SB	—	SB	Mother refused to follow any advice.
4	22	1	2	—	Died NN	Mother lazy and careless.
4	24	1 healthy	1, 1 SB	—	Hydrocephalic	Mother œdematous.
4	24	3, 1 anaemic	—	—	Premature—died at 1 hour	—
4	25	1	1	1	Died NN	Mother anæmic. Four pregnancies in less than 3 years.
4	25	3	—	—	Died I.M. of acute bronchitis and rickets	Mother had complete paralysis of lower limbs. Her father and cousin had died similarly.
4	26	1	1 SB	1	SB	Mother only in moderate health.
4	26	2, but 1 on "cripple" list with rickets	1 at 4 years, 11 months with acute rickets	—	Died at 12 months—acutely rachitic	—
4	27	1	1 rickets, 1 broncho-pneumonia	—	Died broncho-pneumonia at 6 months	Mother "lazy"
4	37	Eldest $4\frac{1}{2}$ yrs. malnourished and bad strabismus. Second $3\frac{1}{3}$ yrs. severe rickets. Third $1\frac{2}{3}$ yrs. cleft palate	—	—	4th child deformed and died at 4 months	Mother in poor health, and pregnant again at death of 4th child.
5	22	1 healthy	4 NN (1 set twins)	—	Died at 4 months of bronchitis.	—

APPENDIX 6—*continued.*

Mother's Parity	Mother's Age	Result of previous pregnancies			Result of last pregnancy	Comments by H.V.
		Alive	Dead	MC		
5	24	2	2	—	NN	Mother anaemic. Father unemployed.
5	25	4 healthy	—	—	Overlaid	Eldest child just five. Only 2 beds for 7 persons. Father miner unemployed.
5	32	3 but 2 in sanatorium and 1 attending dispensary	1 meningitis	—	NN	Mother's health bad.
6	27	4 but 2 with rickets	1	—	SB	Mother 'dirty and lazy'
6	27	3	1, 1 SB	—	SB	Mother eclamptic.
6	28	1st 3 alive	4th & 5th SB	—	SB	—
6	33	1	4	—	Died	—
6	34	2	1 (debilityfrom birth) 1 SB	1	NN	Mother epileptic. Died at birth of 6th child.
6	35	4 but 2 with chorea	1	—	NN	Father died of tuberculosis 20 mins after birth of 6th baby.
6	37	—	1 difficult delivery—child NN. 1 Caesar-child NN 3 SB	—	Dead	Mother and child died at 6th birth.
6	38	4	5th SB13/1/33	—	6th SB 28/10/33	—
7	27	5, 1 delicate	—	1	MC	Mother was very ill—taken to hospital and later notified TB. "Home help" given. Home help left. Mother in Sanatorium and finally children removed from home after inspection by N.S.P.CC

Mother's Parity	Mother's Age	Result of previous pregnancies			Result of last pregnancy	Comments by H.V.
		Alive	Dead	MC		
7	31	2	4 SB	—	SB	—
7	32	5 but 2 M.D.	1 SB	—	Died at a few hours	Mother epileptic.
8	31	3	3	1	Lived 4 days	Mother anaemic.
8	33	3	1, 2 SB	1	SB	Mother anaemic.
8	34	6	1	—	NN	Mother epileptic.
8	34	4	3	—	SB	Mother anaemic.
8	34	3	1, 1 SB	2	Lived 30 mins.	Mother attributed trouble to frequency of pregnancies.
8	34	2, 6 & 8 years old, both bad rickets	5	—	SB	Mother notified and visited as M.D.
8	37	4, but 1 M.D.	3	—	Alive but extremely backward—will probably prove to be M.D.	—
8	39	2	4	1	Lived few hours only	Mother had uterine trouble.
9	31	5	3	—	Died	Mother not very efficient.
9	31	5	2 SB	1	SB	Mother in very poor health—very deaf and of very low mentality.
9	33	4	2, 2 SB	—	SB	—
9	33	5	2 SB, 1	—	SB	Mother debilitated and anaemic. Home help given.
9	35	4	4 NN	—	This N.N. All only lived a few hours	Mother moderate. Free milk given
9	39	3 but 2 tuberculous	3	2	NN	—
9	40	5	3 NN	—	SB	—
9	41	3	4 SB, 1 at 1 hr.	—	Weighed 2¾ lbs. lived 3 days	Mother in poor health—father tuberculous.
10	29	5	2 SB	2	Alive	Mother very low mentality—M.D.?

