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## THE NEWBORN: SOME PROBLEMS OF SURVIVAL \*

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THE importance attached to the survival of the newborn infant has varied immeasurably through the centuries, and also between different communities in the same era. Even at the present time it depends to a large extent on sex, race, rank in family, legitimacy, and other factors which render the future of the newborn the sport of chance. Of all members of the community the newborn is least able to control his own destiny. Unlike the aged and outworn, who may be a greater burden on the State, he has no vocal contemporaries who can plead his case and no record of previous service to justify his continued consideration. When he has survived, it has been in virtue of future promise, and as an investment or nest-egg which is expected to pay future dividends.

It would probably be true to say that the newborn has never received more consideration than he does in most civilised countries to-day. But it is worth considering briefly how and why this has come about, how far it is justified, and of how recent growth this cult of baby-worship may be. Has it reached its zenith already, or can we look forward to more and better babies, and, if so, by what means can this object be achieved? These are questions which I cannot attempt to answer, but I should like to present a little of the raw material from which the answers may ultimately emerge. In the first instance, it should be remembered that whilst the neonatal mortality (deaths under one month) has been substantially reduced in this country during the present century, the reduction of newborn deaths has been less dramatic than the decrease of post-natal mortality (deaths from 1 to 12 months). This in itself provides a reason for concentrating attention on the newborn.

*Reproduction and Wastage.*—The process of reproduction provided by nature for every species including man, is one which allows for such a high percentage of wastage that the survival of all possible progeny from every mating is unthinkable. It is true that as the scale is

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ascended, the wastage becomes less. Thus the time taken to reach maturity becomes longer and the period of gestation increased. In man, the reproductive period is further limited by a period of relative sterility in both sexes after secondary sexual characters have appeared—the so-called adolescent sterility (Montague, 1946)—and a period of relative infertility before the menopause in the female or absolute sterility in the male is reached. The reproductive cycle is itself so restricted that conception is only likely to occur during a comparatively small number of days each month. But even with these limitations,

NEONATAL, POSTNATAL, AND INFANT MORTALITY RATES PER  
1000 LIVE BIRTHS.  
QUINQUENNIAL AVERAGES : EDINBURGH

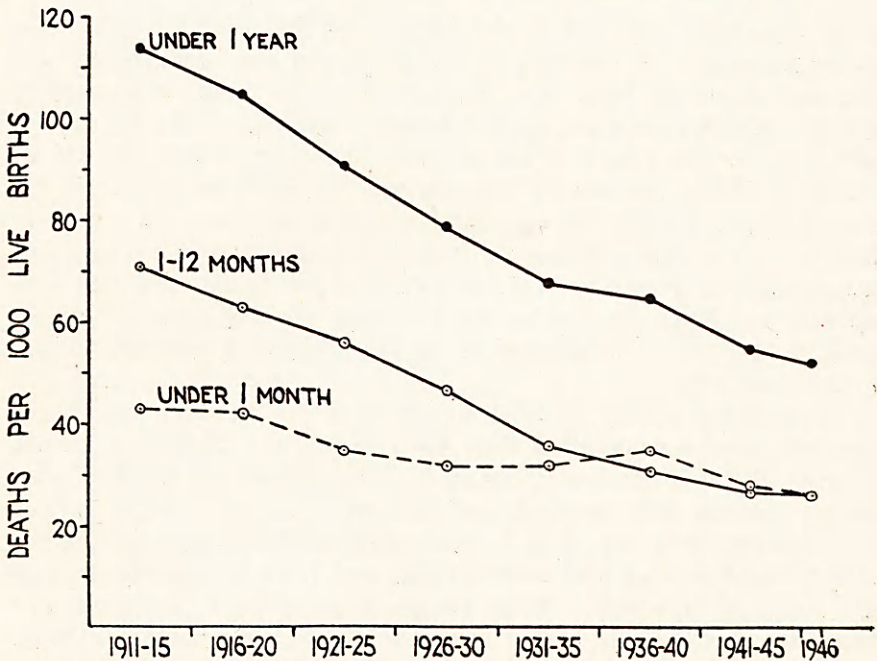


FIG. 1.—Edinburgh. Reduction of the total infant mortality rate is shown to be due principally to reduction in death-rate from one to twelve months. Ratio of neonatal to post-natal deaths for quinquennium 1911-14 was 43:71. In 1946, the ratio was 26:26.

many human couples would be capable of engendering between twenty and thirty foetuses during their reproductive life, and indeed the bearing of fifteen to twenty living infants is not by any means phenomenal. Since popular interest is always aroused by extreme fecundity and multiple births, the literature abounds with examples of variable authenticity. Thus the press has recently carried the story of an English mother of seventeen children who became a great grandmother at the age of fifty-three, whilst Ploss *et al.* (1935a), quote the case of a negress who gave birth to sixteen children in five pregnancies, and examples of sextuplet and septuplet births, some at least of which are

probably authentic. It is significant, however, that the mortality of multiple births and births of great multiparity is high.

