A STUDY OF POSTMATURITY AND PLACENTAL INSUFFICIENCY: IN PARTICULAR THE EFFECT OF THESE CONDITIONS ON PERINATAL MORBIDITY AND MORTALITY AND THE SOCIAL QUOTIENT OF THE CHILD AT THE AGE OF ONE YEAR

A Thesis

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by

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FOETAL MEDICINE - WHO IS TO PRACTISE IT?

Up to now the formidable inaccessibility of the human foetus has meant that foetal medicine (apart perhaps from foetal electrocardiography) has virtually not existed...

With the advent of the techniques of amnioscopy and foetal blood sampling developed by Saling, and of amniocentesis and foetal transfusion due to Bevis and to Liley, we witness the end of the long period of foetal inaccessibility and, we hopefully believe, the start of the science of foetal medicine...

Is a new kind of doctor needed, at least at the academic level, who, by combining the interests and skills of both the obstetrician and the paediatrician, can act as the foetus's doctor?

Editorial (Dobbs, R.H. and Gairdner, D) 1966
Archives of Disease of Childhood, 41:453.

I N D E X

INTRODUCTION

Despite the many references to studies of postmaturity in the literature, certain problems remain unresolved. The basic issue of whether or not postmaturity is even a problem has been debated until quite recently. The general impression is that British obstetricians regard the prolongation of pregnancy beyond 42 weeks with more apprehension than their American colleagues. However, attitudes have changed since the publication of the results of the 1958 British survey, which showed a steeply increasing perinatal mortality rate after 42 weeks gestation, surely indicating a major problem.

Why then has the issue remained clouded for so long? The prime reason is that there have been too few prospective surveys, and these have not included adequate detail of the infant's condition at birth or of his behaviour during the neonatal period and at long term follow up. Varying obstetric and paediatric care, and different terminology and standards adopted by authors, makes comparison between the results of surveys difficult. All of these facts have added to the confusion surrounding the subject.

In his description of the placental dysfunction syndrome, Clifford (1954) showed an increased perinatal mortality and morbidity. Sjostedt (1958) produced similar

results and showed that the clinical syndrome was not confined to postmaturity. With a known increase in perinatal mortality and birth asphyxia, it would be surprising if there were no neurological sequelae, and yet this does not seem to have been investigated. The small for dates baby has been the subject of intensive investigation in recent years but there is little reference in the paediatric literature to studies of postmature babies or those with placental insufficiency.

Dobbing (1967) has produced evidence that towards the end of pregnancy and soon after birth, there is a vulnerable period in which quite minor restrictions of food can affect the rate and ultimate extent of growth of the brain. Babies born with placental insufficiency appear to have suffered intra-uterine malnutrition. Does this affect the subsequent development of the child?

> Wagner and Arndt (1968) state:
> "Although the number of cases is not large, our study has impressed on us greater consideration of postmaturity as a factor in producing a neurologically handicapped child. There is a need for a prospective study on this problem."

This survey was undertaken to determine the neonatal problems associated with postmaturity and placental

insufficiency, to clarify the relationship between these two conditions and to study their effect on the social quotient of the child at the age of one year.

A clinical method of grading the degree of wasting in babies with placental insufficiency is discussed, and this is correlated with the findings during the neonatal period at one year.

The results clearly show that postmaturity is associated with increased birth asphyxia and perinatal morbidity and this is reflected at one year in a high incidence of low social quotients and sleep disorders. Similar results are shown for babies with placental insufficiency, most of whom were born after the expected date of delivery.

The study also shows that the adverse effects on the baby are more severe as the degree of postmaturity and the degree of wasting increase.

These facts are highlighted in the following summary and discussed in detail later in the appropriate sections.

SUMMARY

History and Review of Literature

A review is made of relevant references to perinatal paediatrics from the time of Hippocrates until the end of the nineteenth century.

The difficulty of determining the length of normal pregnancy is discussed and the methods used are reviewed. Historical references are given.

The recognition of postmaturity as a problem and the divergence of opinion on this issue is then considered in some detail.

Problems associated with postmaturity especially those which affect the foetus are outlined and the literature on these aspects is reviewed.

The importance of follow-up studies is illustrated and reference is made to the methods used, with particular emphasis on the Vineland scale used in this survey.

Results

A summary of the significant findings of the survey will be shown as follows:

(1) Postmaturity

Perinatal period

One year examination

(2) Placental insufficiency

(a) Wasted babies

Perinatal period

One year examination

(b) Small for dates babies

Perinatal period

One year examination

(3) Selected groups at one year

(4) Neurological examination V.S.Q.

1st day examination

4th day examination

6 week examination

Postmaturity

During the year following 1st July, 1968 one hundred and sixteen babies were selected from those born to married mothers who were certain of their dates.

A matched normal control was chosen for each baby.

They were examined on the first day, the fourth day, at six weeks and at one year.

Two groups were separated:

POSTMATURITY

	Groups Compared	Statistical Significance
Foetal Distress	A v B	$P < .001$
Meconium Stained Liquor	A v B	$P < .001$
Unhealthy Placenta	A v B	$P < .001$
Caesarean Section Rate	A v B	$P < .001$
Low Apgar at 5^{o}	A v B	$P < .001$
Time to Establish Respirations	A v B	$P < .001$
Intubation	A v B	$P < .001$
C.N.S. Abnormality	A v B	$P < .001$
Wasting	A v B	$< .02$ $P < .05$
Low S.Q. at One Year	Postmature v Controls	$P < .001$
Low S.Q. at One Year	A v B	$P < .001$
Sleep Disorders	Postmature v Controls	$P < .001$
Illness During First Year	Postmature v Controls	$P < .001$

A = 42-43 weeks gestation

B = 43 weeks gestation

(1) Gestation 14 to 20 days past term.

(2) Gestation more than 20 days past term.

The details of the pregnancy, the labour and birth were recorded at the time of the first examination.

The results submitted to statistical analysis show a markedly increased incidence of a number of adverse factors particularly in the more postmature group. Viz:

Foetal distress during labour.

Meconium stained liquor.

Unhealthy placentas.

Caesarean sections.

Birth asphyxia.

Central nervous system abnormality during the perinatal period.

Soft tissue wasting.

Low Social Quotient at one year.

Considered as a group, there was a high incidence of sleep disorders at one year and illness during the first year when compared with controls.

Placental Insufficiency

During the year of the survey, all babies born at the hospital were screened and included if they were more than 38 weeks gestation and showed a wasting score (Section II

PLACENTAL INSUFFICIENCY

	Groups Compared	Statistical Significance
Foetal Distress	1 v 2	$p < .001$
Meconium Stained Liquor	1 v 2	$< .01$ $P < .02$
Caesarean Section Rate	1 v 2	$< .001$ $P < .002$
Low Apgar at 5 Minutes	1 v 2	$P < .001$
Time to Establish Respiration	1 v 2	$P < .001$
Intubation	1 v 2	$P < .001$
CNS Abnormality 1st Day	1 v 2	$P < .001$
Low S.Q. at 1 Year	Wasted v Controls	$P < .001$
Low S.Q. at 1 Year	1 v 2	$P < .001$
Sleep Disorder	Wasted v Controls	$P < .001$
Illness at 1 Year	Wasted v Controls	$P < .001$

Group 1 = Moderate Wasting

Group 2 = Severe Wasting

of more than 2, or if they were small for dates.

(1) Wasted Babies

One hundred and sixty three babies were included for study and they were divided into two groups according to the degree of wasting:

(1) Moderate Wasting

(2) Severe Wasting

The details of the pregnancy, labour and birth were recorded at the time of the first examination.

They were examined on the first and fourth days, at six weeks and at one year.

A matched normal control was chosen for each baby.

The results submitted to statistical analysis show a markedly increased incidence of a number of adverse factors particularly in the more wasted group. Viz:

Foetal distress during labour.

Meconium stained liquor.

Caesarean sections.

Birth asphyxia.

Central nervous system abnormality during the peri-natal period.

Low Social Quotient at one year.

SMALL FOR DATES

	Groups Compared	Statistical Significance
Meconium in Liquor	3 v 4	$P < .001$
Birth Asphyxia	3 v 4	$P < .001$
CNS Abnormality 1st Day	3 v 4	$P < .001$
Low S.Q. at 1 Year	Small for Dates v Controls	$P < .001$
Sleep Disorders	Small for Dates v Controls	$P < .001$
Illness During 1st Year	Small for Dates v Controls	$P < .001$

Group 3 = Non-Wasted Small for Dates
Group 4 = Wasted Small for Dates

OTHER SIGNS

	Groups Compared	Statistical Significance
Low S.Q. at 1 Year	Meconium in Liquor v Clear Liquor	$< .001$ $P < .002$
Low S.Q.	Stained nails & cord v No Staining	$P < .001$
Low S.Q.	Adducted Thumbs v Normal Position	$< .002$ $P < .01$

Considered as a group, there was a higher incidence of sleep disorders at one year and illness during the first year compared with controls.

(2) Small for Dates Babies

Thirty three babies were selected and the details recorded as for the other two groups.

They were also examined on the first and the fourth days, at six weeks and at one year.

A matched normal control was chosen for each baby.

Five babies who had severe congenital abnormalities were studied separately.

The remaining twenty-eight were divided into two groups, wasted and non-wasted.

The results were analysed statistically and showed significant changes according to the degree of wasting as described in the section on wasted babies.

Compared with the control babies, there was a highly significant increase in the number of babies with low social quotients and sleep disorders at one year and with illness during the first year of life.

Other Groups at One Year

Meconium stained liquor, meconium staining of the baby and adduction of the baby's thumbs were all significantly related to a low social quotient at one year.

DECLARATION OF ORIGINALITY

This thesis contains no material which has been accepted for the award of any other degree or diploma in any University and to the best of my knowledge and belief, it contains no material previously published or written by another person, except when due reference is made in the text of the thesis.

I state that this work is entirely original and that I planned the survey and personally interviewed each mother and examined each baby at the times specified in the thesis.

Keith E. Lovell

ORIGINAL CONTRIBUTIONS TO MEDICAL KNOWLEDGE

This survey makes a number of contributions to medical knowledge which, to the best of my belief, are original.

It shows that:

Postmaturity and Placental Insufficiency

Perinatal Period

(1) Adversely affect the foetus.

(2) Adversely affect the baby at birth.

(3) Adversely affect the baby during the neonatal period.

These facts are demonstrated statistically by the highly significant findings relating to foetal distress, perinatal mortality, birth asphyxia, central nervous system abnormality and other morbidity in the perinatal period.

Postmaturity and Placental Insufficiency

also

(1) Adversely affect the social maturity of the infant at one year. To my knowledge this has not been demonstrated before.

and One Year

(2) Adversely affect the health of the infant during the first year. This is evidenced by:

(a) The high incidence of sleep disorders, and

(b) The high incidence of hospital admissions in each of the 3 groups of babies studied.

These facts have not been previously described.

Degree of Wasting and Postmaturity

The survey also clearly shows that the adverse effects in the perinatal period and the low Social Quotients at one year are more likely to occur as the degree of post-maturity or wasting increase. This has not been demonstrated before.

Wasting

The method of assessing wasting described by Griffiths (1966) is shown to have an important clinical application. It is used to determine (in a hospital population) the incidence of soft tissue wasting, its degree and its relationship to the length of gestation. Its association with abnormal neurological signs in the neonatal period, and low Social Quotients at one year reveals that it is an important clinical sign, and if present, the infant must be regarded as at risk. To the best of my knowledge this method of grading has not been previously applied to a prospective study of infants with soft tissue wasting.

This survey confirms the higher incidence of birth asphyxia and neonatal morbidity when the amniotic fluid is meconium stained and also demonstrates its association with lowered Social Quotients at one year. When the baby shows meconium staining of the nails and umbilical cord as well, these findings are even more significant.

Meconium Stained Liquor

The association shown between adducted thumbs, abnormal neurological signs in the neonatal period and a low Social Quotient at one year, is also an original contribution to medical knowledge.

Adducted Thumbs

Also demonstrated by the survey is the value of early neurological examination. A significant correlation is shown between central nervous system abnormality during the first week and a low Social Quotient at one year.

Neurological Examination

This study clearly demonstrates that post-mature, wasted and small for dates babies are at risk. The importance of precise definition and uniformity of classification

Terminology

is apparent, and this aspect is emphasized in the thesis.

ACKNOWLEDGEMENTS

I would like to thank the members of the Board of the Queen Victoria Hospital for permission to carry out this study at the hospital.

I am very grateful to Professor G. M. Maxwell, whose guidance was invaluable during the early stages of the project and at intervals throughout the work. Assistance with statistical methods was freely available from members of his department.

My thanks are also due to Dr. E. M. Symonds who was always willing to help with obstetric problems which presented during the study, and to Dr. E. B. Sims for his constant encouragement of my interest in the newborn baby.

I would like to thank the nursing staff of the hospital for their co-operation throughout the survey particularly Sister Buick in the nursery and Sister Susman in the follow-up clinic.

Finally I wish to express my gratitude to the many mothers who reported regularly with their babies for examination, despite the inconvenience it must have caused.

PART I

TERMINOLOGY

A review of the literature reveals the confusion which surrounds the terminology relating to postmaturity and placental insufficiency.

The importance of postmaturity and the possibility of adverse effects on the baby were apparently not considered until the late nineteenth and early twentieth century.

Since then the subject has received attention from obstetricians, pathologists and paediatricians, each looking at different aspects of the problem and often introducing new terms into the literature. Lack of precise definition has led to these terms being used in a different sense by subsequent authors.

Some of the more commonly used terms will now be discussed and an attempt made to arrive at the most appropriate designations.

POSTMATURITY

The expected date of confinement is usually calculated from Naegele's rule, viz. two hundred and eighty days from the date of the first day of the last menstrual period. When pregnancy is prolonged fourteen or more days beyond

this date, the term "postmaturity" is frequently applied. However it has been correctly pointed out by Mitchell and Farr (1965) that:

> "Although 'prolonged gestation' is commonly used interchangeably with 'postmaturity', it will be apparent that the terms are not quite synonymous, since the former relates to time spent in utero and the latter to the state of preparedness for birth."