APPENDIX 6—*continued.*

Mother's Parity	Mother's Age	Result of previous pregnancies			Result of last pregnancy	Comments by H.V.
		Alive	Dead	MC		
10	35	4	5 NN	—	This NN	6 premature infants who all died at a few days were born within four years.
10	35	6 mod. health	2, 1 SB	—	SB	10 children in 13 years.
10	35	7	—	2	SB (see comments)	1 natural birth, 5 difficult instrumental births, 2 Caesarian deliveries. Last Caesarian delivery and hysterectomy, following ruptured uterus.
10	37	7, 1 TB and 1 perf. palate	1, 1 SB	—	SB	Father continuously out of work.
10	39	6 mod. health, 1 TB hip	1 SB	2	SB	Mother TB
10	40	4, 1 20 yrs. old has had fits since 1 yr. old	3, 2 SB	—	SB	—
10	41	4	3, 1 SB	1	SB	—
10	42	6	2, 1 SB	—	SB	—
10	43	5	4	—	SB	Mother acute cardiac case.
11	28	2	6 NN	2	NN	Father out of work. Parents frequently parted. Mother's health fair.
11	31	2	2	6	NN	—
11	33	5	3	2	SB	Mother refused to obey doctor or nurse.
11	38	6 healthy	2, 1 SB	1	NN	Father drunkard. Mother in poor health.
11	38	10, 2 notified TB	—	—	NN	Mother and father both in very poor health.

APPENDIX 6—*continued.*

Mother's Parity	Mother's Age	Result of previous pregnancies			Result of last pregnancy	Comments by H.V.
		Alive	Dead	MC		
11	39	5	5	—	NN	Mother suffering from uterine discharge.
11	40	8, 3 very rachitic	2 NN	—	SB	—
11	40	7	1, 2 SB	—	SB monster	—
11	43	2	8 SB	—	SB	Mother in poor health and not V.D.
11	44	6	1, 3 SB	—	SB	Mother had believed herself to be at the menopause.
11	45	6	3	1	SB	Mother suffering from cardiac disease.
12	31	6, only 5 healthy	2, 2 SB	1	NN	Mother's health poor, antepartum haemorrhage.
12	35	8	3	—	NN	Mother's health poor.
12	39	7	3, 1 SB	—	SB	Mother anaemic and suffering from kidney disease.
12	39	8	3	—	NN (cyanosed at birth)	Mother's health poor—prolapsed uterus.
13	39	7 all only mod.	5	—	SB	Mother's health very poor.
13	40	4	1 SB	7	NN	Excellent mother.
14	36	1 (1st) healthy at 16 years of age	5 SB (prem.)	7	Died at 1 day (7 mths. baby)	Mother twice in hospital for operations.
14	41	7	1, 3 SB	2	SB	—
14	41	5, 1 dislocated hip	3, 5 SB	—	SB	—
14	43	10	—	3	Alive	Mother dragged downstairs when baby 3 days old by 2 drunkards and badly bruised
14	43	9, 8 healthy	4	—	NN	—

APPENDIX 6—*concluded.*

Mother's Parity	Mother's Age	Result of previous pregnancies			Result of last pregnancy	Comments by H.V.
		Alive	Dead	MC		
14	45	6 healthy	1 TB, 1 SB	5 MC	NN	—
15	35	10	2, 2 SB	—	SB	Mother in ill-health for years.
19	45	10, 3 clubf'ted	1 SB	7 M C	SB	—
20	44	11	8 SB or died later	—	SB	This woman had several children during the period investigated and the statements *re* deaths and still-births did not always tally. The sum was consistent, however. Clearly she didn't differentiate between a still-birth and a death. She herself died at the 20th birth.