*Infanticide.*—Until comparatively recent times, the dangers of over-population of the globe were limited by a naturally high neonatal and infant mortality, famine, epidemic disease, and war. Where these were insufficient, man himself took a hand in increasing the neonatal mortality, and infanticide was a common practice amongst primitive people. Ploss *et al.* (1935), give numerous examples, and it is of interest that in the majority of these cases there was a selective destruction of female infants rather than of male. Thus in Hindustan the destruction of female infants survived until comparatively recently; the pre-Islamite inhabitants of Arabia buried female infants in the sand, the natives of Greenland in the snow. The Hak-Ka tribe in South China immersed them in a domestic utensil, and it is estimated that two-thirds of female infants were so destroyed. Rare examples of selective destruction of males are described in matrilineal societies, *e.g.* Fijians and Banks Island natives, whilst in certain Uganda tribes the firstborn was killed if a son, since otherwise it was believed that the father was doomed.

In New Guinea, on the other hand, newborn infants were killed irrespective of sex if they were deformed or had suffered prolonged or difficult delivery, whilst amongst the Australian aborigines infanticide was widely practised with only partial preference given to survival of the male.

Sex discrimination against the female is of particular interest when it is considered in relation to present-day vital statistics. From these it is clearly obvious that the chances of survival are heavily weighted against the male. This would be easily understandable if it applied only to birth injury (since the male infant is on the average slightly larger than the female) or to other traumatic causes of death, but it runs throughout almost every age period and applies to such various conditions as respiratory infections, intestinal obstruction and prematurity. To take two random examples from near home, the incidence of gastroenteritis amongst newborn in the Simpson Memorial Pavilion was, from a recent analysis made over an eight-year period (Thomson, 1948), 308 cases; of these 181 were males and 127 females, the mortality being 60 males and 42 females. The incidence of hæmorrhagic disease of the newborn in the same hospital over a similar period was 27 males and 17 females. One is reluctantly forced to the conclusion that the male is in fact the weaker vessel, and it is poor consolation to learn that in 1945 amongst Scottish ladies aged ninety-five to a hundred, deaths by violence were nine times as frequent as amongst males.

Thus female infanticide was a rough and ready method of redressing the balance of the sexes at an early stage in life.

*Illegitimacy.*—When we come to consider infanticide in Great Britain in the eighteenth and nineteenth centuries, we find that it was no longer based on sex-discrimination but largely depended on whether

the infant was legitimate or born out of wedlock. This insistence on the infant being a member of a family unit can be paralleled amongst primitive tribes, *e.g.* in the Solomon Islands where the infants born out of wedlock were destroyed, but appears to have reached its maximum intensity with the economic pressure of the industrial era. The employment of female labour in factories rendered the illegitimate infant a burden which many women were eager to shuffle off, and the absence of any organised care for the unwanted newborn resulted in most of these infants dying of exposure or by other means. Captain Thomas Coram was led to establish the Foundling Hospital in 1739 from his concern at the number of dead infants he saw thrown out on dung hills. But this beginning proved pitifully inadequate to meet the demand, and when a government grant was obtained for the hospital on condition that all infants brought to its doors must be accepted, the mortality within the hospital itself rose to 66 per cent. (Nichols and Wray, 1935), and both government grant and indiscriminate admission had to be abandoned.

During the nineteenth century, infanticide became almost a recognised profession, and "baby farmers" flourished in a society where there was a steady supply of infants for disposal with no questions asked. Owing to the unreliability of registration of both births and infant deaths, the total number of infants who were destroyed or allowed to die from neglect can never be known, but when the Society for the Preservation of Infant Life was founded in 1870 it was estimated that of all infants handed over to baby farmers, between 60 and 90 per cent. died. As late as 1896, the trial of Mrs Dyer proved that infanticide for profit was still being practised on a considerable scale.

During the present century, legislation and a certain reorientation of social conscience has reduced the systematic destruction of illegitimate infants, but there is still a very considerable bias against their survival as compared with that of legitimate infants. Thus in England and Wales in 1939, the neonatal mortality rate (deaths under four weeks) for all infants was 28.3 per 1000 related live births, whereas that for illegitimate infants was 50.7; the corresponding infant mortality rates (deaths under one year) were 44.4 and 90.0 respectively. In Scotland, McKinlay (1948*a*) has shown that in the triennium 1943-45 the infant mortality rate of illegitimate infants shows an excess over the general rate of the order of 60 per cent., the relative disadvantage of illegitimate infants being most obvious in deaths from syphilis, diphtheria, abdominal tuberculosis, debility, overlying, diarrhoea and prematurity. In stillborn infants, the excess mortality in illegitimates is in the order of 20 per cent., indicating that even before birth the scales are weighted against the illegitimate infant.