As obstetricians are concerned with maternal and foetal welfare when pregnancy is prolonged beyond the expected date, they will favour the term "prolonged pregnancy", at least until a method of determining maturity in utero is available.

The latter will present difficulties of some magnitude, because of the problem of defining maturity in a rapidly growing foetus with organs maturing at different rates. One must agree with the contention of Mitchell and Farr (1965) that the criteria likely to prove of the greatest value are those which correspond most closely with survival and outcome. Examination of the statistics of the 1958 British Perinatal Mortality Survey shows the optimum time for birth to be between 39 and 41 weeks gestation. It would seem reasonable therefore, to assume

that most foetuses reach "maturity" during this period.

Clifford, whose work has so influenced thinking on the subject, stated in 1957:

> "The confusion surrounding the subject of abnormal prolongation of pregnancy, and its effect on the infant, has resulted from considering postmaturity itself as the etiologic factor in certain cases of fetal and neonatal disease and death ... prematurity, maturity and postmaturity are convenient chronologic designations for different stages of growth and development just as are the seven ages of man. Each period has problems common to all, as well as complications peculiar unto itself."

If the term postmaturity is to be used as such a chronological designation for a gestation period greater than 42 weeks, obviously it must not be used to describe the physical signs which often accompany prolonged gestation, viz. skin dryness, subcutaneous wasting, etc.

Sjostedt recognized this in 1958 and thought the term postmaturity should be avoided, because of the confusing use of the word in the literature.

That this confusion still exists in apparent from the following extracts from recent articles:

"It must be emphasized that the features of post-maturity have been seen in infants delivered prior to term." (Greene, 1969).

"In modern parlance the terms placental insufficiency, postmaturity syndrome and intrauterine growth retardation are synonymous..." (Beisher, et al. 1969).

There are arguments against using gestational age for the purposes of classification, but as there is international recognition for defining prematurity on this basis, a similar standard for prolonged pregnancy seems correct. Provided the term is used only as a convenient chronological designation, as suggested by Clifford, I can see no objection to the use of "postmaturity" instead of "prolonged pregnancy".

This conclusion is also reached by Butler and Bonham (1963):

"It appears to us that the use of the term post-maturity for the infant born at 42 weeks (294 days) or greater after a prolonged pregnancy is a justifiable and useful one."

Post-Term - this term was recommended in the second report of the British perinatal mortality survey (Butler

and Bonham, 1969).

PLACENTAL INSUFFICIENCY (or Placental Dysfunction)

(1) Wasted Babies

To an obstetrician this usually means a slowing of the normal intrauterine growth rate, (Morris, 1968) whereas a paediatrician tends to think of Clifford's classification of dry wasted babies (1954).

As both of these states are probably due to some abnormality of the placental function, the term is acceptable, but only when it is used in a broad sense, as it is in this thesis in which both aspects are discussed.

It would be preferable if obstetricians used "intrauterine growth retardation" to describe the slow growth, as this title does not presume a placental pathology and it adequately summarizes the clinical situation. However the term should not be used by paediatricians, because a more accurate designation should be possible after the baby has been examined.

Clifford's original division into 3 groups of dry wasted babies with or without meconium staining was confined to primagravidae with prolonged pregnancy (300 days). For this reason a new term, dysmaturity was introduced by Sjostedt et al. (1958):

> "If the child shows the clinical syndrome which Clifford designates as the 'placental dysfunction syndrome', known in German as 'uberreif', we use the expression dysmaturity without regard to the duration of pregnancy."

This word has found favour with some authors (Wagner (1963), Lanman (1968), Donald (1969) and Browne (1969)), but not with others. Neligan (1967) commented that it was unfortunate that Sjostedt's term 'dysmaturity' has become widely applied to the state of simply being light for dates.

This confusion was also clearly recognized by Scott and Usher (1966) who introduced another term "fetal malnutrition".

> "Existing terminology for intra uterine malnutrition has sometimes assumed a specific etiology (placental dysfunction or insufficiency, or postmaturity) or has restricted its scope to the underweight infant for gestional age (dysmaturity, pseudoprematurity, intrauterine growth retardation or the small for term infant). In the present state of knowledge of this condition, a descriptive term which encompassed both the underweight and wasting aspects of the clinical syndrome would seem to be preferable."

Although it would seem simpler to include these two conditions under one heading, it seems unlikely they have a common aetiology and therefore the introduction of a new term is not warranted.

Strand (1966) recommended the term "prolonged fetal distress" equivalent to Gruenwald's "subacute fetal distress" (see page 60). He stated:

> "Placental insufficiency is an inappropriate and inadequate term, because failure of placental function does not necessarily mean that all the functions are inadequate."

The term currently applied by most people to babies with a birth weight low for gestational age is "small for dates" (see below). Finding a suitable term for babies with the clinical condition described by Clifford (1954) is more difficult. He chose placental insufficiency (dysfunction) but this is not suitable except when used in a broad sense. His contribution to the subject has been so valuable however, that the adoption of "Clifford's syndrome" (Georgiades et al. 1963) seems a reasonable solution, at least until the position has been clarified. Sjostedt has shown that the syndrome is not confined to a particular gestational age, so terms which include the word

"maturity" are best avoided, viz. the postmaturity syndrome, pseudoprematurity and perhaps even Sjostedt's own choice "dysmaturity."

This thesis will show that clinical wasting is easily recognized and graded, and that it is an important sign associated with increased abnormality of the nervous system in the neonatal period. Wasting is the main feature of "Clifford's syndrome" (usually with desquamation), so for the purpose of this survey babies with this feature will be called "wasted babies".

(2) Small for Dates Babies

Babies with a birth weight low for gestational age are also referred to in different terms:

Pseudoprematurity (Soderling, 1953).
Chronic fetal distress (Gruenwald, 1963).
Fetal malnutrition (Scott and Usher, 1966).
Intra uterine growth retardation or dwarfism (Babson and Benson, 1966).
Light for dates (Neligan, 1967).
Small for gestational age (Battaglia, 1970).

The most suitable term, and the one which has gained the widest acceptance, is "small-for-dates" (Butler and

Bonham, 1963, Andrews, 1970).

Morris (1968) stated:

"The adoption of the term 'small for dates' foetus would unify the terminology used by the obstetrician, paediatrician and pathologist. It would make no assumptions concerning aetiology nor would it imply that the baby shows any characteristic feature apart from its small weight for its maturity."

SUMMARY

The terms used in this thesis will be:

(1) Postmaturity (or post-term) for babies of at least 294 days gestation.

(2) Placental Insufficiency used as a broad term to describe:
   (a) Wasted babies.
   (b) Small for dates babies.

PART II - RESEARCH PLAN AND METHODS USED

RESEARCH PLAN

Two groups of babies were chosen for study:

(1) Postmature - over 42 weeks gestation.

(2) Placental insufficiency.

  (a) Babies showing signs of wasting.

  (b) Babies who were small for dates and over 38 weeks gestation.

A control baby was chosen for each survey baby, matching in maternal age, parity, nationality and method of delivery. Information about the pregnancy and labour was recorded in each case (Appendix I).

Babies were examined:

(1) On the first day (Appendix II).
  General examination for congenital abnormalities.
  Neurological examination.
  Assessment of wasting and desquamation.
  Measurements.

(2) On the fourth day (Appendix III).
  General examination.
  Neurological examination.

(3) At six weeks (Appendix IV).

History of developmental milestones, feeding, sleeping.

General examination.

Neurological examination.

Measurements.

(4) At one year (Appendix V).

Developmental history, sleeping habits, illness.

General examination.

Neurological examination.

Measurements.

Social Quotient.

The results have been submitted to statistical analysis in order to study the correlation between postmaturity, placental insufficiency, neonatal morbidity and the general health, development and social maturity of the child at one year.

NOTES ON SPECIAL METHODS USED IN THE SURVEY

(1) Resuscitation

All babies born at the Queen Victoria Hospital are resuscitated by resident doctors trained to perform endotrachael intubation when required.

(a) Aspiration

Most babies need only simple aspiration of oral and pharyngeal mucus and this is done under direct vision when possible, particularly if there has been meconium in the liquor.

(b) Bag and Mask

Moderately asphyxiated babies receive oxygen under intermittent positive pressure from a closely fitting face mask connected to a rubber bag with a safety bottle allowing a pressure of only 20 cm. of water.

(c) Intubation

Severely asphyxiated babies are resuscitated by endotracheal intubation and intermittent positive pressure from a manually compressed bag connected to a safety bottle containing 20 cm. of water.

(d) Supportive Therapy

If spontaneous respirations are not soon established, blood is taken for acid base measurements. Acidosis is corrected by the intravenous infusion of sodium bicarbonate (8.4%) in dextrose (10%) through a catheter in the umbilical vein.
Amount of dextrose = 65 mls. per Kg. per day.
Amount of bicarbonate is calculated from the

formula m.Eq. of Sod. bicarbonate = Weight in Kg. x 0.3 x Base Deficit.

(2) Wasting and Desquamation

All babies in the survey were examined for signs of subcutaneous wasting and desquamation. The method used was that described by Griffiths (1966).

(a) Wasting

Three sites were examined:

(i) Abdominal wall

(ii) Upper thighs

(iii) Legs

The degree of wasting at each site was estimated as:

Absent	0
Mild	1
Moderate	2
Severe	3

Half points were scored in doubtful cases.

The total score was calculated for each baby by summing the scores:

Minimum	0
Maximum	9

Abdominal Wall

Lower Leg

All Showing Moderate Wasting

Wrist and Hand

The babies were separated into 3 groups according to the score:

0-2 No or mild wasting

3-5 Moderate wasting

6-9 Severe wasting

With very little practice, it was simple and quick to score each baby.

Validity of Assessment

Griffiths compared the clinical assessment of wasting on the first day with that based on caliper measurements and found no statistical difference between the two methods.

14.7% Were wasted clinically

15.4% Were wasted by measurement

Farr et al. (1966) evaluated the external characteristics used in the assessment of gestational age in the newborn infant, one of them being skin texture. This was tested by picking up a fold of abdominal skin between the finger and thumb, and by inspection. A score was allocated by four independent observers and a check showed that there were no babies in whom the observers' scores differed by more than one point.

These two studies show that it is possible to assess and reliably score the degree of wasting in babies using a simple clinical method.

(b) Desquamation

Griffiths (1966) also described a method of scoring desquamation, using 4 sites. For this survey only 3 sites were used.

Abdominal wall

Feet and ankles

Hands and wrists

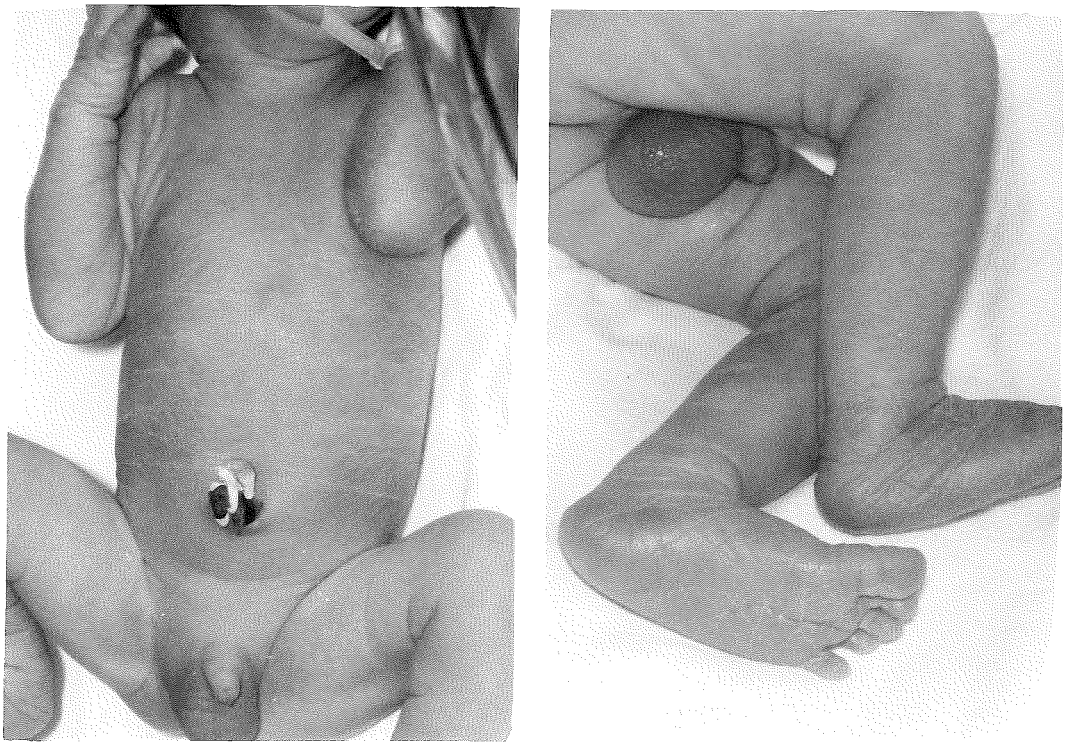
The scoring at each site was as follows:

No desquamation	0
Mild-fine branny desquamation	1
Moderate-between mild and severe	2
Severe-large flakes of desquamation (Collodion skin)	3

The total score was calculated by summing the scores at each site:

Minimum	0
Maximum	9

The total scores were divided into three groups:



Above: Minimal fine desquamation Score 1

Below: Severe Peeling Score 3

0-2 No or mild desquamation

3-6 Moderate

7-9 Severe

(3) Examination of the Central Nervous System

Included in the first day examination was an assessment of the infant's neurological status.

Minor Abnormality

Babies were classed in this group if they exhibited any one of the following signs:

(a) Irritability

(b) Tremors

(c) Increased or decreased muscle tone

(d) Some abnormality of the Moro, grasp or sucking reflexes.