This list merely consists of a record of those families to whom special visits were being made, or who were receiving some form of special help. It was compiled over a few days when record cards were being examined for maternal deaths. Since such families include particularly tuberculous and epileptic individuals, it is probable that the death-rate among them is swelled by this fact. Most of the families will be seen to fall into the rapidly-bred group who have been previously shown to constitute such a considerable part of the social and educational problem to be solved.

There are, however, some cases—particularly in the fairly small families of young parents where two apparently careful and healthy parents produce deformed or unhealthy children, sometimes several such children successively. Here there is clearly quite a different problem—a biological and medical question.

So many of the mothers concerned do seem to put up such a good fight against overwhelming odds, that it is difficult to believe that if the right type of education could be made available early enough, much of the misery and ill-health which can be deduced from these records might be avoided.

APPENDIX 7.

THE CALCULATION OF MATERNAL DEATH-RATES IN DIFFERENT BIOLOGICAL GROUPS.

As already pointed out, in 1930, there were 17,049 births in the health visitors' records, in the maternity and child welfare unit studied. Of these children, 16,500 were visited regularly until five years of age, removal or death, if that occurred earlier. The parity of the mothers of all these children was known, but age was known only in 15,510 cases. The comparable figures for 1936 were 13,705, 13,289 and 13,235. For the purpose of calculating the maternal death-rates, the mean of the numbers in each parity group was deduced from the 16,500 in 1930 and the 13,289 in 1936. To relate maternal death-rate and age, the mean of the age groups in 1930 and 1936 was used, as, although this gave results 3% too high, this did not affect the validity of the conclusions.

All the rates involving age were thus calculated on groups which totalled 14,372. Groups of known parity totalled on the average 14,895, and the mean number of records for the two years, including those of unvisited children, and the small number of whom nothing was known was 15,372. The number of live and still-births which occurred in the maternity and child welfare unit of the administrative county during the period 1930-36 inclusive was deduced from the County Medical Officer of Health's reports. They numbered 17,131, 16,452, 16,277, 14,872, 14,173, 14,107, 13,896 respectively and averaged 15,272. This exceeded the figure of 14,895 used for relating maternal parity with death-rate by 377, *i.e.* by 2%. In the year 1930, there were certainly two women whose deaths were classed as maternal deaths, whose parity was unknown because they were of the unvisited class, and in the other years there seemed to be usually one or two. There were, however, usually one or two cases of women who died, and whose relatives promptly left the district, so that information concerning them was not available. It was not, therefore, possible to class in the 'unvisited' class all the maternal deaths for which no details were available.

Since all the maternal deaths known to belong to this social class were excluded from consideration. it seemed justifiable to exclude the births. The alternative would have been to classify all the births in this class in parity and age groups in proportion to their distribution in these groups in the few cases where information was available. It was not possible to determine whether socially border-line cases might be visited when the mother died, who, if all had been well, would not have been visited. Since, moreover, the occupation of the father was not known in anything up to 30% of the total cases where the mother died, nothing could be done in the way of social classification of maternal deaths. The reason for this was twofold. Many babies who were thus left motherless were taken to be reared by relatives. The information given about the mother's health always referred to the mother of the child, as the health visitor would usually already be cognisant of the

mother's fate. The information given about the father might, however, possibly relate to the real father, or to the husband of the foster mother. Since this man's occupation, etc. largely determined the welfare of the child in the way that a father's occupation does in the usual home, this was justifiable. Secondly, where child as well as mother died at or shortly after birth, details were frequently few for obvious reasons.

Since only very large differences in the maternal death-rate were considered as having any significance at all, it was clear that the methods used in comparing the figures could not interfere with the validity of the conclusions.

APPENDIX 8.

THE DEATH-RATE FROM TUBERCULOSIS IN COUNTY DURHAM AMONG WOMEN OF CHILD-BEARING AGE.