This excessive stillbirth rate and the still more excessive neonatal and infant mortality rates are, in the last analysis, an index of society's reaction to the unmarried mother and her child. During pregnancy the mother, and after birth the infant, receive less care and are exposed

to greater risks than those that form part of a normal family unit. The difference is not solely an economic one, though the support of a wage-earner is undoubtedly of very great importance. Even in the case of an unmarried mother who is economically independent, the difficulties in keeping and rearing her child are such that an alternative is usually preferred. Again, in modern states where official efforts have been made to encourage reproduction without marriage or to render divorce so easy that marriage is largely nominal, the experiments cannot be said to have met with any great measure of success. But

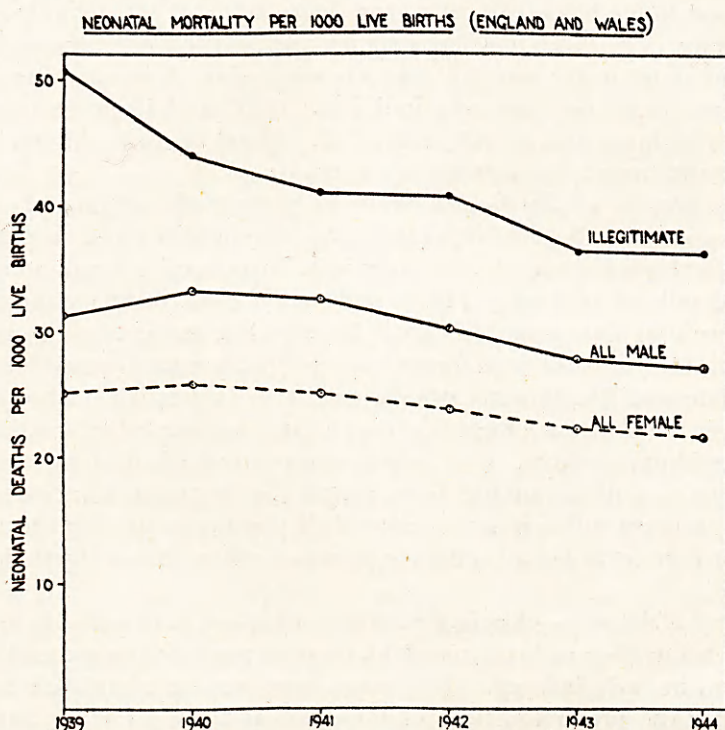


FIG. 2.—Neonatal mortality rates of all male, all female, and illegitimate infants in England and Wales (1939-44). The illegitimate neonatal death-rate is consistently higher than the general neonatal death-rate, and the neonatal death-rate of males higher than that of females.

whilst one must reach the somewhat platitudinous conclusion that marriage is a biologically sound institution, and that the family unit provides the infant with the best prospects of survival, there is clearly much that can still be done to improve the status of the illegitimate child. When it is remembered that in Scotland in 1945, illegitimate births represented 8.57 per cent. of all live-born children (the highest percentage recorded this century), it will be realised that illegitimacy is one of the major problems of the newborn period. Care of these infants can be attempted along one of various ways:—(1) Improved facilities for the unmarried mother to care for her own child, including extended provision of hostel accommodation before and after the birth

of the child, (2) legal adoption, (3) care in foster homes, and (4) care in institutions. Of these four, care of young infants in institutions is probably the least satisfactory, even when such units are small and adequately staffed and equipped. The infant can never receive the same individual attention as in a private home, and "the institution child" is an inevitable product. Unfortunately, some at least of the large voluntary organisations which had previously boarded out infants in foster homes have had to revert to this group system owing to the difficulty of finding suitable foster parents under present circumstances. The good foster home can, of course, have many of the advantages of the family unit, though where infants are boarded out for payment, and the same foster parents take on successive children over many years, the bond between any individual child and its foster parents tends to be loose and readily shaken off. Many of these children pass on to institutions when infancy is passed.

*Certification of Birth.*—In order to prevent the stigma of illegitimacy appearing on the birth certificate (whether the child be adopted or not), a shortened form has recently been introduced in England which omits details of parentage but is sufficient for all ordinary purposes. In order that this protection shall be effective, however, it is highly desirable that the shortened form should be that commonly used for both legitimate and illegitimate infants, and it is interesting to note that although the shortened form is cheaper there is some reluctance to use it for legitimate infants. One practical way in which doctors can help to relieve the disadvantage from which the illegitimate members of the community suffer, is to recommend all parents to use the shortened form of certificate for all ordinary purposes when date of birth only is required.

*Legal Adoption.*—Where circumstances make it impossible for the unmarried mother to keep her child, there is much to recommend legal adoption in early infancy. This must, however, be adequately supervised, for the protection both of the child and the adopting parents. If applications for adoption are carefully scrutinised it will be found that they are sometimes made from such motives as desire to cure a partner of drunkenness or neurosis, and that no real consideration has been given to the welfare of the child. On the other hand, couples may wish to adopt a particular infant with no realisation of its unsuitability. One example of this was recently encountered when no less than five mothers in a ward were so attracted by an illegitimate baby that they more or less seriously said they would like to adopt it. On enquiring the reasons, three said it was "so good," *i.e.* did not cry, two said it was small, and all added that it was "so sweet." The infant was, in fact, a premature mongolian idiot with congenital morbus cordis.

A point that often receives insufficient attention is that the unmarried mother is often faced with the decision as to whether she should keep or give up her infant during the puerperium. Of all times in her life, this is probably the one at which she is least well able to face

making a major decision on her own initiative, and great responsibility lies on whoever urges one course or the other. If the mother has been admitted to a hostel before delivery, she will have had the opportunity of asking advice beforehand, but it cannot be too strongly emphasised that whoever gives it should be a person of real understanding and sympathy, who is ready to go into the individual circumstances in detail, and who does not start with preconceived principles that "all unmarried mothers" should be bullied into doing this or that. Spence (1946) has painted a gloomy picture of a future in which the welfare of children may fall more and more into the hands of spinsters or civil servants who are themselves only children and have little conception of what the family really means. I would urge that every hostel for unmarried mothers should have on the staff at least one carefully chosen woman who has had children of her own, legitimate or otherwise. Indeed, since approximately seven thousand illegitimate children are born in Scotland every year, and fifty-four thousand in England and Wales, it should not be difficult to select from this great number of unmarried mothers a proportion for training as house mothers who would be well fitted for this work, and would approach it with an understanding which is only acquired laboriously, if at all, by the more orthodox social worker.