Major Abnormality

Babies were classed in this group if one of the following signs was present:

(a) Severely depressed Moro grasp or sucking reflexes

(b) Convulsions

OR if all the signs listed under minor abnormality were present.

A similar assessment was made on the fourth day. Craven (1964) has shown that persistence of cerebral irritability on the fourth day is related to a diminished Social Quotient at 2 years.

(4) Adducted Thumbs

At the first examination, the position of the babies thumbs in relation to the palms was recorded as follows:

T1 - The thumbs were adducted tightly across the palms
T2 - A position intermediate between T1 and T3
T3 - The thumbs were abducted with the hand held partly open with the baby at rest.

In a number of babies, the thumbs were in the adducted position at rest but opened when the Moro reflex was elicited. These babies were included in group T2, which is the position adopted by most babies.

(5) Meconium Staining

A baby was classed as "meconium stained" if the umbilical cord, finger and toenails were discoloured yellowish-green. Staining of the skin was not essential for inclusion but was present in a number of babies.

Blood Glucose

The majority of babies were screened for hypoglycaemia using Ames Dextrostix strips. If the reading was below 45 mg. %, a true blood glucose estimation was done on capillary blood (usually from a warmed heel).

(6) The Placenta

After all deliveries the placenta was inspected by the senior labour ward sister and the following categories applied:

(a) Healthy
(b) Calcified
(c) Infarcted
(d) Combination of (b) and (c)

The whole umbilical cord, foetal membranes and all blood clots were then removed and the placenta weighed.

No microscopic examinations were made.

(7) Sleep

At the one year examination, each mother was questioned about her baby's sleeping habits.

The baby was classified as having a severe sleep disorder if the parents were forced to attend to him at least once each night for the whole of the first year, or several times each night for a lesser period (minimum of nine months).

(8) Illness

In South Australia the great majority of babies with a severe illness are admitted to the Adelaide Children's Hospital.

Survey babies were classed as having suffered a severe illness only if they had been admitted to this hospital during the first year. Illnesses treated by the family doctor were not counted.

(9) Social Maturity

At the time of the one year examination a Vineland Maturity Scale form was completed for each baby and the social age determined. The Social Quotient was obtained by dividing the social age by corresponding life age and multiplying by 100. The life age was calculated as a fraction in all cases to allow for the slight difference in age at the time of the one year examination (i.e. 50 weeks = .96, 54 weeks = 1.04 years).

An attempt was made to eliminate bias by questioning mothers before referring to the baby's neonatal history.

The mean Social Quotient of the control babies at one year was found to be 104, with a standard deviation of 5.5.

All babies with a Social Quotient lower than 93 (i.e. 2 standard deviations below the mean) were considered abnormal.

PART III - HISTORY AND REVIEW OF LITERATURE

Perinatal Paediatrics from the Time of Hippocrates Until 1900

Hippocrates (460 - 370 B.C.)

Nourishment of the Foetus

The child in utero sucks in both nourishment and air from the womb, the mother's respiration brings to it air which the child takes into its heart, whence heat and motion are carried to the various parts of the body. "If anyone asks how one knows that the child draws and sucks in utero one may reply that when a child comes into the world he is found to have faeces in the intestine, and man and beasts directly they are born pass this through the bowel; moreover if the child had not sucked in utero he would not know how to suck the teats as he does directly he is born." (Still, 1965).

He is also reported to have linked the onset of labour to the lack of nourishment to the foetus. Among his aphorisms were the following references to nourishment:

"Old men bear fasting more easily, next to them men in the prime of life, less well young lads, but least of all children."

"The growing have most innate heat, therefore require most nourishment."

Cerebral Palsy

He also made the first known reference to cerebral disorders following birth:

"... it is the occurrence of phlegm obstructing the air in the veins which causes an epileptic attack. The brain should become clear of this phlegm before birth, but this clearing process may occur before birth."

He then discusses the association of convulsions with cerebral palsies.

Aristotle (Born 384 B.C.)

Resuscitation

"Frequently the child appears to be born dead when it is feeble and when, before the tying of the cord, a flux of blood occurs into the cord and adjacent parts. Some nurses who have already acquired skill squeeze (the blood) back out of the cord (into the child's body) and at once the baby, who had previously been as if drained of

blood, comes to life again."

Meconium

"Directly they come forth they cry out and bring their hands to their mouth. There is evacuation of exrement sometimes at once, sometimes soon, but always within the day." Women call it meconium.

Cord Treatment

"The division of the cord is the province of the nurse and requires intelligence that does not blunder...she must be quick witted in emergencies...in the matter of the tying of the cord...if the knot comes undone the infant dies of haemorrhage."

Congenital Abnormalities

"In man the male is more often born with deformity than the female."

Milestones of Development

"Babies after birth for the first 40 days do not laugh or cry when awake, but at night they sometimes do both."

Soranus (AD 98 - 117)

In his book "Gynecology", translated by Dr. N. J. Eastman, there are references to the care of the newborn.

"Now the midwife, having received the newborn,

Examination should first put it upon earth, having examined beforehand whether the infant is male or female..."

Maternal Health During Pregnancy

"She should also consider whether it is worth rearing or not, and the infant which is suited by nature for rearing will be distinguished by the fact that its mother has spent the period of pregnancy in good health for conditions, which require medical care especially those of the body, also harm the foetus, and enfeeble the foundations of its life. Second by the

Maturity

fact that it has been born at the end of nine months.

Condition at Birth

Furthermore by the fact that when put to earth it immediately cries with proper vigour; for one that lives for some length of time without crying, or cries but weakly is suspected of being so on account of some unfavourable condition. Also by the fact that it is perfect in all its parts."

Galen (130 - 200 AD)

Breast

"Hence children fed on the mother's milk are not only having the customary food but also the most proper, and nature seems not only to

Feeding

have prepared such nourishment for infants, but at the same time endowed them from the beginning with an inborn faculty enabling them to use it. For if you place the teat

Sucking

in the mouth of a child just born it sucks and swallows most readily."

Avicenna (AD 980)

This Arabian physician was frequently quoted by early English medical writers.

Ante Natal Care

"Let care be taken of the infant in his mother's womb, that no harm happen to his body...let the mother's blood be kept in good order and let the excess of it, out of which the infant is formed, be kept pure."

Little was written about paediatrics from the time of the Arabian physicians until the 15th century.

Bagellardo (Died 1492)

This Italian physician wrote "On the Regimen of Infants in the First Month" and made the following references to the immediate post-natal care of the baby.

"When the infant at God's bidding comes forth from the womb, then shall the midwife without haste or roughness, having in her hand a linen cloth...wrap the child therein... and take heed withal whether the child be

Examination

alive or not, whether it show any blemish, which is to say, whether it be black or white or ruddy in colour, whether it taketh breath or not.

Resuscitation Mouth to Mouth

If she find it to be warm and not black, she shall blow into its mouth, if it be that he has no breathing.

Warmth

Then when the tying of the navel has been done the midwife shall place the infant in a warm bath...not scalding, nor cold, nor salt..."

Caesarean Section

In the sixteenth century, Mercurio (1540) wrote a textbook for Italian midwives in which he recommended Caesarean section for contracted pelvis.

In Britain, interest in perinatal paediatrics did not grow until the sixteenth century when Phaer wrote the first English book of

Paediatrics in Britain

paediatrics "The Boke of Chyldren (1546). He made only a brief reference to the management of the newborn entrusting this duty to the midwife.

Infant Welfare

The Italian physician Ferrarus (1577) suggested that babies should be placed under the supervision of a man "trained in the art of preserving health."

Enbryology

Fabricius (1537 to 1619) the Italian anatomist who so influenced the great William Harvey made a special study of the development of the embryo. Radcliffe (1967).

Sex Determination

The French obstetrician Guillemeau (1544 to 1612) did much to discard superstition, including the rejection of methods of determining sex before birth.

Midwives

During the seventeenth century, French obstetrics advanced rapidly compared with British. The status of the French midwife was far in advance of her British counterpart owing to the schools for midwives established by Mauriceau. (Corner, 1964).

Mauriceau's Treatise was translated into

the English by Hugh Chamberlen and this had profound influence on the development of obstetrics in Britain.

Asphyxia

In 1741 Smellie described the treatment of birth asphyxia, recommending firstly slapping the soles of the feet and secondly mouth to mouth artificial respiration.

Birth Weight

The earliest correct reports of birth weight were made by Roederer, 1753 a German obstetrician. In a paper to the Royal Society of Gottingen, he measured 27 full-term infants and found that the average weight of males was 6 lbs. 9 oz., and females 6 lbs. 2½ ozs.

Induction of Labour

In 1756 there was the first recorded attempt by a physician to save the life of an unborn child. Dr. Mccauley artificially ruptured the membranes of a linen draper's wife to bring on premature labour for disproportion.

He performed the operation 3 times, resulting in 2 living children. (Corner, 1964).

Infant Mortality

William Buchan read his dissertation "On the preservation of infant life" in Edinburgh in 1761 - he based this on the terrible infantile mortality "One half of the human race" he says, "die in infancy."

The nineteenth century saw a considerable increase in interest the newborn.

Jaundice

John Syer (1812) who was apologetic about his subject, wrote a "Treatise on the Management of Infants". He described neonatal jaundice for which purging with calomel was recommended.

Infantile Diseases

In France, Billard (1828) published his treatise correlating postmortem and clinical findings and produced the first important classification of infantile diseases.

Physiology

In 1836, Richard Evanson, Professor of Medicine, and Henry Mansell, Professor of Midwifery in the Royal College of Surgeons in Ireland, devoted much attention in "A Practical Treatise on the Management and

and Diseases of Children" to the physiology of early life and stressed the high neonatal mortality rate:

"The infant at birth may labour under certain morbid conditions, or it may suffer from accidents or diseases either peculiar to the first moments of existence or materially modified by the circumstances belonging to that period..."

Resuscitation

They discussed the causes of stillbirths and methods of resuscitation and quoted Edward Jorg, who introduced the term 'atelectasis'. They also noted the fall of about $3^{o}F$ in body temperature immediately after birth. Artificial inflation of the lungs is considered, but "the gentle filling of the lungs with air does, however, certainly incite respiratory movements and also facilitates pulmonary circulation and it should therefore be cautiously practised." (Corner, 1964).

Combined Midwifery

In 1852 Charles West published his lectures on midwifery and the diseases

and Paediatrics

of infancy and childhood.

Resuscitation

In 1852, Marchant described gavage feeding and advised resuscitation by nasal intubation, or the Chaussier procedure for laryngeal intubation with positive pressure respiration by mouth to mouth methods.

Other French obstetricians showed interest in the newborn and standards for premature baby care were laid down by Budin (1895) and the first modern incubator was used.

First Perinatal Mortality Survey

The Registration of Births and Deaths Act, 1837 (Amended 1874) for the first time gave information as to births after the 28th week of pregnancy and infant deaths in England and Wales. In 1869, Dr. Farr of the Registrar General's Department was so appalled at the high infant mortality rate that he recommended the Obstetrical Society of London to undertake the first perinatal mortality survey. This showed that throughout the country 50-90% of births were attended by midwives only, often untrained and quite unequal to any emergency situation (Carnegie United Kingdom Trust, 1917).

Despite the agitation aroused by these findings, in 1892 a Parliamentary Select Committee considered that a large number of infant deaths was caused from inefficiency and want of skill of many midwives: "They are perfectly ignorant and make no attempt to resuscitate apparently stillborn children, they think that it is the will of God that they should die. If the child is alive, it is alive, and there it is, but if not they must leave it, that is all." (Corner, 1964).

American Paediatrics

J. L. Smith, the best known American paediatrician of his time (except Jacobi), published his Treatise or the Diseases of Infancy and Childhood in 1869. It was based on his own clinical experience and pathological findings. Jacobi (1830-1919) lectured on paediatrics to the New York College of Physicians and Surgeons and is thus credited with having "pressed the buttons which set the paediatric clinic in motion." Abt. Garrisons History, 1965.

Little (1861) was one of the first to recognize the association between birth trauma and asphyxia and subsequent neurological deficit. He presented a paper to the London Obstetrical Society "On the Influence of Abnormal Parturition, Difficult Labours, Premature Birth and Asphyxia Neonatorum on the Mental and Physical Condition of the Child, especially in Relation to Deformities". The following are excerts from this lecture:

Birth Trauma

"Nearly 20 years ago, in a course of lectures published in the 'Lancet' and more fully in a "Treatise on Deformities" published in 1853, I showed that Premature Birth, Difficult Labours, Mechanical Injuries during parturition to head and neck - where life had been saved convulsions following the act of birth, were apt to be succeeded by a determinate affection of the limbs of the child which I designated, Spastic rigidity of the limbs of the Newborn, Spastic rigidity from Asphyxia Neonatorum."

Little's Disease

Incidence

"I have however witnessed so many cases of deformity mental and physical, traceable to

causes operative at birth, that I consider the subject worthy the notice of the Obstetric Society."

Social Maturity

"I have observed that in impaired intellect from abnormal birth...it varies much in degree...it is often not sufficient to exclude the individual from family society."

Mental Defect

John Thompson (1956 to 1926) was regarded as the father of Scottish paediatrics. He made a study of mental defect in infancy and early childhood.

Post-maturity

Ballantyne (1891) established the idea that there was continuity through birth of perinatal life and its disorders. Reference will be made later to his work on post-maturity.

The Twentieth Century

The twentieth century has been the age of fact-finding and many advances have been made in the investigation and management of problems associated with the perinatal period.

How these advances have influenced the management of

postmaturity and placental insufficiency will be discussed in the next section.

The Duration of Pregnancy and its Determination

The normal gestation period and the definition of prolonged pregnancy have been contentious issues since ancient times.

The Ancient Hindus — Believed that although pregnancy usually lasted nine months it could be prolonged up to one year.

Hippocrates — Accepted 280 days as the limit of gestation. He is also believed to have thought that an eight month foetus was less viable than a seven month (based on astrological and iatro-mathematical arguments). This assumption was held until the Middle Ages. (Curiosa from old Medical Papers. Hippokrates V.37, 1966).