It was only possible to secure figures for the whole Administrative County, and not for the Maternity and Child-Welfare Unit alone. Three of the smaller boroughs are included in the former but not in the latter.

From the Annual Reports of the County Medical Officer of Health, it was deduced that the total number of deaths from tuberculosis of all forms among men and women aged twenty to forty-five ranged from 340 in 1937 to 440 in 1932, and over the years 1931, 1932, 1933, 1935, 1936 and 1937, the number averaged 404. It was assumed that these deaths would be approximately equal in the sexes, so that this would give an average of 202 deaths among women. The age 20-45 was chosen, partly because this is the main period of reproduction, but mainly because the actual number of deaths among women of this age was supplied by the Chief Tuberculosis Medical Officer for the years 1935 and 1936. Calculated as above, the number of deaths among women of this age was estimated at 202 for 1935 and 183 for 1936. The actual numbers were 208 in 1935 and 174 in 1936. It seems reasonable, therefore, to assume that the estimated average for the years under consideration would at 202 be fairly accurate. Taking the total number of women of this age in the County from the 1931 census, it is then found that the death-rate from tuberculosis among such women is approximately 1·2/1000. The rate was similarly calculated for women 15-45 for one year and proved to be 1·15/1000.

APPENDIX 9.

THE PROBABLE DISTRIBUTION OF BIRTHS IN ENGLAND AND WALES ACCORDING TO THE PARITY OF THE MOTHER.

In her study of the factors influencing infant mortality Campbell [1929] estimated the probable distribution of births according to parity of mother at different levels of birth-rate, basing her estimates on American figures.

TABLE A. % DISTRIBUTION OF BIRTHS.

Parity	Campbell's estimate for live birth-rate under 19·7	Campbell's estimate for live birthrate of 21·2—22·7	Durham 1930 Maternity Unit (live birth-rate 20·6)	Durham 1936 Maternity Unit (live birth-rate 17·0)
1	31·9	29·7	29·5	33·1
2	25·1	23·0	20·1	23·3
3	15·6	14·8	14·3	14·7
4	9·8	10·2	10·5	8·9
5	6·4	7·1	7·5	6·3
6	4·1	5·0	5·6	4·2
7	2·6	3·5	4·1	3·1
8	1·7	2·5	2·8	2·2
9	1·0	1·7	2·0	1·4
10 & 10 +	1·7	2·6	3·5	2·8
6 & 6 +	11·1	15·3	18·0	13·7
8 & 8 +	4·4	6·8	8·3	6·4

In Sunderland, with a birth-rate of 22·2/1000, she estimated (according to the distribution of column 2) that there would be 306 sixth and seventh births and 242 eighth and later births. Of the total 3,620 births in the year studied, she was able to get the actual distribution by parity of 3,050, and found among these 348 sixth and seventh births, and 373 eighth and later births. The death-rate among sixth and later children in this County Borough calculated for her *estimated* number of births was 288/1000. If it was assumed that among the 570 births about which she was unable to get information, there were no sixth or later births, the fact that the *actual* number of such births among the *known* group was 721 as against the estimated figure of 548 means that the real death-rate (still-birth + infant death rate) among these sixth and later children did not in fact exceed 219/1000. If there were sixth or later children among the 570 unknown, then the actual death-rate would be less than 219. This may be compared with the figure of 173/1000 found for sixth and later births in 1930 for the adjacent county area. Thus it is seen that where the actual figure for births is used the death-rate approximates more closely to that of County Durham, since the estimated figure in this case was too low.

Croydon and Oxford had birth-rates of 14·99 and 15·25/1000—rates very similar to that of the whole country for 1933-39. Campbell

estimated (by the distribution in column 1 of Table A) that sixth and later births would equal 11% of the total.

TABLE B. Death-rates SB plus IM to the end of the first year.