*Maternal Illness.*—Maternal illness requiring separation from the infant is another problem of the newborn period which in this country is still very inadequately met. The outstanding example is open pulmonary tuberculosis in the mother. Here the newborn infant runs a grave risk of infection if it is in contact with the mother, and the risk is little reduced by weaning the infant if the mother is bottle-feeding it herself. Ideally, the infant should be completely separated from birth until the mother has become sputum-negative. In many European countries, B.C.G. inoculation has been used with the purpose of increasing the infant's immunity during the period of separation. Unfortunately, there is no conclusive evidence as to the effectiveness of antibody formation by this means during early infancy. It is known that the newborn does not readily develop antibodies, and B.C.G. inoculation is usually delayed until the second month of life. The vaccine is given in relatively larger doses than to older children to produce positive tuberculin reactions (which cannot be regarded as any exact measure of immunity). Since the results must be assessed in clinical trials, it is only possible to say at present that the weight of evidence is becoming more favourable to the use of B.C.G. in general, and that medical opinion in Great Britain has probably been unduly influenced against its use by the statistical criticism of the earlier claims presented.

*Stillbirth and Neonatal Mortality by Social Class.*—It has been increasingly recognised that the stillbirth, neonatal, and post-natal mortality rates are lowest amongst the more well-to-do classes, and tend to increase with "poverty." Classification of infant and foetal

deaths in the Registrar General's report is now made by occupation of father, Class I including the professional and economically independent groups, Class III, skilled artisans, and Class V unskilled labourers; Class II represents those intermediate between Class I and III, and Class IV semi-skilled labourers. A number of excellent statistical studies have appeared, in some of which attempts have been made to assess the relative importance as causes of infant death of different factors with which poverty is likely to be associated. Thus Woolf (1947) in a study of stillbirths and infant deaths in county boroughs of England and Wales for the years 1928-38, calculated multiple regression equations showing relation between mortality rates and seven indices of social conditions, viz., percentage of families living more than one person per room, average monthly percentage of insured males unemployed, percentage of occupied males in Registrar General's Classes IV and V, percentage of females aged fourteen and over employed in manufacture, degrees of latitude north of  $50^{\circ} 30'$ , gross reproduction rate, and a weighted index of persons per acre. He concluded that poverty (probably mainly malnutrition) and crowding are of approximately equal importance in infant mortality, but that whereas crowding is relatively unimportant in stillbirth, poverty has a very big effect. He also concluded that the fall in stillbirth and infant mortality rates from the 1938 level during the war period is of the order of magnitude to be expected from the levelling up of nutritional standards amongst the worst-off sections of the community. Sutherland (1946) found that the stillbirth rate began to decrease gradually from 1935, but that the decline was rapid during the war years, particularly in those areas where it was previously highest. This has been tentatively attributed to improved nutrition, since other factors tending to produce stillbirth remained operative (Evans and Russell, 1947). Baird (1947) also considered that the fall in stillbirth rate during the war years was probably due largely to improved nutrition during pregnancy.

In this connection, the recent findings of McKinlay (1948*b*) are of great interest. In Scotland, although there has been an overall reduction in stillbirth rates in all classes, the difference in incidence between the social classes is actually greater in 1945 than it was in 1939. The class difference in neonatal and post-natal infant mortality which were shown in 1939 are maintained in 1945. This is clearly not the finding that would have been expected if a levelling-up of nutritional standards during the war had been the sole factor in reducing the overall stillbirth and neonatal mortality rates.

The interest of McKinlay's observation appears to centre on the improvement in the stillbirth rate which has taken place during the war years in Classes I, II and III, rather than on the very slight improvement in Classes IV and V which was less than might have been expected with improved diet. It is possible that it is related to better education, antenatal supervision, and obstetrics, though it is



very doubtful if the conditions of pregnancy and delivery were significantly better even for the higher income groups in 1945 than they were in 1939. Analysis by parity and maternal age in groups I, II and III may provide the explanation.