Aristotle — Wrote that some people believed pregnancy could last eleven months.

The Romans — "Gellius Aulus, for instance, in his collection of incongruous matter, called Noctes Atticae, stated that the Emporor Hadrian,

having consulted with the physicians and wise men, decreed that in cases in which woman was of chaste manners and irreproachable conduct the child born eleven months after the death of the husband was legitimate." Cited by Ballantyne and Browne (1922).

Mediaeval Authors

In a number of 17th and 18th century cases of questioned legitmacy, gestation intervals of eleven to eighteen months were accepted.

Eighteenth Century

Modern obstetrics is generally dated from this time. Both Mauriceau (1739) and Smellie (1752) wrote of the increased dangers associated with prolonged pregnancy.

Nineteenth Century The Gardner Peerage Trial

At this famous trial in the House of Lords, five eminent London obstetricians testified that under no circumstances could human pregnancy exceed forty weeks in duration; and an equal number of eminent physicians took an opposite view.

Apart from the recording of isolated cases, little knowledge was added until statistical evidence about the duration of pregnancy was produced by several authors. (Merriman 1927, Murphy 1847 and Reid 1850). Cited by Cope (1959).

Simpson (1853) believed there was sufficient physiological and obstetric evidence to prove that the term of human pregnancy was not fixed, as many physicians of his time thought.

Ahlfeld (1869) reported the average duration of gestation from the time of conception to be 269-291 days.

Cooke-Hirst (1892) believed that the average duration of pregnancy was 269 days after coitus.

Twentieth Century

Ballantyne (1902) a Scottish obstetrician, drew attention to the problems of post-maturity as well as the difficulties in determining the length of gestation. "So, in treating of the postmature infant it is a perplexing question to fix the date of maturity and to define over-maturity."

Ballantyne and Browne (1922) "The great conclusion would seem to be that one is unable to fix any upward limit to the time of gestation and that one must consider every case on its individual merits."

In 1924, Eden read a paper to the Medico-Legal Society, London, in which he emphasized that gestation prolonged over three hundred and twenty days should necessarily be associated with undue weight and length of the child, undue ossification of its skull and a difficult labour, before it could be accepted on medical grounds.

Because no scientific limit could be placed on the possible length of time between insemination and fertilization, judges allowed periods of 346 (1947) days and 349 days (1948). However in 1948 a judge declined to accept a period of 340 days after hearing evidence from distinguished obstetricians that new physiological evidence had accumulated. Kerr, Johnston and Phillips, 1954.

Sutton, 1950 found the median of 13,660 natural single births in Sydney was 282.53 days.

Naegele's Rule

Despite its inherent weakness, Naegele's rule is the method used by most people to calculate the expected date of delivery.

Franz Karl Naegele (1778-1851) was a German obstetrician whose rule is defined as follows:

"A rule for calculating the day that labour is due to commence: the first day of the last menstrual period less three months plus 7 days." (Butterworth's Medical Dictionary, 1961).

Clifford (1957) said:

"Whether we like it or not, gestational age calculated from the first day of the last menstrual period is the only practical method available of achieving a common definition of postmaturity."

Referring to its accuracy, Gruenwald (1968) stated:

"While errors in the stated gestational age do occur, it has been the experience of a number of workers that this information if properly elicited and recorded is quite valuable."

Others have commented on the need to use other information to help in the assessment. Brown (1963) said:

Diagnosis of prolonged pregnancy must be based on observations made and recorded at the earliest stage of gestation."

The longest period of human gestation on record is that of an anencephalic monster which remained viable up to the time of delivery by Caesarean section at 389 days (Lanman, 1968) .

Rawlings and Moore (1970) referred to the use of Naegele's rule and the date of quickening for greater accuracy:
"It does appear therefore, that no method of assessing the duration of pregnancy is accurate. However these figures support the thesis that two fairly unreliable methods, if combined, would lead to, a more accurate assessment than each alone."

Methods of Evaluating Foetal Maturity

In recent years, considerable interest has been shown in seeking new methods of evaluating foetal maturity. Doubt has been cast on the value of radiology, particularly if intrauterine growth retardation is present (Scott and Usher, 1964).

Russell (1969) found that radiological assessment of foetal maturity predicted the date of delivery more accurately than the menstrual history.

Urinary oestriol levels and vaginal cytology have been helpful but not conclusive.

Brosens, Gordon and Baert (1969) described a new method of radiological examination based on the intra-amniotic injection of a lipo-soluble contrast medium for the intrauterine vizualization of the foetal vernix layer. Combining this with the cytological examination of cells in the amniotic fluid after staining with Nile blue sulphate, an accurate estimation of the foetal maturity was possible.

Bentrem et al. (1970) analysed samples of amniotic fluid by spectrophotometry, Nile blue stain, creatinine concentration, colour and turbibity. They concluded that by correlating creatinine concentration with Nile blue staining, the accuracy in determining foetal maturity was improved over a single parameter.

These new methods highlight the difficulties still apparent in determining the maturity of the foetus, a problem clearly stated by Ballantyne in 1902.

The Problem of Postmaturity

Although the first major contribution to the study of postmaturity was made by Ballantyne (1902), the problem was recognized by the 18th century obstetricians Mauriceau (1739) and Smellie (1752). Hirst, in 1892, seems to have been one of the first American obstetricians to point out the possible dangers in postmaturity (Nesbitt, 1955).

Ten years later, Ballantyne (1902) made a great contribution with his description and assessment of its importance to the mother and baby:

> "The postmature infant...has remained so long in utero that his difficulty is to be born with safety to himself and his mother; his troubles come on during birth."

Ballantyne and Brown (1922) in a further review of postmaturity, made the following statement which is equally applicable to the present time:

> "The great conclusion would seem to be that one is unable to fix any upward limit to the time of gestation, and that one must consider every case on its individual merits..."

According to Nesbitt the problem of postmaturity was regarded with some concern in America until the 1940's.

Authors of this period believed that the question of induction of labour in postmaturity was an individual problem.

In 1951, Smith said:

"The literature on postmaturity seems to be concerned especially with the possibility that physical growth of the fetus may reach proportions incompatible with safe delivery. This eventually may occur, but certainly rarely."

In the medical literature of the last twenty years there have appeared many references to the subject of postmaturity and its relative importance. The striking difference of opinion is well illustrated in the following representative extracts.

Eastman (1949):

"The infants in such cases are rarely larger than the normal range and actually 'the problem of postmaturity' is non-existent."

Hill (1952):

"Postmaturity per se does not affect the mother, her labour or her infant."

Burnett (1955):

"Until recent work appeared, the subject of post-

maturity could very reasonably be called a contentious one about which many highly competent and sincere workers held diametrically opposed views; but when a succession of painstaking careful investigators like McKiddie, Hamilton, Latto, Racher, Walker and others produce evidence that foetal distress and stillbirth occur more frequently in postmaturity and that these catastrophes increase in frequency with the degree of postmaturity, the reasons for that opposition needs careful revision."

Nesbitt (1955):

At the end of an excellent review of postmaturity, Nesbitt arrived at the following conclusion: "There is suggestive evidence, both experimental and clinical, that fetal welfare is jeopardized if pregnancy continues far beyond the calculated date. Nevertheless, we are sufficiently impressed with the data to recognize a genuine need for further study of this subject; and our final opinion must be held in abeyance until such work is completed."

Browne (1957):

"It is suggested that many cases of so-called postmaturity are really examples of slow maturation of the foetus and placenta and that as a good or better

perinatal mortality rates can be got in these cases without induction."

Clifford (1957):

Clifford contributed enormously to the literature or postmaturity with particular emphasis on placental dysfunction. This will be considered in another chapter.

Butler and Bonham (1963):

In the first report of the British perinatal mortality survey, the rate was shown to be doubled between 42 and 43 weeks gestation and quadrupled by the 44th week.

Cushner (1964):

"It is certainly obvious that there is a wide difference of opinion both in this country and abroad regarding the answers to these questions. The controversial nature of the subject is readily appreciated if one reviews the standard textbooks of obstetrics and finds very wide range of opinions regarding the nature of the problem and the necessity for any active therapy."

Gruenwald (1964):

Commenting on the divergence of opinion Gruenwald said:

"This divergence is partly due to variations in the selection and evaluation of patients, but also is partly inherent in the ill defined nature of the condition." He also said:

"The present observation indicates that, quite apart from the occurrence of grossly malnourished (dysmature) infants, prolonged pregnancy is increasingly unfavourable for the average fetus."

The Year Book of Obstetrics and Gynaecology (1965-66) Editorial:

"In brief may I say I am not as concerned about postmaturity as are some of our colleagues in Great Britain."

Smith et al. (1966):

"The management of prolonged pregnancy requires excellent clinical judgement."

Holtorff and Schmidt (1966):

The prognosis for the child is therefore favourable even if pregnancy continues for more than two weeks after the expected term."

Beischer et al. (1969):

"The Management of prolonged pregnancy remains obscure because authoritative opinion varies not

just considerably but completely on the subject."

"There is no doubt that few patients or obstetricians view prolonged pregnancy with equanimity."

Donald (1969):

"To the practising obstetrician the problem of postmaturity constantly recurs and it is surprising how little guidance most of the textbooks supply."

Brown (1969):

It is of interest that dysmaturity and postmaturity have achieved more notoriety in Britain than in the United States, though Gruenwald has shown that the problem is not peculiar to Britain."

Greene (1969):

"There has been controversy concerning the pregnancy that lasts longer than two hundred and ninety four days."

Editorial British Medical Journal (1969):

"Not the least of many problems facing the clinician is the estimation of the duration of pregnancy. ...and it is imperative that every woman with suspected prolongation of pregnancy be given the benefit of assessment and delivery in a specialist unit."

Problems Associated with Postmaturity

(1) Perinatal Mortality

Increased perinatal mortality rates in postmaturity have been quoted by many authors:

> McKiddie (1949), Clifford et al. (1951), Gibberd (1952), Lindell (1954), Kloosterman (1954), Nesbitt (1956), Clifford (1957), Brown (1963), Gruenwald (1964), Lucas et al. (1965), Noack (1966), Zwerdling (1967) and Sinnathuray (1967).

After excluding deaths due to congenital abnormalities, Evans et al. (1963) surprisingly found no such increase in perinatal mortality.

Their paper was read at the seventy third annual meeting of the American Association of Obstetricians and Gynaecologists. After the reading a discussion took place in which the following conversation occurred:

> Dr. K. T. McFarlane: "During my adolescence in our specialty I was brought up to believe, the old adage that 'the ripe apple will drop'...
>
> Prof. C. J. McLure Browne: "I am so glad that Dr. McFarlane brought up the story of the ripe apple because every autumn I take disbelievers into my

garden and show them the apple tree from which all the apples have fallen that are going to. You go back in December and you will find one or two shrivelled, dead apples sticking on that tree. These I suppose, represent perinatal mortality...I do think that this expression of the runt apple and the statements about the apple falling when it is ripe have been responsible for a lot of wastage of human life when it is avoidable."

In summary it may be said that the first report of the British perinatal mortality survey produced proof that postmaturity is a problem and this is now generally accepted.

However, the management of individual cases will remain a problem until there are available more certain methods of confirming the duration of pregnancy and assessing the welfare of the foetus after term has been reached.

Other factors contributing to the uncertainty are:

(a) The lack of an accepted definition of post-maturity.

(b) The varying standards of obstetric and paediatric care which must affect the perinatal

mortality and morbidity rates.

(c) The lack of follow-up studies to determine the progress of infants born after prolonged pregnancy.

(2) Induction of Labour

With such a wide divergence of opinion as to the significance of postmaturity, it is to be expected that a similar controversy has existed over the management of such cases.

Hayes (1944) concluded:
"It is strongly recommended that no induction be attempted for maturity or postmaturity."

Gibberd (1953) stated:
"We must accept that postmaturity carries an increased risk to the foetus, but this is not necessarily a good reason for forcing the foetus out of the frying pan of postmaturity into the fire of induction of labour."

Perlin (1960) forcibly condemned induction considering it to result in an increased Caesarean section rate.

Gerisch et al. (1964) considered the risk to the foetus to be overestimated and rejected "all vigorous

methods for induction."

Lucas et al. (1965) produced data which they considered was against recommending elective induction of labour, even after forty three weeks.

Although a few authors have recommended routine induction for postmaturity (Rosenvasser and Rosenvasser (1954), Georgakopoulos (1964), and Sinnathuray (1967)), the majority of obstetricians have favoured selective induction. Even with this policy there has been a difference in the degree of conservatism in various countries. The "American" compared with the "English" viewpoint has been discussed by Greene (1969) who states:

> "It has been a commonly held view by English obstetricians that no pregnancy should be allowed to progress past 42 weeks and that induction of labour is the proper method of treatment if no maternal contraindication exists. The majority of obstetricians in the United States favor watchful waiting rather than termination of pregnancy solely on the basis of postdatism."

Illustrating this difference, Mead and Marcus (New York, 1964) recommended conservatism unless unquestioned placental insufficiency was present, whereas Browne

(London, 1963) considered induction of labour at the end of 42 weeks was justified, provided the decision to intervene was not undertaken lightly and adequate facilities for Caesarean section were available.

Induction of labour for prolonged pregnancy has been advised by European (Lindell 1954, Morbis and Carol 1965), and Russian (Landau and Bekkermann, 1968) obstetricians and similar reports have come from other parts of the world.

As early as 1957, Browne pointed out that many cases of "so called postmaturity" were really examples of slow maturation of the foetus and placenta. Although this is certainly true, there must be foetuses who are compromised by prolongation of pregnancy.

Recent methods of assessing the welfare of the foetus, such as amnioscopy and estimation of urinary oestriol levels have made it easier to decide when induction is necessary. Saling (1966) claims that the use of amnioscopy has reduced the frequency of induced labour (for postmaturity) from 36% to 7%.

After consideration of all factors, the obstetrician concerned must answer the question posed by McKinnon (1953):

> "...the fundamental and primary indication for induction must always be: is the patient better off with the uterus empty; or if the infant is alive and in good condition, are its chances of survival increased by early delivery?"