Birth Rank	County Durham			Oxford	Croydon	Mean of Oxford and Croydon
	1930	1936	Mean of 1930 &1936			
1	109	198	103	103·6	73·8	89
2	92	89	90	60·2	34·4	47
3	95	95	95	66·5	74·0	70
4 & 5	116	117	116	82	101	91
6 & 6 +	173	147	160	121	129	125

Table B shows the infant death-rates at different stages of family in County Durham in 1930 and 1936, and Campbell's figures for Oxford and Croydon. These figures suggest that conditions are better in the two latter areas so that, at all stages of family, the death-rate is slightly lower than in Durham. If, however, the number of large families exceeded the estimated 11% (as the estimate was exceeded in Sunderland) then the death-rate for sixth and later children would be below the 125 found.

In County Durham it was found that the decrease in death-rate due to improved social conditions was quite marked in the early stages of the family but decreased at the later stages. It would not then be expected that the better social conditions of Oxford and Croydon would more greatly increase the difference in death-rate between these areas and Durham at the later stages of family than the earlier. In fact the reverse would be expected. It seems improbable then that 11% is an under-estimate for sixth and later births for communities with a birth-rate round about 15/1000. It is much more probably an over-estimate.

This seems to be supported by the figures given in the University of Bristol Social Survey [1938] which gives the size of *living* families in a total of 4,491. Of all these families, 2·4% only had six or more living children. Of those families in which there were any children, 3·6% had 6 or more children. (This assumes that each family consisted of two parents and their children. This assumption is probably not quite correct but it is a close enough approximation.) If 10% of all families had had six or more conceptions of which 33% had resulted in abortions, still-births or children who had died before the investigation, the proportion of families left with 6 or more living children would hardly be reduced to 3-4% of all families. It seems, therefore, improbable that the number of families in which six or more conceptions had occurred exceeded 10%.

APPENDIX 10.

EXPECTATION OF LIFE IN YEARS.

Country	Date	Sex	Age 0	1	10	20	30	40	50	60	70
England and Wales	1930-1932	M	58·74	62·25	55·79	46·81	38·21	29·62	21·60	14·43	8·62
		F	62·88	65·48	58·87	49·88	41·22	32·55	24·18	16·50	10·02
British India	1931	M	26·91	34·68	36·38	29·57	23·60	18·60	14·31	10·25	6·35
		F	26·56	33·48	33·61	27·08	22·30	18·23	14·65	10·81	6·74
Bulgaria	... 1925-1928	M	45·92	54·37	53·75	45·78	38·45	30·70	23·23	16·45	10·88
		F	46·64	53·73	53·20	45·45	38·97	31·73	24·32	17·18	11·05

APPENDIX 11.

A SURVEY OF THE CHANGES IN THE DEATH-RATES OF THE TWO SEXES AT DIFFERENT AGES, 1840-1930

Percentage drop in death-rate at each age calculated on the death-rate during the period 1840-45 (a negative drop means a rise in death-rate).

MALES.

Period	All ages	0—5	5—10	10—15	15—20	20—25	25—35	35—45	45—55	55—65	65—75	75—85	over 85 yrs.	Under 1 year
From 1841-45 to 1871-75	–3·7	–1·7	19·3	16·7	16·2	10·0	–6·3	–17·2	–18·0	–14·8	–7·0	–4·1	–6·0	–3·1
,, 1871-75 to 1901-05	30·6	22·1	38·6	39·6	36·8	41·1	43·6	37·7	19·2	7·9	7·3	8·4	15·3	9·9
,, 1901-05 to 1931-35	23·6	50·4	15·9	14·6	11·8	13·3	27·6	35·3	33·7	29·4	13·0	1·7	0·7	50·0
Total from 1841-45 to 1931-35	50·4	70·7	73·8	70·9	64·7	64·4	64·9	55·8	34·9	22·4	13·3	5·9	8·6	56·8

FEMALES.