There is undoubtedly, as Baird pointed out, still a considerable difference in the diet and physique of Classes I and II as compared with those of Classes III, IV, and V, but this alone would not explain the present findings unless the difference were relatively greater, and the nutrition of the upper income groups better, in 1945 than in 1939. It is possible that the improvement in the stillbirth rates in the lower income groups is less than might be expected from improvement in

THE MORTALITIES OF INFANCY BY SOCIAL CLASSES IN SCOTLAND, 1939 AND 1945

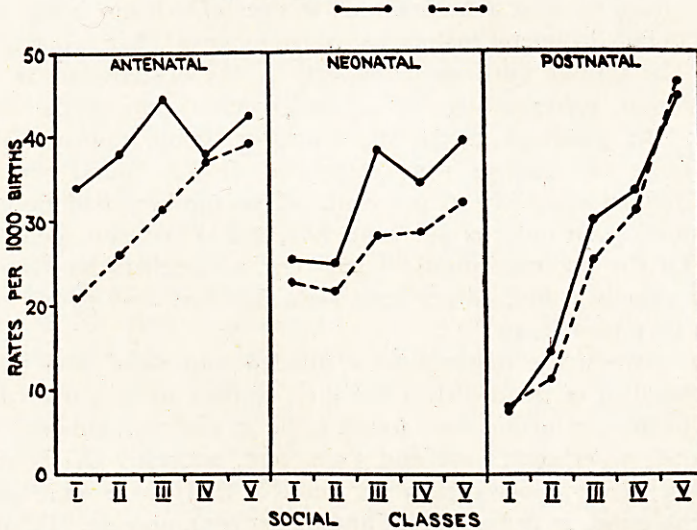


FIG. 3.—Scotland. Antenatal, neonatal, and post-natal mortality rates in 1939 (unbroken line) and 1945 (broken line) by social class, showing the difference in stillbirth rate between social classes to be greater in 1945 than in 1939. (After McKinlay.)

diet, owing to an increased incidence of overcrowding and post-war difficulties affecting Classes IV and V to a disproportionate extent. Certainly these factors are likely to have helped in maintaining the differences in neonatal and post-natal mortality rates existing between social classes.

*Effect of Maternal Diet on the Infant's Status at Birth.*—A number of large-scale clinical experiments have been undertaken, with a view to determining the effects of dietetic supplements during pregnancy on the prospects of the infant's survival and condition at birth. Of these, the investigations undertaken by the People's League of Health (1942, 1946) in London, that of Balfour (1944), in 18 depressed areas in England and Wales, and that of Ebbs *et al.* (1941) in Toronto have been widely quoted. The first claimed that the incidence of prematurity and toxæmia of pregnancy were significantly reduced in cases

receiving supplements containing minerals and Vitamins A and D, B complex, and C. The effect on foetal death, however, were not striking, and when the stillbirths and deaths under eight days are added together the figures for the controls and treated groups are almost identical.

Balfour (1944) claimed a significant reduction in the incidence of stillbirth and neonatal mortality in the infants of mothers receiving a supplement of Vitamin B complex, but in neither of these two experiments were the constituents of the basic diet at all accurately assessed.

Although based on a much smaller number of cases (a total of 216 mothers), a study made by Burke *et al.* (1946) in Boston is considerably more informative with regard to the relation of maternal diet to the status of the infant at birth. These workers approached the problem of prenatal nutrition from a somewhat different angle, the diets of mothers from the first antenatal visit to time of delivery being assessed from a detailed dietetic history as excellent, good, fair, poor and very poor. The infants born were assessed by the obstetrician at time of delivery and subsequently by a pædiatrician during the neonatal period; the gradings given were superior, good, fair and poorest. When these two ratings were correlated, it was found that of the infants judged superior, 56 per cent. of the mothers had been on an excellent or good diet, 35 per cent. fair, and 9 per cent. poor to very poor. Of the poorest infants, 3 per cent. of mothers had been on a good or excellent diet, 18 per cent. on a fair diet, and 79 per cent. on poor to very poor diets.

Again, when the mothers were divided into those who had been on an excellent or good diet, a fair diet, or poor to very poor diet, the infants in the first group were found to be 42 per cent. superior, 52 per cent. good, 3 per cent. poor and 3 per cent. poorest. Of the mothers on a poor to very poor diet, 3 per cent. of the infants were superior, 5 per cent. good, 25 per cent. fair, and 67 per cent. poorest. In addition, all the infants who were stillborn, all who were premature, and all except one dying within a few days of birth, were born to mothers whose diet during pregnancy were very inadequate.

The effects of extreme deprivation during pregnancy have been studied in Holland by Smith (1947), where a sharply limited period of severe malnutrition occurred from September 1944 to May 1945. Diets of pregnant women were particularly deficient in calories, protein, calcium, Vitamin A, niacin and riboflavin. Smith found evidence that during the last half or trimester of pregnancy this had interfered with the prenatal growth of infants as shown by foetal weight and length. Menstruation ceased in approximately 50 per cent. of urban women and became irregular in 50 per cent. of the others. Data as to abortion and miscarriage were not statistically reliable. There was a slight but significant increase in premature birth, but figures relating to neonatal mortality (which were dubiously valid) did not demonstrate an increase, and those in relation to congenital abnormalities were inconclusive, (being invalidated by amenorrhœa and low conception

rate). Lactation as judged by ability to feed an infant, was not significantly influenced.

There is as yet no conclusive evidence that dietetic deficiency in early pregnancy is liable to produce congenital deformities in human infants, though there is considerable experimental evidence (Warkany, 1947), that deformities of the eyes, ears, and palate may be determined by controlled vitamin deficiencies in pregnant sows and rats.