In the existing controversy over postmaturity considerable importance has naturally been attached to the high associated perinatal mortality, but little consideration has been given to the quality of the surviving infant. This is a most important aspect and is one of the issues discussed in this thesis.

(3) Foetal Distress During Labour

Cox (1961) when discussing the causes of pathophysiology of foetal distress, stated:

> "...new methods of investigation must be evolved to discover the variations in placental exchange of oxygen. Only here will a worthwhile breakthrough in knowledge occur."

Many advances have been made since then, notably by Saling (1966), but one must agree with the British Medical Journal editorial (1969) which said:

> "Yet during labour, the detection of foetal distress

is often a relatively haphazard affair."

An increased incidence of foetal distress has been reported in both postmaturity and placental insufficiency. This also has been clearly shown in the present survey and the high incidence of subsequent birth asphyxia emphasizes the need for early detection of foetal distress in utero. This will be discussed in greater detail in the section on meconium stained liquor.

(a) Postmaturity

Many authors have shown a higher incidence of foetal distress with pregnancy prolonged past term (McKiddie 1949, Clayton 1953, Burnett 1955, Clifford 1957, Brown 1963, Mead and Marcus 1964, Carr 1967 and Beischer et al. 1969). Perlin (1960) claimed no difference in his 2 groups (mature c.f. postmature) but examination of his quoted figures shows a statistically significant increase in foetal distress in the postmature group both in utero and 5 minutes after birth.

The British Medical Journal editorial quoted above also stated:

"In prolonged pregnancy, foetal death may occur before labour commences, but the greatest hazard is associated with anoxia during labour especially if mechanical

problems supervene."

(b) Placental Insufficiency

Scott and Usher showed that foetal distress occurred twice as commonly in wasted infants as in normal controls. The same increase did not occur in the small for dates babies (< 10th percentile) who were not wasted.

(4) Placental Insufficiency

(a) Wasted Babies

The earliest references to subcutaneous wasting are found in reviews of postmaturity.

Ballantyne (1902) noted the desquamation which usually accompanies wasting (see page 5):
"The desquamation of the cuticle was going on at birth. It was 10 days old when I saw it...the epidermis was still coming away in large flakes."

According to Sjostedt (1958) several European authors (Bossi 1907, Bacher 1915 and Runge 1939) have given good clinical descriptions of dysmaturity, the word he chose to designate wasted infants (see page 5).

The condition was not recognised elsewhere until Clifford described 46 cases in 1945.

In 1954 he discussed its association with postmaturity particularly in the early primagravida. His clinical description is summarised below because of its importance in bringing the condition to the attention of paediatricians, a point which was made by Sjostedt in 1957.

Calling it the placental dysfunction syndrome, he divided in into 3 stages:

Stage 1 - dry, peeling, parchment-like skin with wasting of the subcutaneous tissues.

Stage 2 - the skin changes of the first stage but with meconium stained liquor and green staining of the placental membranes and umbilical cord.

Stage 3 - the infant has passed through the first 2 stages and the meconium has been present long enough to stain the nails and skin a bright yellow and the cord a dirty yellow green.

In another major contribution to the subject, Clifford published a review of postmaturity in 1957, in which he discussed the incidence of the placental dysfunction

syndrome and the increased perinatal mortality and morbidity associated with it.

Sjostedt (1957) was the next to stimulate interest with an investigation of 1171 newborn infants (mainly past term) classifying them in a manner similar to Clifford. He studied the incidence, the relationship to gestation, the body length and a certain haemotological and biochemical aspect. A follow-up study of these dysmature infants was made by Engleson et al. (1963).

Gruenwald (1963) in his broad concept of foetal distress in placental insufficiency considered these babies had suffered from subacute foetal distress, resulting from deprivation for several days prior to birth.

"It occurs late in pregnancy and affects a previously well nourished fetus, then the subcutaneous fat tissue wastes away and the fetus is born 'long and thin'."

There do not appear to have been any studies which correlate the degree of wasting with the state of the infant at birth and his subsequent progress. To do this, an attempt has been made to divide babies

according to the degree of wasting, using a score to simplify statistical analysis.

Scott and Usher (1966) published an important paper on "fetal malnutrition". They divided babies into 2 groups, those with soft tissue wasting and those with a birth weight below the tenth percentile for gestational age. They pointed out that this was a large proportion of live births to be considered abnormal and felt that the diagnosis of foetal malnutrition should be restricted to infants who were either markedly wasted or below the third percentile for birth weight. They also discussed the difficulty in defining and measuring soft tissue wasting which could not be "readily quantitated."

In 1963, Wagner suggested that it might be possible to quantify an impression of loss, of subcutaneous fat through measurement with skin calipers.

Several years later (1967), Wagner et al. commented on the need for standardization and verification of the clinical signs of dysmaturity and stated that they found skinfold thickness measured by calipers to be reliable especially at the umbilical and quadriceps sites.

Gruenwald, who has made a great contribution to the pathology of this problem ("subacute and chronic fetal distress"), suggested that the study of skinfold thickness would make recognition of the wasted infant possible in the future, using arbitrarily set standards (Gruenwald, 1968).

However as the clinical picture is distinct and readily recognized with little training (Sjostedt et al. 1958), I felt a simple clinical assessment by Griffiths in 1966 seemed suitable and after a preliminary investigation which confirmed its simplicity and reliability it was used in the present survey (page 13).

(b) History of Small for Dates Babies

Credit is given to Piller (1936) for recognizing that not all small newborns were born early (Gruenwald, 1968). In 1951, McKeown and Gibson pointed out that the use of weight as an index of maturity was unsatisfactory.

Soderling (1953) criticized the practise of "equalizing low weight and immaturity" and stressed the need for different treatment of those babies who, although weighing less than 2,500 G at birth, "may have spent

an intra-uterine period which does not fall below that of a fully developed child."

Occasional case reports of undernourished full term infants appeared in the literature and the problem was officially acknowledged by the World Health Organization in 1961. The first major study however was made by Gruenwald, and he published a complete report in 1963.

His concept of foetal distress in a very broad sense, was of such importance that his own words will be quoted from a later review (1968):

"...and on the basis of the presumed duration prior to birth three phases were outlined. The distinction of these phases is obviously an arbitrary one, and difficulties may arise with classifying individual cases because combination and transition forms exist.

Acute perinatal distress is of short duration and is usually associated with labour and the birth process. Deprivation may be more profound than in the other phases and leave the fetus severely and acutely compromised; this is what has generally been called fetal distress.

Subacute fetal distress is the result of deprivation for several days prior to birth. If this occurs late in pregnancy and affects a previously well-nourished fetus, then the subcutaneous fat tissue wastes away and the fetus is born 'long and thin'.

Chronic fetal distress affects fetuses for several weeks or even months. Growth gradually slows down and eventually ceases, but since the fetus had not previously accumulated significant amounts of subcutaneous fat tissue there can be no wasting. The relationship of body weight to length is, even in severely affected infants, very close to what it would be in normal fetus of similar weight but of shorter gestational age.

Thus, acute perinatal distress produces disturbances of vital metabolic function without an effect on growth or body proportions; subacute fetal distress produces fetuses which are not measurably retarded in longitudinal growth but have wasted; and chronic fetal distress results in measurable growth retardation in weight and length. The weight deficit of chronic distress is of sufficient magnitude to be apprehended by standards based on normal growth. The most commonly used arbitrary borderline of fetal

growth retardation are either the tenth percentile, or a weight below mean minus 2 standard deviations, all with respect to the particular week of gestation. The former standard includes more than three times as many cases as the latter."

Since then (Gruenwald, 1963) many articles have appeared in the world literature stressing the clinical importance of the baby with a birth weight lower than expected for the length of gestation (Butler and Bonham 1963, Dawkins 1963, Scott and Usher 1966, Walker 1967, Neligan 1967, Rabor et al. 1968, Michaelis et al. 1970, Bettaglia 1970).

Andrews (1970) has edited a review of the "Small-for-dates" infant in a recent issue of the Paediatric Clinics of North America, with an extensive cover of the subject.

Despite the volume of literature, there has been no world-wide acceptance of a definition. This aspect is discussed further in the section on Terminology. Whatever the definition however, the following summary reflects current thinking on the overall problem.

"In summary, the growth-retarded newborn infant is associated with a distinct group of obstetric and

neonatal medical complications which set him apart from the premature infant of comparable size. Clearly, a great deal more work needs to be done in defining the kinds of obstetric problems likely to affect normal intra-uterine growth rate as well as clarifying the degree to which this growth retardation persists into later life. However, sufficient clinical studies have been carried out pointing to the urgency of making the diagnosis of intrauterine growth retardation as early as possible, preferably in prenatal clinic, and if not then, in the immediate neonatal period." (Battaglia, 1970).

(5) Meconium Stained Liquor

Aristotle first used the word meconium because of the resemblance to poppy juice (Mekon (Greek) - a poppy).

It is probable that foetal hypoxia causes vagal stimulation of the foetal gut and relaxation of the anal sphincters with the passage of meconium into the liquor.

This survey shows a high incidence of meconium stained liquor in postmaturity and placental insufficiency. It is generally considered to be an important sign of foetal distress, so a number of references to it in recent literature will be given.

Incidence

White (1955) recorded an incidence of meconium in the liquor in 5% of 4,350 vertex deliveries.

Wood and Pinkerton (1961) found an incidence of 13% with an average gestation period of 41 weeks c.f. 40 weeks for clear liquor.

Barham (1968) also showed an incidence of 13% of his 540 cases at risk for meconium stained liquor, 60% were associated with prolonged pregnancy.

Gruenwald (1964) commented that the incidence of meconium staining of the placenta rose sharply after term.

Beischer et al. (1969) in a study of postmaturity found an incidence of 6.9% at amniocentesis and noted the higher number of foetal heart rate abnormalities in this group.

Importance

In both stillbirths reported by Ley (1953) in his series of postmature babies, the liquor was meconium stained.

White (1955) found a greater need for resuscitation when meconium was present in the liquor (33% c.f. 7.5%).

Wood and Pinkerton (1961) showed that delay in the onset of regular respirations was significantly higher in cases with severe meconium staining of the liquor.

Saling (1966), whose work has been invaluable, stated:

"A foetus that is surrounded by meconium stained, bilirubin stained or deficient liquor, must be regarded as in danger."

Management

Wood et al. (1969) stated:

"Most obstetricians consider that the presence of meconium in the liquor is sufficient reason to induce labour."

Diagnosis

The presence of meconium in the liquor can be determined before the onset of labour by amnioscopy and amniocentesis, both of which are considered safe procedures.

Saling (1966) pioneered the study of amnioscopy and made the following statement:

"Amnioscopy should be carried out if there is any suspicion of placental insufficiency during the last

six weeks of pregnancy...the main hazards are maternal toxaemia and suspected postmaturity."

Others to unhesitatingly recommend it were Randow et al. (1967), Pulle (1967), Barham (1968), Browne and Brennan (1968).

Beischer et al. (1969) regarded amniocentesis as an important diagnostic examination when meconium was suspected.

(6) Pathology of Postmaturity and Placental Insufficiency

In a panel discussion on placental insufficiency, Gruenwald et al. (1963) wrote:

"Occasionally one finds cerebral changes; the one that I have found most characteristic...consists of areas of degeneration in the white matter of the hemispheres, not far from the lateral ventricles."

Gruenwald (1964) found the thymus to be the only organ which decreased significantly in size after term, indicating involution as a result of chronic stress. When considering dysmature (wasted) infants, he found the brain to be least affected and the heart somewhat more; some organs were retarded, and the thymus actually decreased in size. He considered "that the average foetus post term

suffers some measure of deprivation and malnutrition as a result of subacute foetal distress."

After a study of organ weights in small for dates babies, Wigglesworth (1967) said:

> "The lack of subcutaneous white fat noted clinically is confirmed...the changes in relative weights of the organis result in an increased ratio of brain to liver weight, from the normal of about 3.1 up to as high as 6.1 in babies who are markedly small for dates."

Naeye (1967) in a necropsy study of 16 postmature newborn infants found the weights of the adrenals, liver, spleen and thymus to be disproportionately small, particularly in the 10 growth retarded infants. The organs had a subnormal number of parenchymal cells which had a subnormal mass of cytoplasm. He felt that these abnormalities resembled those encountered in undernutrition rather than chronic prenatal hypoxia. Changes due to intrauterine hypoxia were present in both stillborn and liveborn infants, viz. meconium staining, inhalation of amniotic debris, multiple petechiae on the pleural and pericardial surfaces.

In a review of the pathology of cerebral hypoxia

damage, Claireaux (1969) stated:

> "It is assumed that some severe cerebral lesions, not in themselves lethal to the fetus or newborn infant, result in permanent brain injury and are responsible for some cases of cerebral palsy or mental retardation...this aspect of brain damage... may occur some time before the onset of labour. If this is true, it might explain the occurrence of obvious cerebral damage in infants delivered without difficulty and without any apparent hypoxic episode."

Brown (1969) discussed the importance of knowledge of the normal neurological function of the neonate, to help correlate abnormal patterns with specific pathology:

> "We still have a long way to go before we can correlate changes in these functions with morbid pathological and path-physiological changes in the nervous system, so that we can think in terms of a pathological lesion in the neurologically abnormal infant with the same accuracy as in the older child."

Follow Up Studies

1861 Little was the first to associate the influence of asphyxia on the mental and physical development of the child.

He wrote:

"Medical writers seemed unaware that abnormal parturition, besides ending in the death or recovery of the child, had another termination ...namely, in other diseases...convulsions of newborn children, and the spastic rigidity, paralysis, and idiocy subsequently witnessed." Cited by Nelson (1966).

1902 Ballantyne also realized the importance of birth trauma:

"Even when the postmature infant escapes an intra natal death, his future health may be seriously interfered with by the results of the traumatism through which he has passed; his later pathological development will take on a special character therefrom."

One of his illustrative cases (postmaturity) demonstrated a delay in walking.