From 1842-72	1·5	–2·4	23·2	23·1	23·4	14·0	7·1	0·8	–5·3	–5·5	–3·7	–2·7	–1·8	–3·8
1872-1902	24·7	24·2	32·6	34·6	37·7	43·0	42·4	33·1	18·6	12·1	11·0	11·7	15·4	10·5
,, 1902-32	30·3	50·9	19·8	15·4	10·4	10·4	19·2	30·6	34·4	31·3	20·0	7·7	0·6	52·6
Total 1842-1932	56·5	72·7	75·6	73·1	71·5	67·4	68·7	64·5	47·7	37·9	27·2	16·7	14·2	59·3

The ages at which the greatest gains took place are underlined.

DEATHS UNDER 5 YEARS OF AGE (BOTH SEXES).

	Under 1 year per 1000 live births	Per 1000 survivors. 1-2 years	2-5 years
1871-75	153	59	60
1901-05	138	41	35
1931-35	62	14	10
PERCENTAGE DROP IN THE TWO PERIODS CALCULATED ON THE 1871-75 FIGURES.			
From 1872-1902	9·8	30·5	41·6
„ 1902-32	49·7	45·8	41·6
Total	59·5	76·3	83·2

DEATH-RATES PER 1000 AT DIFFERENT AGES.

		All ages.	0—5	5—10	10—15	15—20	20—25	25—35	35—45	45—55	55—65	65—75	75—85	85 +	Infant under 1 year
1841-5	M	21·6	68·7	8·8	4·8	6·8	9·0	9·4	12·2	17·2	30·3	65·5	143·7	305·1	162
	F	19·8	58·6	8·6	5·2	7·7	8·6	9·9	12·1	15·1	27·2	59·1	131·8	288·6	133
1871-5	M	22·4	69·9	7·1	4·0	5·7	8·1	10·0	14·3	20·3	34·8	70·1	149·6	323·3	167
	F	19·5	60·0	6·6	4·0	5·9	7·4	9·2	12·0	15·9	28·7	61·3	135·3	293·9	138
1901-5	M	15·8	54·7	3·7	2·1	3·2	4·4	5·9	9·7	17·0	38·4	65·3	137·6	276·6	151
	F	14·6	45·8	3·8	2·2	3·0	3·7	5·0	8·0	13·1	25·4	54·8	119·9	249·4	124
1931-5	M	10·7	20·1	2·3	1·4	2·4	3·2	3·3	5·4	11·2	23·5	56·8	135·2	278·8	70
	F	8·6	16·0	2·1	1·4	2·2	2·8	3·1	4·3	7·9	16·9	43·0	109·7	247·6	54

APPENDIX 11—concluded.

DEATH-RATE IN MEN AND MARRIED AND SINGLE WOMEN.

		15—20	20—25	25—35	35—45	over 45
1911	Men ...	3·1	3·8	5·0	8·1	14·9
	Married women ...	6·2	3·9	4·2	6·5	10·8
	Single women ...	2·6	2·9	3·8	6·1	11·1
1931	Men ...	2·6	3·2	3·5	5·7	11·2
	Married women ...	3·8	3·0	3·1	4·3	7·7
	Single women ...	2·3	2·7	3·4	4·8	8·7

FALL IN DEATH-RATE DURING THE PERIOD 1911-1931.

(Deaths per 1000 of the population).

	15—20	20—25	25—35	35—45	over 45
Men ...	·5	·6	1·5	2·4	3·7
Married women ...	2·4	·9	1·2	2·2	3·1
Single women ...	·3	·2	·4	1·3	2·4

APPENDIX 12.

DEATH-RATES IN 1930 AND 1936 IN COUNTY DURHAM ACCORDING TO AGE AND PARITY OF THE MOTHER.

MATERNAL AGE.