*Causes of Stillbirth and Neonatal Death.*—Before considering these in detail, it should be emphasised that many of the statistical studies published have been based on the Registrar General's Reports. These in turn are entirely dependent on correct certification of the cause of death. In no group of cases is unaided clinical assessment of cause of death likely to be more at fault than in dealing with the newborn, and both intracranial hæmorrhage and infection are particularly liable to be overlooked. In fact, Spence and Miller (1939), in a study of infantile deaths in Newcastle reached the conclusion that in a third of the total cases certification of death had been inaccurate. The fact that approximately 10 per cent. of neonatal deaths in the Registrar General's reports are described as "congenital debility" (as distinct from prematurity) is itself an indication that in a substantial proportion of deaths the cause remains virtually undiagnosed. It may be urged that analysis of post-mortems on infants dying in maternity hospitals are not representative, since hospital practice will tend to be over-weighted with abnormal deliveries. But until post-mortem examination of stillbirths and neonatal deaths occurring in domiciliary practice is much more general than it is at present, hospital records are probably more representative than analyses based on national certification.

Prematurity may be regarded as a contributory cause of death in more than 50 per cent. of infants dying within the newborn period, and its role in stillbirth is almost equally important. Thus in Drillien's (1947) analysis of neonatal deaths occurring in the Simpson Memorial Maternity Pavilion in 1943-5, 142 were premature and 62 full term; similarly in McGregor's (1946) analysis of 618 post-mortems on newborn infants dying in the same hospital, 436 were premature, though prematurity was regarded as the primary cause of death in only 9 per cent. of the total series. In 453 post-mortems on stillborn infants (McGregor 1946), 235 were premature and in 51 (21.7 per cent.) of the premature group no other cause of death was found. (Drillien's figures show a similar though slightly lower ratio of premature to mature or post-mature stillbirths viz., 177; 195). Since the prevention of prematurity is partly an obstetric and partly a social problem, I will only here mention the importance of diet during the antenatal period; the general health, age, and parity of the mother; the early recognition and treatment of maternal infection, e.g. syphilis; the prevention and treatment of toxæmia; and the general principles of antenatal care. There remain, however, a considerable proportion of premature births of which the cause is unknown. Although much

can be done post-natally for the successful rearing of premature infants, it is at best a laborious and often discouraging substitute for prevention. With this qualification, however, it should be said that remarkably good results have been obtained by Dr F. J. W. Miller of Newcastle in the domiciliary treatment of prematures, where a trained nursing service has been organised; except for the smaller prematures, the results in most unpromising surroundings bore comparison with those obtained under optimum hospital conditions.

Apart from the contributory role played by prematurity, the causes of neonatal death in McGregor's series were, in order of importance, infections (30.7 per cent.), intracranial hæmorrhage (27.6 per cent.), asphyxia (13.1 per cent.), and developmental defects (10.5 per cent.). In the stillbirth series, the most important causes were asphyxia (37.2 per cent.), intracranial hæmorrhage (24.1 per cent.), and developmental defects (20.2 per cent.). Here infections accounted for only 3.2 per cent. of all stillbirths. Where neonatal deaths after the third day were analysed separately, it was found that infection accounted for 65.5 per cent.

*Neonatal infection* must therefore be regarded as of outstanding importance, particularly after the first forty-eight hours of the neonatal period. This is understandable, since the newborn infant has only a limited congenital immunity to certain infections, to which the mother is herself immune, and is otherwise poorly able to produce antibodies. Inhalation of liquor amnii or meconium during birth, or subsequently of vomitus in the case of feeble infants, will increase the likelihood of pulmonary infection, whilst prematurity is again a predisposing factor.

It has been pointed out (Ludlam, 1947) that the fœtus is normally sterile until the rupture of the membranes occurs, at which time it comes in contact with the vaginal organisms. Apart from the risk of gonococcal infection of the eyes, against which prophylactic measures are normally taken as routine, the infant may at this time inhale contaminated liquor or become infected with thrush. This latter infection is often troublesome and may result in feeding difficulties during the newborn period, but is seldom fatal unless it extends to the oesophagus or stomach.

Of fatal infections during the newborn period, pneumonia (occurring either alone or in association with other conditions) is the most important. McGregor (1947) recognises four types characteristic of this age, viz. pneumonia occurring in the first week and affecting lungs which are atelectatic or containing inhaled liquor, septic aspiration pneumonia due to inhaled milk or vomitus, staphylococcal pneumonia, becoming suppurative, and bronchopneumonia due to air-borne infection with a variety of organisms including hæmolytic streptococci, pneumococci or *H. influenzae*. The clinical diagnosis of pneumonia in the newborn is particularly baffling. Not only are physical signs frequently indefinite, but there is often little or no temperature response and no characteristic tachypnœa. Cyanosis or pallor, lethargy, refusal

to suck, feeble cry, and loss of weight may be the only presenting symptoms. X-ray is often inconclusive. Pneumonia should be suspected whenever there has been failure to expand the lungs after a difficult delivery, or inhalation of liquor, and when the newborn fails to thrive. Prophylactic use of oral penicillin (10,000 units three hourly) appears justified in such cases, though in the absence of clear physical or radiological signs it is difficult to assess its effectiveness.