"A few days after birth the infant developed

oedema neonatorum of a very marked type, was seriously ill for about 10 days, but thereafter completely recovered. He did not walk, however, till the end of his 2nd year."

A number of authors have suggested that neurological damage follows postmaturity, placental insufficiency (especially light for dates babies) and birth asphyxia but a few have claimed no such direct relationship. This divergence of opinion is well shown in the following extracts from the literature.

Placental Insufficiency

Albermann(1963)

"A tendency for birth weight to be unduly low for gestational age was found in spastic diplegia, quadriplegia and athetosis, without a history of jaundice. The implication of these findings is that a factor acting prenatally is involved in these types Cerebral Palsy. "

Wagner (1963)

Referring to dysmaturity (placental insufficiency): "...the results at nine months although suggestive of a decrease in average development quotients, were inconclusive in the numbers available."

Engleson et al. (1963)

Referring to dysmaturity (Sjostedt):

"There is no doubt that, taken as a whole group, Stage 2 is inferior to the control infants. However many of the Stage 2 infants are as good as the normals in every respect. Dysmaturity is not only with diagnosis of academic interest in the perinatal period, it is a diagnosis that has importance also for the future development of the infant. At present it may be summarized as being a disadvantage, although not a serious one."

"Statistically the differences were most obvious in those variables where the examination gave a direct figure, i.e. weight and psychological tests."

Neligan (1967)

"That intrauterine malnutrition may be responsible for both the low birth weight and subsequent poor development in light for dates babies were strongly suggested by the important twin studies of Babson et al. (1964). The lighter member of twin pairs, where there was a gross discrepancy at birth, whether uniovular or binovular, showed significant impairments of development during

childhood.

Results confirmed the existence of a tendency for light for dates babies to show inferior subsequent development."

Walker (1967)

"It is for prospective studies to tell us whether 'small for dates at term' is a serious hazard. Perhaps these babies just continue to be not quite so good for always."

Hunter (1968)

"The incidence of significant neurological signs is low in the groups with milder degrees of hypoxia and much higher in the groups with severe hypoxia. It should be noted, however, that all the hypoxic groups included a higher proportion of babies who had foetal malnutrition."

Wagner and Arndt (1968)

"Clearly the incidence of postmaturity in the cerebral palsy and neurologically deficient groups from our study are far above the natural incidence described by McLure Browne (3.5%). When compared with American data on the incidence of prolonged pregnancy 'the differences were

not as striking but still significant."

"Although the number of cases is not large, our study has impressed upon us a greater consideration of postmaturity as a factor in producing a neurologically handicapped infant."

Asphyxia

Apgar et al. (1955)

"No significant correlation was found between levels of blood oxygen content measured in the first three hours after birth and intelligence as gauged by Stanford-Binet testing in early childhood."

Keith and Gage (1960)

"The findings of the present study reinforce the conclusions in the previous report from this clinic - that prolonged labour, asphyxia or delayed respiration ae birth did NOT cause any neurological abnormality in children who survive the early months of life, and that convulsions of any type are not commoner among children who had difficulty at birth than among children who did not have difficulty at birth."

Billings (1969)

"The survey emphasizes the importance of anoxia in the aetiology of cerebral birth trauma.

Postmaturity

Bierman et al. (1965)

"Nor was there evidence of any greater risk for the postmature infants in terms of all unfavourable outcomes studied, i.e. fetal deaths, deaths under age two, cerebral palsy or convulsive disorders and I.Q.'s under 80."

Zwerdling (1967)

"Thus on the basis of this small number of children, no deleterious effect of prolonged pregnancy is evident 5 years after birth."

British Medical Journal (Leading article 1969)

"Surprisingly no long term sequelae have yet been found, as judged by studies of growth and intelligence."

Such varied opinion makes it apparent that prospective long term follow up is essential not only for this particular group of babies (i.e. postmature and placental insufficiency) but for all those who are 'at risk'.

The need for such studies has been frequently recognized, and is well stated by Nelson (1966):

> "The need now, however, is not for generalization but for increasing specification and quantification; which specific etiological factors, acting singly or in combination, cause which specific outcome, in what proportion of cases, conditioned by what additional factor, by what mechanism and with what possibility of prevention by what means?"

Similar opinions have been expressed by the following authors.

Lilienfield and Pasamanick (1955)

> "The hypothesis of the 'continuim of reproductive casualty' provides a conceptual framework for further research. It emphasizes the need for longitudinal study starting as soon after conception as possible and continuing through prenatal and natal periods until the child is several years of age."

Evans et al. (1963)

> "However knowledge of the subsequent development of infants with asphyxia who survived

could be just as important a factor in assessing the fetal hazards of prolonged pregnancy as is the perinatal mortality rate."

"Later determination of the intelligence quotient of individuals born after prolonged pregnancies would be valuable additions."

Gruenwald (1963)

"It has been noted by those investigating postmature infants in chronic and subacute fetal distress, that the chance of survival is good if the infant is born alive."

"...apart from increased mortality, the problem of greatest medical significance in the study of chronic fetal distress, is that of cerebral damage in the survivors...at this time, the magnitude of the problem is unknown."

Gruenwald (1965)

"In addition, new follow-up studies of infants born after chronic or subacute fetal distress should be carried out to correlate fetal disturbances with late sequelae."

Gruenwald (1968)

"Proper follow-up studies will be of the greatest

significance for pre-natal medicine since they alone will show what complications occur in relation to certain prenatal factors and how successful a given method of diagnosis or management has been. It will be extremely important for the purpose of such studies to record the infant's weight status in relation to gestational age and to describe the steps taken to ascertain the presence or absence of hypoglycaemia and hyperbilirubinaemia. Only then will a follow-up study reveal cerebral damage caused in utero by chronic deprivation."

"Subacute fetal distress has remarkably few sequelae if the infant is born in good condition. There is no known effect on future somatic development. Some infants will probably have brain damage."

The Vineland Social Maturity Scale

In 1947, Doll developed the Vineland Social Maturity Scale to assess various aspects of social development.

Gunzberg (1968) wrote:

"Doll (1953) published a number of valuable studies dealing with the measurement of social competence.

His Vineland Scale of Social Maturity is similar to an orthodox intelligence test because it establishes the age at which certain social skills are first widely practised by the normal child. The technique is well known in paediatric practice when landmarks is maturation provide guidance to normal development in, for example, walking and talking...the summing up of the individual performance in these various aspects of social competence is expressed as a social age (S.A.).

The S.A. of a healthy average child should be roughly the same as his C.A. (chronological age), just as his mental age (M.A.) should be similar to his C.A. The relationship of S.A. to C.A. can be expressed as a proportion in the form of a social quotient (S.Q.) in the same way as an I.Q. indicates the relationship of M.A. to C.A.

The Vineland Scale has proved extremely useful directing attention to this most important aspect of functioning, and particularly in assessing systematically the early stages of social development. It is still used in the form in which it was first presented and no amendment or finer standardization has been added since it was published first. Doll gives

figures which indicate that the relationship between S.A. and C.A. and between S.A. and M.A. is high in normal people."

The method is also discussed by Savage (1968):

"It is however, an extremely useful technique for it can be answered by a parent, close relative or nurse on the child's behalf, when the child itself is unable or unwilling to co-operate. The technique has two major uses, firstly as a measure of intelligence with very young children and secondly, when social maturity and intelligence levels can be compared."

Yang et al. (1968) considered that undue confidence had often been placed on the reliability of gross motor activity in reflecting integrity of the unfolding intellect. They stated:

"This largely stems from observations of a converse situation that when there is delay in achievement of gross minor milestones or when clear neurological deficits appear in infancy, they are frequently associated with deficits in mental function. This study emphasizes that in the absence of such abnormalities there is no

guarantee of the intellectual normality. It also gives additional substance to the thesis of the school of developmental paediatrics which has long insisted that the early signs of mental retardation may lie, not in the spheres of reflex arches of motor function...but rather in observation of adaptive and personal - social behaviour."

Further indication of the value of this scale was given by Warren (1968):

"The most useful adapative behaviour scale available at present is the Vineland Social Maturity Scale developed by E. Doll."

The psychology branch of the South Australian Education Department also uses the scale, which makes comparable follow up studies possible

later, a fact pointed out by Craven (1964).

PART IV

A. POSTMATURITY

Selection of Cases

During the year following 1st July 1968, the case notes of all babies born at the Queen Victoria Hospital were examined. If the gestation period was 294 days or greater the mother was interviewed by me and the baby included in the survey if the following criteria were met:

(1) Regular menstrual history
(2) Reasonable certainty of the date of the last menstrual period
(3) Early attendance at the antenatal clinic
(4) The mother was married and the baby was not for adoption.

At this hospital, the expected date of confinement (E.D.C.) is calculated from Naegele's rule. Recent reviews (Treloar et al. 1967, Gruenwald, 1968) have shown that the use of the menstrual history to calculate the gestational age is reliable for most clinical purposes.

Using Naegele's rule and an accurate reliable menstrual history, the following numbers were selected for the survey:

Group A = 294-300 days gestation
i.e. Term + 14 to 20 days

Group B = 301 days gestation and greater
i.e. Term + 21 days or more

Group A	77
Group B	39
Total	116

Incidence

The incidence in this survey was 5.5% which is much lower than a recent prospective survey in Melbourne by Beischer et al. (1969) who found the incidence of pregnancies prolonged beyond 42 weeks gestation to be 11.4%. A number of reported series give figures which vary from 3.5% to 14.0% for a similar degree of postmaturity, but most of these studies are retrospective. Beischer et al. selected their patients during the first trimester and their figures probably reflect the true incidence.

In this survey selection of the babies occurred after birth and so becomes retrospective for the obstetric factors but prospective for the paediatric ones.

A number of factors combined to reduce the incidence

in this group:

(1) The exclusion of adoption babies. This was felt to be reasonable because of the frequent unreliability of the menstrual history given by the mother, the frequent late attendance at the antenatal clinic and the difficulties associated with follow-up of the baby.

(2) The exclusion of babies whose mothers had doubt about their dates or an irregular menstrual cycle. Careful enquiry early in pregnancy could perhaps have resolved some of these doubts. This applies particularly to those migrants unable to speak English.

(3) Induction after term. Postmaturity is regarded as a hazard by some of the obstetric staff and a number of mothers were induced between 280 and 293 days gestation.

Although these factors reduced the numbers, there is little doubt that those babies selected were 2 weeks or more past term, according to accurate menstrual data.

(1) Maternal Factors

Age	Survey	
18	5	4.3%
18-30	94	81%
30	17	14.7%

Group	Group A	Group B	Total
Australia and U.K.	54	21	75
European	23	15	38

These figures are not significantly different from the hospital population percentages.

	Survey	Hospital
Australia and U.K.	67.2%	63.3%
European	32.8%	33%

Even when separating those of Italian and Greek birth, figures were similar to the hospital population.

	Survey	Hospital
Greek	9.4%	9.5%
Italian	14.8%	13.8%

Parity	Group A	Group B	Total
1	36	15	51
2 to 4	33	21	54
5	8	3	11

Parity	Survey	Hospital
1	44%	43.3%
2 to 4	46.6%	48.3%
5	9.4%	8.4%

These figures show that in this series postmaturity was not influenced by maternal age, race and parity.

(2) Induction of Labour

The policy at the Queen Victoria Hospital varies slightly with each clinic, but in most instances it is similar to that of Beischer et al. (1969), who recommended selective induction or elective Caesarean section depending on the state of the liquor, urinary oestriol levels and foetal distress during labour.

The usual method of induction is surgical rupture of the membranes shown by Noack (1966) to be sufficient for induction of labour in 90% of cases of prolonged pregnancy.

In this series labour was induced in 44 patients (38%).

It has been stated that induction of labour for post-maturity alone is unjustified, as the interference may result in undesirable obstetric complications (Gibberd, 1958, Perlin, 1960). However there was no difference in the Caesarean section rate following induction in the group studied.

	Subsequent Caesarean Section	
Induced (44)	6	13.8%
Not Induced (72)	11	15.3%

No significant difference

(3) Foetal Distress During Labour

In this survey, any one of the following signs constituted "foetal distress".

1. Meconium staining of the liquor
2. Foetal heart rate 160 or 110
3. Irregularities of the foetal heart rhythm
4. Tumultuous foetal movement

The overall incidence of distress was 10.3%.

Miller and Bundey (1962) studied the records of 4,860 deliveries at the Queen Victoria and Queen Elizabeth Hospitals, and found an overall incidence of foetal distress

of 11.6%. However after the exclusion of those with associated abnormalities occurring before term (Toxaemia, antepartum haemorrhage, hypertension, multiple pregnancy, threatened premature labour) the incidence was only 5.8%.

	Foetal Distress
Group A (77)	5 = 6.5%
Group B (39)	7 = 18%
Total (116)	12 = 10.3%

A significant increase in distress occurred in the more postmature group.

Group A (6.5%) $\bar{v}$ Group B (18%)

$P < .001$

Later results will show a higher incidence of asphyxia after delivery in group B, reflecting this high foetal distress rate.

More refined methods of detecting foetal distress during labour would be of great value. This aspect has been discussed in the chapter on meconium stained liquor.

(4) Liquor

The importance of meconium staining of the liquor is well accepted, because of the associated increase in foetal

distress (Beischer et al. 1969), perinatal morbidity (Taylor et al. 1952) and mortality (Ley, 1953).

In this series the incidence was 26%, and there is a highly significant increase in group B compared with group A.

Group A	(77)	14	18.2%
Group B	(39)	16	41%

Meconium staining:

Group A 18.2% $\bar{v}$ Group B 41% $P < .001$.

In 9 of the 30 babies, there were other signs of foetal distress present during labour. Even with these babies excluded, there is still a doubling of the incidence in Group B compared with Group A, i.e. 28.2% compared with 13% ($P < .001$).

This suggests that the meconium was present in the liquor prior to the onset of labour.

Several authors (Taylor et al. 1952, White 1955, Wood and Pinkerton, 1961) have reported an increased rate of asphyxia at birth, with delay in the onset of respiration and the need for active resuscitation, when meconium is present.