Child's Birth Rank	Year	Maternal age under 20 yrs.					20—25					25—30				
		SB	NN	IM[1]	CM	TM	SB	NN	IM[1]	CM	TM	SB	NN	IM[1]	CM	TM
1	1930	26·4	58·2	61·8	29·9	176·3	40·4	39·6	24·1	25·4	129·5	49·4	33·8	20·5	20·6	124·3
	1936	30·7	48·3	32·9			32·3	39·2	15·7			49·8	28·3	20·8		
2	1930	20·0	60	100	0	180	18·6	38·3	38·3	39·0	134·2	27·3	30·5	30·5	25·7	114·0
	1936	20	60	40			29·0	32·0	30·0			20·7	32·6	27·1		
3	1930						17·8	25·4	50·7	43·1	137·0	31·6	24·3	25·3	36·9	118·1
	1936						48·6	29·1	38·9			26·8	28·0	33·1		
4	1930						20·8	41·7	83·3	52·1	197·9	28·1	28·2	65·2	37·0	158·5
	1936						15·9	63·5	47·6			31·5	34·1	28·9		
5	1930											30·9	27·5	41·2	34·4	134·0
	1936											53·6	48·8	43·9		
6	1930											67·2	58·8	42·2	67·2	235·4
	1936											15·9		47·6		
7 & 8	1930															
	1936															
9 & 9+	1930															
	1936															

APPENDIX 12—*concluded.*

MATERNAL AGE.

Child's Birth Rank	Year	30—35					35—40					40—45				
		SB	NN	IM'	CM	TM	SB	NN	IM'	CM	TM	SB	NN	IM'	CM	TM
1	1930	69·6	34·8	14·5	8·7	127·6	69·8	62·0	15·5	31·0	178·3					
	1936	48·0	38·5	26·4			96·8	48·4	16·1							
2	1930	28·1	34·1	28·1	30·1	120·4	56·8	28·4	17·0	11·3	113·5	29·4	58·8	29·4	0	117·6
	1936	33·4	35·1	24·6			55·5	33·3	11·1			62·5	31·2	31·2		
3	1930	36·2	25·8	34·6	27·6	124·2	24·9	45·7	29·0	41·5	141·1	117·7	88·2	58·9	0	264·8
	1936	43·1	26·2	30·0			31·2	27·3	15·6			67·8	33·9	17·0		
4	1930	29·3	31·1	42·1	38·4	140·9	51·6	41·9	19·4	12·9	125·8	74·5	74·2	42·8	21·2	212·7
	1936	31·9	36·4	20·5			39·5	30·7	26·3			152·8	41·7	13·9		
5	1930	40·1	34·2	42·1	46·2	162·6	44·2	34·0	27·2	30·6	136·0	35·3	47·0	11·8	58·8	152·9
	1936	75·3	35·8	25·1			63·6	48·7	18·7			50·6	50·6	25·3		
6	1930	36·9	63·6	41·5	34·1	176·1	44·7	51·1	41·6	44·7	182·1	92·8	51·6	51·6	0	196·0
	1936	53·1	44·2	22·1			28·7	23·9	28·7			100	16·6			
7 & 8	1930	70·5	83·5	28·8	65·3	248·1	52·3	58·4	38·4	30·2	179·3	99·0	67·6	44·9	36·0	247·5
	1936	48·0	52·4	61·1			69·5	44·2	41·0			105·3	59·2	32·9		
9 & 9+	1930						49·0	75·8	57·9	40·1	222·7	62·3	88·0	55·1	41·5	246·9
	1936						60·3	35·4	28·4			111·1	48·2	51·9		

IN CONCLUSION.

By Professor David Burns.

The facts presented in this report are incontrovertible. They can be tested by anyone who will take the trouble to examine the problem and who is capable of doing a little simple arithmetic and applying common sense. Our population, instead of steadily increasing in numbers year by year, is about to reach a peak and then decline. As Lord Eustace Percy points out in his foreword, it must decline because the potential mothers for the next twenty years have been born ; and their *maximum* number is known. Economists deplore this inevitable decrease in the population and predict industrial disaster : but let us look at the matter from another aspect. The decrease in the reproduction-rate coupled with increased longevity means that, in say, twenty years time, there will be absolutely and relatively fewer people of "the earning age" (14-60) in the decreased population. The earners will have to be taxed or otherwise contribute towards the upkeep of (*a*) the fewer young, (*b*) the more numerous aged, and (*c*) the increasing number of the unfit.