Epidemic diarrhoea of the newborn has recently received considerable attention, and outbreaks have been described in Great Britain, Europe, and America. There is experimental evidence that the condition is, or at least may be, due to virus infection. The mortality has varied in different epidemics but has usually been high. Both breast and artificially fed infants are liable to be infected. In one epidemic personally observed in a maternity unit in London, the case incidence was extremely high (breast-fed infants showing no immunity) but the mortality minimal. In this instance, a number of the mothers were also affected with mild diarrhoea, and a few showed temperatures of 99° to 100°. A detailed bacteriological investigation of both mothers and infants revealed no causative organism. Onset of the disease in infants occurred after the third day and was sudden; the passage of an explosive, watery stool was usually the first evidence of infection. In a minority of cases, diarrhoea was preceded by refusal of a feed or lethargy, but these symptoms were seldom noted more than a few hours before onset of diarrhoea, making effective isolation almost impossible. The majority of infants showed mucus in the stools at some time, but no blood. The striking feature of the outbreak was the high infectivity, and spread occurred throughout the unit in spite of all efforts to prevent cross-infection. When the unit was closed and reopened, cases again occurred, due probably to the incidence of diarrhoea amongst mothers in the district served by the hospital. Treatment with sulphaguanidine appeared ineffective.

Although large scale epidemics are fortunately rare, neonatal diarrhoea is a constant danger when large numbers of infants are kept together in newborn nurseries.

Other infections liable to affect the newborn are staphylococcal skin sepsis, umbilical sepsis, and septicæmia. Pyelitis in the newborn is commonly associated with congenital abnormalities of the genito-urinary tract, and may be manifested clinically by anæmia and failure to gain weight. Whilst the majority of cases of skin sepsis remain mild and limited to a few small pustules, the danger of extension, and also spread from infant to infant, is much greater in the newborn than in older patients. Unless the bathing of newborn infants can be carried out with rigid precautions, it is better omitted in a newborn nursery.

*Intracranial Hæmorrhage.*—It has been claimed that minimal degrees of hæmorrhage, giving rise to no clinical symptoms and to no after-effects, are likely to occur in a substantial proportion of newborn infants, particularly prematures. But since these claims are based

largely on the finding of red cells or xanthochromic fluid in otherwise normal infants on whom routine lumbar puncture was done during the newborn period, this interpretation of the findings must be viewed with considerable reserve (Ehrenfest, 1931). There is also considerable difference of opinion as to whether asphyxia *per se* is liable to produce intracranial hæmorrhage (as distinct from small petechiæ), though the two conditions may be associated. Tearing of small or larger vessels sufficient to produce clinical symptoms or death is either the result of abnormal birth trauma or of immaturity of an infant whose tissues are unable to withstand a degree of trauma which would be harmless to an infant at term. In McGregor's series (1946), intracranial hæmorrhage was regarded as the cause of death in 32·3 per cent. of the premature and in 17 per cent. of the mature neonatal deaths. It was present in 24·1 per cent. of the stillbirths. The hæmorrhage may be subdural (from tearing of the vessels draining into the longitudinal sinus), subarachnoid, intraventricular, intracerebral, or occur in a combination of sites. Large tears of the falx (such as are liable to occur when there is great distortion of the foetal head) or of the tentorium or great vein of Galen, are likely to prove rapidly fatal or result in still-birth. Such lesions are notoriously liable to occur in breech deliveries.

Major hæmorrhage is usually shown by lethargy, twitching, failure to suck, irregularity of respiration and possibly by bulging of the anterior fontanelle and separation of the sutures. In some cases the clinical picture will be similar to that of infection, *e.g.* pneumonia. Lumbar puncture is likely to clarify the diagnosis in the case of subtentorial hæmorrhage, though blood-staining of the fluid more frequently occurs in newborns as a direct result of lumbar puncture than in older infants. In subdural hæmorrhage subdural tap through one or both sagittal sutures, laterally to the longitudinal sinus, may be necessary. In some cases of subdural hæmorrhage it is possible to relieve pressure by aspiration or later by operative removal of the clot, but the prognosis is always poor when the hæmorrhage is extensive. The administration of Vitamin K to the mother before delivery and to the infant after birth is indicated as a routine when there is any danger of intracranial hæmorrhage occurring, as in premature or difficult delivery. True hæmorrhagic disease of the newborn in which the prothrombin level of the blood is likely to be abnormally low, and in which hæmorrhages may occur in any site, particularly the gastrointestinal tract, sometimes gives rise to petechial or gross cerebral hæmorrhage; here the hæmorrhages are most likely to occur on the second to fourth day of life.

Apart from major hæmorrhage, however, it is found that many infants suffer some degree of shock during the birth process. In a series of 173 full-term deliveries in the Simpson Memorial Maternity Pavilion (127 spontaneous, 46 forceps), the infants were classified on the basis of cry, colour, reflexes, muscle tone, respiration, etc. into those who showed any abnormality however slight and those who were

regarded as completely normal. It was found that of the forceps deliveries, 22 per cent. of the infants were classified as "abnormal," whilst of those delivered spontaneously 6 per cent. were classified as "abnormal." As would be expected, the analysis also indicated that high forceps delivery was more likely to result in evidence of shock than when low forceps were applied, (Balf 1948).