These findings were also apparent in this series as

shown by the increased number of babies with low Apgar readings and delayed onset of respirations.

Apgar < 4 at 1 minute

Clear liquor	9.2%
Meconium in liquor	26.7%

Significant $P < .001$

Respirations not established until after 4 minutes

Clear liquor	1.2%
Meconium in liquor	10%

Significant $P < .001$

These figures indicate the need for careful appraisal of all patients with meconium stained liquor. Beisc h er et al. (1969) found a rate of 6.9% at amniocentesis before the onset of labour, a figure which is comparable with the rate of 8.7% found at artificial rupture of the membranes in this series. Recognition of this state before the onset of labour should be an advantage in planning subsequent management.

Evidence that meconium stained liquor is associated with increased perinatal mortality and morbidity will be produced in the appropriate sections.

(5) Method of Delivery

Ballantyne (1902) wrote of the difficulty in delivering large, living, postmature babies through the pelvis:

> "...it will also depend upon the state of the infant (whether it be alive, dead or in danger of dying, as ascertained by the state of the foetal heart beats). In the great majority of cases however, he will still decide in favour of craniotomy, but it is quite likely that in 5 or 10 years the operation of choice will be Caesarean section."

Half a century later, figures from the British Perinatal Mortality survey confirm this prophecy and show a doubling of operative delivery at 42 weeks gestation compared with term.

Beischer et al. (1969) showed that after 42 weeks their Caesarean section rate was treble that in patients who were delivered between 38 and 41 weeks.

Delivery by Caesarean section is the method of choice in postmaturity associated with both meconium stained liquor and falling urinary oestriol levels, according to Smith et al. (1966) and Beischer et al. (1969).

In this series there is a marked increase in the Caesarean section rate in Group B compared with Group A

and a significant increase in the total postmature group compared with the overall hospital rate for the period of the survey.

	Normal	Instrumental	Caesarean Section
Group A	75.3%	13%	11.7%
Group B	66.6%	12.8%	20.6%
Total	72.4%	12.9%	14.7%
Overall Hospital Rate Period of Survey	84%	9%	7.2%
Emergency			4.9%
Elective			2.3%

Caesarean Section

Group A 11.7% compared with Group B 20.6%

P <.001

Hospital rate 7.2% compared with Total 14.7%

P <.001

The indications for the Caesarean sections were:

1. Cephalopelvic disproportion with failure to progress during labour, and sometimes foetal distress:
   10 cases - in each instance the baby was big - 5 had a birth weight over 4,000 gms. and the other 5 were between 3,500 and 4,000 gms.

2. Foetal distress (other than disproportion):

   4 cases - 3 of these babies showed evidence of severe wasting as defined in section

3. Elective - 3 cases:

   1 - previous section.

   1 - primagravida with a breech presentation.

   1 - elderly primagravida with infertility.

   The last baby only survived a short time and is described in section

The Placenta

Weight

Kitchen (1968) commented that the most desirable method of recording placental weight was to weigh it after removal of the cord, membranes and blood clot, but for clinical use it was acceptable to weigh it with the membranes attached and the cord cut flush with the placental surface.

This latter approach was used in the present survey with the following results:

Group	Mean Weight
A (42 weeks)	535 Gm
B (43 weeks)	556 Gm
Controls	566 Gm

There is no statistical difference between the groups. Kitchen obtained similar results in his survey on a comparable population.

Clifford (1957) found the foetal placental/weight ratio to be unaltered by prolongation of pregnancy, and considered that much valuable information could be gained from detailed studies correlating histological features in the placenta with gestational age and the clinical picture. Although there is a decrease in this ratio in this series, the difference is not significant.

	Group A	Group B
Foetal/Placental Weight ratio	6.72	5.86

Macroscopic Changes

Inspection of the placenta was made after all deliveries by the senior labour ward sister and the following categories applied:

1. Healthy
2. Calcification
3. Infarcted
4. Combination (2) and (3)

Clayton (1941) found no difference in the gross appearance with postmaturity and Arnot and Nelson (1962) found that pathological lesions werepresent in the placenta but there was no characteristic placental lesion pathognomonic of postmaturity. In this series, the placenta was found to be healthy in only 37.1% of the postmature group but in 60.9% of the control group. This difference is highly significant ($P < 001$). No attempt was made to group them according to the degree of calcification and infarction, because the number of different observers responsible for the recording could have made subdivision inaccurate. There are a few reports of histological examination of the postmature placenta in the literature, but these do not relate any specific changes.

Durst (1963) reported fibrosis of villi, deposition of intervillous fibrin and a reduction in the number of capillaries in prolonged pregnancy.

De Palo (1967), using electron microscopy, considered the changes to differ quantitatively but not qualitatively from those seen in a normal full term placenta.

Histological examination of the placenta was not performed in this survey.

The Baby

(a) Sex Ratio

In their studies of prolonged pregnancy Gajardo (1954) and Ramirez (1954) each found a slight increase in the number of boys.

In this study there was no significant difference in the sex ratio either in the total number or in the 2 groups considered separately.

	Male	Female
Group A	37	40
Group B	21	18
Total	58	58

(b) Birth Weight

Group	Mean (Gm)
Total	3460
Group A (14-21 days)	3490
Group B (< 21 days)	3400

There is a fall of 90 gm. in the mean birth weight of the more postmature group, and although this is not statistically significant a similar drop after 42 weeks gestation has been shown by others (Kitchen 1968, Betheras et al. 1969, Rathbun 1943).

The significance of this weight fall will be discussed in the section on placental insufficiency.

(c) Other Measurements

Head circumference (H.C.) Crown rump (C.R.) and Crown Heel (C.H.)

Group	Mean H.C. (Cm)	Mean C.R.	Mean C.H.
All Postmatures	34.4	33.3	50.6
Group A (14-21 days)	34.5	33.5	50.7
Group B (< 21 days)	34.1	32.9	50.5

The mean measurements of Group B are all smaller than in Group A but the differences are not statistically significant.

(d) Asphyxia

With a high incidence of foetal distress in postmaturity, a similar increase in birth asphyxia would be expected.

This is clearly shown in the present survey, with a greater increase in the more postmature group.

The degree of asphyxia is reflected by:

(1) The Apgar score
  (a) At one minute
  (b) At five minutes
(2) The time to establish respiration
(3) The type of resuscitation required and the need for supportive measures.

(1) Apgar Score

(a) One minute

Apgar	Group A	Group B
8 - 10	74%	61.5%
5 - 7	14.3%	20.5%
0 - 4	11.7%	18.0%

There is an increased number of low readings (0 - 4) in the more postmature group.

Group A (11.7%) $\bar{v}$ Group B (18.0%) $<.02$ $P<.05$

(b) Five Minutes

Apgar	Group A	Group B
7	2.6%	7.7%

This increase in low scores (i.e. under 7) as postmaturity increases is highly significant. $P<.001$.

The Apgar rating at five minutes has been shown to have a greater prognostic significance than at one minute (Drage and Berendes, 1966).

(2) Time to Establish Respiration After Birth

A time clock is started at birth and an accurate measure made of this time interval.

Time (Minutes)	Group A	Group B
0 - 2	84.4%	76.9%
2	15.6%	23.1%

As postmaturity increases, there is a significant increase in the percentage of babies taking more than two

minutes to establish regular respiration.

Group A (15.6%) compared with Group B (23.1%)

$< .02 \quad P \quad < .05$

(3) Resuscitation

The methods of resuscitation used at the Queen Victoria Hospital have been discussed in another section.

	Group A	Group B
Aspiration	75.3%	64.1%
Bag and Mask	18.2%	23.1%
Intubation	6.5%	12.8%

With increasing postmaturity, there was an increased need for more active resuscitation, reflecting the greater degree of asphyxia.

There is a highly significant increase in the percentage of babies requiring intubation after 43 weeks gestation.

Intubation: Group A (6.5%) $\bar{v}$ Group B (12.8%)

$P < .001$

There was also a highly significant increase in the number of babies requiring intravenous infusion of dextrose and alkali in the more postmature group.

Intravenous therapy:

Group A (1.3%) compared with Group B (7.7%) P <.001

As stated by Evans et al. (1963):

"...knowledge of the subsequent development of infants with asphyxia who survived could be just as important a factor in assessing the fetal hazards of prolonged pregnancy as is the perinatal mortality rate."

Perinatal Mortality

During the period of the survey there was one stillbirth and one neonatal death in pregnancies prolonged beyond forty two weeks, i.e. 2.6% of the selected postmature babies.

Stillbirth

Baby M.

Mother 40 years

Gravida 6

Gestation - Term + 18 days

Intrauterine death 2 days before delivery of slightly macerated foetus.

Autopsy: No gross abnormality found

Both lower femoral and upper tibial epiphyses were present.

Neonatal Death

Baby R.

Mother 39 years

Primagravida. Infertile.

Gestation - term + 14 days.

Elective Caesarean section.

Foetal heart heard prior to operation.

Heart beat recorded at delivery.

Resuscitation: Immediate intubation and intermittent positive pressure resuscitation, but heart beat stopped at 3 minutes.

Birth weight - 3,175 gm.

The placenta weighed only 255 gm. compared with mean 535 gm. for the series.

Autopsy: Oedema of the subcutaneous tissues, bile-stained fluid in the peritoneal cavity. Tardieu spots over the lungs and pericardial sac, meconium in the trachea, solid "airless" lungs.

The table below shows the organ weights compared with those of the next hospital neonatal death occurring in a male baby of similar birth weight.

Organ	Ruzic	Control	Organ	Ruzic	Control
Brain	383	427	R. Lung	41	45
Thyroid	1.0	2.5	L. Lung	34	33
Thymus	4.5	13	Spleen	5	15
Heart	20.5	25	Adrenals	-	11
Liver	60	154	Kidneys	19	31

Weight in Gm.

There is a significant decrease in the weights of several organs especially the thymus, spleen, kidneys, liver and thyroid. There is some reduction in the weight of the brain and heart. This is consistent with the findings of Gruenwald who demonstrated that the weight of the thymus decreased rapidly after term compared with other organs, especially the brain.

Perinatal Morbidity

Central Nervous System Abnormality (first day)

Most of the available world literature about post-maturity has been concerned with obstetric problems and perinatal mortality and it is only in recent years that some interest has been focussed on the baby. The stimulus for this seems to have come from Clifford with his clinical work on the placental dysfunction syndrome and from the pathologist Gruenwald who has written extensively on the

subject. Frequent reference to the importance of their studies will be found in this thesis. However there do not appear to be references to studies of otherwise unselected babies born after prolonged pregnancy, particularly of their clinical state, problems of neonatal management and long term follow up. With an increased incidence of intrauterine foetal distress and birth asphyxia in postmaturity already shown, it would not be surprising to find an increased number of babies showing signs of central nervous system disturbance during the neonatal period. This proved to be so in this series.

	Group A	Group B
Minor Abnormality	20.8%	23%
Severe Abnormality	2.6%	10.3%

Major Abnormality

There is a statistically significant increase in severe abnormality in the more postmature group ($P < .001$). The following is a summary of the case histories of the severely affected babies.

Group A:

There were only 2 severely affected babies in Group A compared with 4 in Group B, and one was the only neonatal death in either group. Details are given in the

section on perinatal mortality.

Summary:

Baby R.

Elderly primagravida

Infertile

Term + 14 days

Elective Caesarean section

Baby B.

Gravida 2. Birth weight 3,230 gm.

Normal delivery. Apgar 8.

Gestation - Term + 17 days.

Meconium stained liquor.

The baby was irritable when disturbed, respirations were rapid and grunting and she made continuous writhing movements during the first day.

The skin, nails and umbilical cord were meconium stained, the thumbs were adducted across the palms, the reflexes were absent (moro, grasp and sucking) the skin was dry and peeling and the subcutaneous tissues wasted. A chest X-ray showed cardiac enlargement and normal lung markings. Her general condition improved rapidly and by the fourth day her behaviour seemed normal.

No abnormality could be found at the 6 weeks examination. Her social quotient at 1 year was 118.

Group B (< 21 days)

Severe abnormality - 4 babies.

Baby E.

Gravida 2

Gestation - term + 28 days

Normal delivery. Meconium stained liquor.

Apgar 1 at 1 minute

1 at 5 minutes

Respirations established at 11°.

Resuscitation:

Endotracheal intubation with intermittent pressure insufflation. Intravenous dextrose and sodium bicarbonate.

Thick greenish material was aspirated via the endotracheal tube.

On examination, the skin, nails and umbilical cord were meconium stained, respirations were shallow and the Moro, grasp and sucking reflexes were absent. The skin was very dry and the subcutaneous tissues wasted. Respiratory arrest occurred 3 hours after birth but responded to re-intubation and insufflation with oxygen. Examination of the acid-base status at this stage revealed a respiratory acidosis - pH 7.15 pCO_2 93. Improvement occurred gradually until 36 hours, when he

again became cyanosed. This was relieved after the aspiration of a large amount of thick greenish material via the endotracheal tube.

There were radiological changes consistent with inhaled meconium.

On the fourth day he was still sucking poorly, had a weak grasp reflex and muscle tone was increased. His clinical condition improved gradually during the next 10 days, and he was discharged on the twelvth day.

At the six weeks examination his muscle tone was thought to be increased.

His social quotient at one year was 89.

Baby P.

Gravida 1.

Maternal age 19 years.

Gestation - Term + 24.

Caesarean section for failure to progress in labour.

Meconium stained liquor.

Birth weight 4,820 gms.

Apgar 3 at 1 minute

7 at 4 minutes

Respirations were established at 5 minutes.

The baby had meconium staining of the nails and umbilical cord, the skin was dry and peeling, and the respiratory rate was rapid. The Moro, grasp and sucking reflexes

were diminished and the thumbs were adducted across the palm. Acid base tests after birth showed a combined metabolic and respiratory acidosis:

pH 6.97 pCO_2 84 Base Deficit 17.5

This was rapidly corrected by intravenous infusion of dextrose and bicarbonate, with clinical improvement. The respiratory rate remained rapid and a chest X-ray suggested aspiration pneumonia. The baby remained irritable for several days but gradual improvement was maintained until discharge on the tenth day. At six weeks the right thumb was still adducted but he appeared normal otherwise.