Leave alone, for the moment, the special problems raised by the third category, and focus your attention on the second group—the over sixties. If the general standard of living is to be maintained, the increase of this group will necessitate the introduction of more women into "gainful" employment and/or their staying in such employment for a longer period. That will put a handicap on early marriage, especially of the fittest women, or, if marriage is not postponed, probably the foundation of a family will be delayed to a maternal age shown by this report to be inadvisable for the safety of both mother and offspring. This postponement, at present the custom among the professional and black-coated workers, and not altogether absent among skilled manual workers, will not only become more usual among the latter, but may, in time, spread throughout the entire working population. This probability, which is almost a certainty, will exacerbate the second series of problems, those associated with the "*c*" group mentioned above.

These are the misfits of civilisation who at present form about 10% of our population and on whom most of our social services concentrate (page 62 *et seq.*) They will form about 30% of the next generation and, if the present fertility rates of this "submerged tenth" are continued, in two generations we will be flooded with unskilled labour that industry cannot absorb, unfit people to crowd our hospitals, misfits for our asylums and prisons, and, worst of all, the great army of the "just not well" struggling on amid circumstances a little too hard for them. These people form a problem in all civilised countries (pp. 65 and 228). They are the results of bad biological breeding. As Hooton put it in *"The Twilight of Man"* **"The wages of biological sin is evolutionary death."** The unfit are not confined to any one social class, but for several reasons, the unemployable found at the very bottom of the social scale get a publicity which those whose relatives are comparatively well-to-do, are able to avoid. It is common knowledge that the hard-headed man of business, the astute politician, or the

successful financier, may marry a woman of such a low grade of intelligence that no efficient employer would even consider offering her a post in his business. Similarly, the so-called "protective instinct" may lead an intelligent woman to a union with a man who could not earn a living except as an unskilled labourer. These matters are common knowledge, but it is difficult to prove that the progeny of such unions should be classed with the submerged tenth. One would need to compare the fitness for life of half-brothers, and there are not enough of them in "high places" for statistical comparison.

These are authoritative statements. They can be checked and tested. You may not agree with them, but that does not invalidate them. If you do agree, what is to be done about putting this part of our national house in order? Some people can be induced to act by carefully reasoned arguments, others by fear of approaching doom (but the doom must be appreciably near or they emulate Micawber), while many act only on sentimental grounds.

'Sir Auckland Geddes proceeded to affirm that "*in politics, in the affairs with which Governments have to deal, it is not accurate knowledge which matters, it is emotion*" concluding with an exhortation that we should let ourselves go on the great wave of emotion sweeping the nation towards the millennium which the Ministry of Reconstruction, unhampered by accurate knowledge, was preparing for us.'

(Dean Inge—report of Galton Lecture, 1919, in "Outspoken Essays".)

In the case histories of the problem families, (page 62) in the story of the wastage of potential citizens by early death or lack of health, and in the toll of motherhood, adequate grounds are given for an appeal to reason, to fear or to emotion for action to be taken now.

In any sound scheme of social reconstruction, some method must be thought out (1) to enable those who desire children to have them at a "safe age". either (*a*) by some form of family endowment to allow of early marriage and/or (*b*) by making it possible for women who so wish, to continue part-time paid work after marriage and so re-arranging domestic work that it will be a "job" done by those who want to do it. This would give the women a sense of self-reliance and a real sense of citizenship, (2) to reduce the flotsam in future generations. This is the most difficult problem. It cannot be solved by doles or patchwork legislation but, after a sympathetic study of the causes of the evil, these causes could, in a large proportion of the victims of bad biological breeding, be removed by education. They are, in large part, not "bad" people, but just feckless and so require guidance and constant supervision. In time, the defects could be "bred out". The black spot cannot be "bred out" of a terrier's litter by *merely* giving the mother a good kennel. Meantime, one must try not so much to fit the people to their environment as to adapt the environment to fit the people.

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