Although the general standard of midwifery has greatly improved in Great Britain during the present century, and some of the birth-deaths must be regarded as inevitable, there is little doubt that neonatal mortality and birth injury can still further be reduced by a yet higher standard of obstetric care. Indeed, the figures for both America and Great Britain suggest that the mortality from birth injury is actually rising (Evans and Russell, 1947), though here allowance must be made for more accurate certification.

Asphyxia, which is an important cause of stillbirth and neonatal death, is also largely an obstetric problem, but here the prompt use of oxygen after birth and the prevention of infection may save a proportion of infants who would otherwise succumb.

*Congenital abnormalities* represent a cause of infant death, and disability in those that survive, that until recently has offered little cause for optimism. Such abnormalities account for approximately 10 per cent. of stillbirths and 20 per cent. of neonatal deaths, there being a tendency for neonatal deaths from this cause to rise when the stillbirth rate is reduced, *i.e.* a proportion of congenitally deformed infants being liveborn and subsequently dying, who would previously have died during pregnancy.

Recently, however, the recognition by Gregg (1941), Swan (1944), and others that maternal infection, *e.g.*, rubella during pregnancy may cause congenital abnormality if it occurs at the period of organogenesis, opens a new field of approach, whilst the experimental work of Warkany (1947) on the effects of nutritional deprivation during early pregnancy suggests another. Even the modes of the inheritance of those abnormalities which are genetically determined may in some instances be sufficiently understood for it to be possible to give advice on the likelihood of abnormality occurring as the result of a particular mating. Hæmolytic disease of the newborn, in so far as its occurrence depends on the rhesus constitution of the parents, is a case in point, whilst the understanding of its cause has led to a significant lowering of case-mortality.

It has been said that a good egg in a bad environment may develop in much the same manner as a bad egg in a good environment, and though we are not yet sufficiently skilled eggglers to eliminate all the bad eggs we can at least hope to see eventually the great majority of good eggs going into good baskets.

In conclusion, I would like to return to the questions originally asked. Can we expect more babies? The downward trend of the birth-rate in Great Britain has recently shown a significant improve-

ment, but it is too early to say whether this is a purely temporary reaction to war conditions. The position is complicated by the fact that contraception has to a large extent replaced infanticide as a means of limiting the population, and in spite of the good work carried out by numerous clinics is still to a large extent "control without control." Delay of marriage and reproduction until relatively late in the reproductive age period are factors which adversely affect the birth-rate, and which affect different social classes somewhat unevenly. I do not propose to discuss the vexed question of artificial insemination, though the problem of the infertile marriage is a very considerable one, which can only partially be solved by the systematic study of sterility. Better organisation of the system of adoption offers one method by which childless couples can rear healthy children, and help to reduce the high mortality of illegitimate infants.

As to the production of better babies, there seems no question that this can be done. Not only the nutrition of the mother during pregnancy but her physique before she becomes pregnant are of first importance, so that any improvement in social conditions is only likely to bear full fruit in one or more generations.

Whether or not the care of the newborn has reached a maximum, will depend in the last analysis on economic and international factors which we cannot foresee. But I would emphatically urge that there is much more yet that can usefully be done, both in reducing the present wastage of foetal life and in giving those infants that survive the optimum chance of future health. It has recently been estimated that the stillbirth rate in Scotland could be reduced to half its present figure (Baird, 1947); and if we are in any danger of feeling complacent about Edinburgh's neonatal mortality rate of 26, it is salutary to remember that in Chicago the rate was reduced from 25 to 18 in a period of three years. This is surely a challenge which it would be pusillanimous to refuse.

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## DISCUSSION

*Sir Henry Wade* called for a vote of thanks to Professor Ellis for his most interesting paper, and complimented him on the manner in which he had dealt with the problem from all angles and referred briefly to a few points on the social side of the problem that had been discussed.

*Dr Fahmy* said that, while Cæsarean section reduces enormously the risk of fetal damage in the properly chosen cases, yet an infant born by abdominal section could suffer intracranial hæmorrhage and die thereafter.

In regard to pregnancy toxæmia—while there was some evidence to show that dietary factors play a part, yet it was a well recognised fact that toxæmia occurred irrespective of the social class to which the patient might belong.

*Professor McNeil* said that the whole question of the wastage of infant life was receiving increasing attention, and it was interesting to look back over a period of one hundred years and realise how much progress had been made in the last thirty or forty years. It was a curious fact, however, that one hundred years ago the infant mortality rate was less in Scotland than in England—now the reverse was the state of affairs.

*Dr Martin* referred to a ten year survey she had carried through of still-born and neonatal deaths in the Elsie Inglis Hospital and, in the deaths due to congenital abnormality, the major factor was *spina bifida*. A careful scrutiny of the history of the mothers in these cases had provided no clue to their causation.

She had been surprised at the unexpectedly high number of babies who suffered from shock through Cæsarean births.

*Dr Traquair* referred to retinal hæmorrhages in the newborn. These were usually ascribed to a prolonged second stage of labour. He was interested to know if they also occurred in infants delivered by Cæsarian section.

*Professor Ellis*, replying, said he did not maintain that asphyxia could never produce cerebral hæmorrhage, but that Ford had failed to produce anatomical lesions of the brain experimentally in asphyxiated animals; when cerebral hæmorrhage and asphyxia were found in association in the newborn it was often impossible to say which was cause and which effect.