Smiled at 6/52. Social quotient at one year 83.

Baby S.

Gravida 2.

Maternal age 29 years.

Gestation - Term + 37 days.

Meconium stained liquor.

Normal delivery.

Birth weight 3,500 gms.

Apgar 5 at 1 minute

7 at 5 minutes

Resuscitation - bag and mask.

Respirations were established at 5 minutes.

There was meconium staining of the nails and cord, the

skin was dry and peeling and the reflexes were sluggish.
A chest X-ray showed consolidation of each lower lobe.
The baby was acidotic:

pH 7.20 pCO_2 55 Base Deficit 9.0

and his blood glucose was low - 23 mg.%.
Improvement occurred after correction with intravenous dextrose and alkali but he was still sucking poorly on the fourth day and required gavaging.
He seemed normal at the six weeks examination.
Social quotient at one year - 114.

Baby S.

Gravida 2. Greek.
Maternal age 32 years.
Gestation - Term + 37 days.
Instrumental delivery after rotation with Kielland's forceps.
Meconium stained liquor.
Apgar 1 at 1 minute
1 at 4 minutes
Respirations were established spontaneously at 4 hours.
Resuscitation - endotracheal intubation.
Birth weight 3,500 gms.
This baby's behaviour after birth was quite extra-ordinary. She was intubated at 4 minutes and became pink immediately, but despite intermittent positive

pressure with oxygen she took only an occasional gasp until regular spontaneous respirations were established at 4 hours. Blood taken during this interval revealed a normal acid base balance:

pH 7.37 pCO_2 37 Base Deficit 4.0

Blood glucose 58 mg.

A chest X-ray showed a slightly enlarged heart and incompletely expanded lungs.

The cord and nails were meconium stained, the skin was dry and peeling and there was considerable wasting of the subcutaneous tissues, the thumbs were adducted and the Moro, grasp and sucking reflexes were absent. She began to suck on the third day, but still showed some increase in the respiratory rate on the fourth day.

At six weeks she seemed to have made good progress, but was not smiling.

Social quotient at one year - 79.

Examination of these summaries shows that the following signs were common to all of the severely affected babies:

(1) Meconium staining of the umbilical cord and nails.

(2) Dry peeling skin and wasting of the subcutaneous tissues.

(3) Thumbs adducted across the palms.

These points and their significance, will be discussed in more detail in the section on placental insufficiency.

(b) Minor Central Nervous System Abnormality

Case Summaries

Key:
D = Desquamation score
W = Wasting score
S.Q. = Social Quotient at one year

Baby F.

Mother 24 years. Gravida 1. Term + 15 days.
Clear liquor. Birth weight 4,120. Apgar 6-8.
E.R. 3. Bag and Mask. D1 W1. Head retraction.
Irritable. Adducted thumbs. S.Q. 114.

Baby K.

Mother 19 years. Gravida 1. Term + 15 days.
Clear liquor. Birth weight 3,990. Apgar 8. E.R. 1.
Aspiration D3 W2. Increased tone. Adducted thumbs.
S.Q. 100.

Baby D.

Mother 21 years. Gravida 1. Term + 16 days.
Clear liquor. Birth weight 4,090. Apgar 9. E.R. 1.
Aspiration D0 W2. Sucking poorly. S.Q. 114.

Baby H.

Mother 23 years. Gravida 1. Term + 18 days. Clear liquor. Birth weight 4,050. Apgar 3-8. E.R. 5. Intubation D2 W1. Sucking poorly. S.Q. 96.

Baby M.

Mother 20 years. Gravida 2. Term + 23 days. Clear liquor. Birth weight 3,430. Apgar 9. E.R. 1. Aspiration D2 W1. Sucking poorly. Hypoglycaemia. Blood glucose 23 mg.%. S.Q. 105.

Baby D. P.

Mother 23 years. Gravida 3. Term + 28 days. Clear liquor. Birth weight 3,460. Apgar 8. E.R. 1. Aspiration D4 W2. Increased tone. Thumbs adducted. S.Q. 108.

Baby M.

Mother 21 years. Gravida 1. Term + 17 days. Clear liquor. Birth weight 2,950. Apgar 9. E.R. 1. Aspiration D2 W2. Not sucking. S.Q. 112. Poor sleeper.

Baby B.

Mother 19 years. Gravida 1. Term + 26 days. Clear liquor. Birth weight 3,520. Apgar 10. E.R. 1. Aspiration D2 W1. Sucking poorly. S.Q. did not attend.

Baby F.

Mother 25 years. Gravida 5. Term + 14 days.

Clear liquor. Birth weight 2,910. Apgar 7. E.R. 2. Aspiration D2 W2. Sucking poorly. Hypoglycaemia. Blood glucose 24 mg.%. S.Q. did not attend.

Four of these nine non-wasted postmature babies had a birth weight of approximately 4 KGm. This cephalo-pelvic disproportion probably contributed to their cerebral symptoms during the first day.

Wasted Postmature Babies:

Baby D.

Mother 20 years. Gravida 1. Term + 19 days. Clear liquor. Birth weight 3,060. Apgar 7. E.R. 2. Bag and mask. D4 W4. Increased tone. S.Q. 108. Poor sleeper.

Baby F.

Mother 19 years. Gravida 1. Term + 20 days. Meconium stained liquor. Birth weight 3,260. Apgar 8. E.R. 1. Aspiration D2 W4. Increased tone. Thumbs adducted. Irritable. Hypoblycaemia. Blood glucose 23 mg.%. S.Q.106.

Baby T.

Mother 20 years. Gravida 1. Term + 20 days. Clear liquor. Birth weight 2,560. Apgar 4-9. E.R. 4. Bag and mask. D3W3. Sucking poorly. S.Q. 109. Poor sleeper.

Baby C.

Mother 22 years. Gravida 3. Term + 16 days. Clear

liquor. Birth weight 3,035. Apgar 10. E.R. 1. Aspiration D4 W3. Not sucking. S.Q. 96.

Baby F.

Mother 31 years. Gravida 7. Term + 17 days. Clear liquor. Birth weight 3,150. Apgar 9. E.R. 1. Aspiration D1 W3. Tremors. Tone increased. S.Q. 102.

Baby R.

Mother 37 years. Gravida 4. Term + 20 days. Meconium in liquor. Birth weight 3,210. Apgar 8. E.R. 1. Aspiration D4 "5. Increased tone. Sluggish reflexes. S.Q. 91. Overactive.

Baby M.

Mother 36 years. Gravida 4. Term + 16 days. Clear liquor. Birth weight 3,850. Apgar 10. E.R. 1. Aspiration D3 W3. Increased tone. S.Q. 100.

Baby K.

Mother 21 years. Gravida 1. Term + 16 days. Clear liquor. Birth weight 3,560. Apgar 9. E.R. 1. Aspiration D5 W5. Tone increased. Sucking poorly. S.Q. 108. Sleep poor.

Baby V.

Mother 21 years. Gravida 3. Term + 14 days. Clear liquor. Birth weight 3,170. Apgar 4-7. E.R. 5. Bag and mask. D8 W3. Sucking poorly. S.Q. 96.

Baby H.

Mother 21 years. Gravida 1. Term + 16 days. Meconium in liquor. Birth weight 3,000. Apgar 2-10. E.R. 2. Intubation. D7 W9. Sucking poorly. Intravenous therapy. S.Q. 98.

Baby D.

Mother 30 years. Gravida 1. Term + 25 days. Clear liquor. Birth weight 2,980. Apgar 8. E.R. 1. Bag and mask. D2 W3. Increased tone. Tremors. S.Q. 87.

Baby M.

Mother 38 years. Gravida 4. Term + 21 days. Meconium in liquor. Birth weight 3,345. Apgar 7. E.R. 5. Bag and mask. D6 W3. Increased tone. S.Q. 100.

Baby M.

Mother 26 years. Gravida 4. Term + 21 days. Meconium in liquor. Birth weight 2,500. Apgar 5-9. E.R. 2. Intubation D3 W3. Not sucking. S.Q. 106.

Baby I.

Mother 29 years. Gravida 2. Term + 21 days. Meconium in liquor. Birth weight 3,010. Apgar 1-8. E.R. 4. Intubation. D5 W6. Tone increased. Sucking poorly. S.Q. 89.

Baby G.

Mother 24 years. Gravida 1. Term + 26 days. Meconium in liquor. Birth weight 3,310. Apgar 8. E.R. 1. Aspiration D3 W6. Not sucking. Sluggish. S.Q. 118.

Baby B.

Mother 19 years. Gravida 1. Term + 15 days. Clear liquor. Birth weight 2,840. Apgar 9. E.R. 1. Aspiration D7 W5. Increased tone. S.Q. 96.

Baby I.

Mother 19 years. Gravida 2. Term + 15 days. Meconium in liquor. Birth weight 3,760. Apgar 8. E.R. 1. Aspiration D2 W5. Sucking poorly. Depressed Moro. S.Q. did not attend.

Baby C.

Mother 19 years. Gravida 1. Term + 17 days. Clear liquor. Birth weight 3,170. Apgar 9. E.R. 1. Aspiration D3 W4. Increased tone. S.Q. did not attend.

(2) Congenital Abnormalities

Ballantyne (1902) stated:

"Finally, it would seem that in the pathology of the postmature foetus, teratological states occur with greater frequency than in that of ordinary infants."

He gave instances of anencephalics, one with a gestation of 320 days. The association between anencephaly and post-maturity is well recognized (Malpas 1933, Clayton 1941). Clifford (1957) considered that congenital abnormalities were responsible for only a small percentage of foetal deaths in postmaturity. Zwerdling (1967) reported small increases in the rates for all congenital anomalies and severe congenital anomalies. Beischer et al. (1969) found no influence from congenital malformations on the death rate in their survey.

There were no major congenital abnormalities in this series and the incidence of minor abnormalities was low.

After the exclusion of trivial abnormalities such as umbilical hernia, small naevi and skin tags, the following were recorded:

(1) Intestinal obstruction

This baby developed the classical signs of intestinal obstruction (bile stained vomiting, abdominal distention, failure to pass meconium and fluid levels in a plain X-ray of the abdomen). His symptoms were relieved after the passage of a meconium plug following a second rectal examination. He unfortunately died of accidental poisoning at 11 months.

(2) Cavernous haemangioma

This lesion on the baby's leg measured 4 cm. by 2 cm. shortly after birth and at one year was showing signs of regression.

(3) Major orthopaedic abnormalities

(a) One baby had bilateral dislocated hips and in another the hips were considered to be subluxated. Both were splinted in abduction.

(b) One baby had a severe unilateral metatarsus varus requiring splinting.

(4) Minor orthopaedic abnormalities

Nineteen babies had minor orthopaedic abnormalities which responded to active stretching by the mother. The majority were in the calcaneo valgus position.

(3) Wasting

About half of the postmature babies showed moderate to severe wasting as assessed by the method described in Part II ~~Appendix~~

As this was the criterion for admission to the placental insufficiency survey, a detailed discussion of the method will be found in that section. However the relevant statistics will be given now.

One baby (the early neonatal death) was not included in this assessment. All others were examined after the surface skin moisture had dried - i.e. between 6 and 24 hours after birth.

Degree of wasting	Number
None	57
Moderate	51
Severe	7

Considering the wasted babies as one group (because of the small number of severely wasted babies involved), there is a statistically significant increase in wasting as gestation increases beyond 42 weeks.

Moderate and severe wasting:

Group A	Group B
43.2%	66.7%

Group A compared with Group B $< .02$ $P < .05$

The following table shows the effect of wasting on the mean birth weight of each group:

	Mild	Moderate	Severe
Mean Birth weight gm.	3580	3350	3180
Standard Deviation	450	380	170

Not unexpectedly, the mean birth weight is significantly lower as wasting increases. The difference between the mildly and severely wasted group being most significant:

Mild $\bar{v}$ Severe P $<.001$

Mild $\bar{v}$ Moderate P $<.01$

Moderate $\bar{v}$ Severe P $=.05$

The birth weight was the only parameter measured significantly altered by wasting. There were slight differences in the head circumference, crown rump and crown heel lengths, but these were not significant even between the mildly and severely wasted groups.

	Mild	Moderate	Severe
H.C.	34.8	34.7	34.1
C.R.	33.6	33.2	33.3
L.	50.7	50.7	50.7

All measurements in centimetres.

There is a statistically significant increase in severe

disorder of the central nervous system as wasting increases ($P < .001$).

	Number	Severe abnormality	
No wasting	57	0	0
Moderate	51	3	5.9%
Severe	7	2	29%

This aspect will be considered in more detail in the section on placental insufficiency.

Ackerman, Taylor and O'Loughlin (1969) found that "Thirteen of forty postmature infants had a skinfold thickness which was less than that of any of the term infants."

Desquamation

All babies, other than the one who lived for only a few minutes, were assessed for the degree of desquamation by the method described in Section

Division was made into 3 groups:

(a) Mild 56

(b) Moderate 49

(c) Severe 10

	Mild		Moderate	Severe
Group A	76	52.4%	39.6%	8%
Group B	39	41%	49%	10%

These findings are similar to those of Griffiths (1966) who found a rapid increase in desquamation between the 40th and 42nd week after which a decrease occurred. When only those born after 42 completed weeks were considered however, no significant decrease in desquamation with increasing gestational age was apparent.

There was a significant correlation between the degree of wasting and desquamation when either the groups or the raw scores are considered.

Desquamation $\bar{v}$ Wasting

Raw scores $r = .57$ $P < .001$

Groups (mild, moderate, severe) $r = .68$ $P < .001$

This will be considered in greater detail in the section on placental insufficiency.

(4) Position of Thumbs

At the initial examination, the position of the baby's

thumb in relation to the palms was recorded as follows:

T1 - Thumbs adducted tightly across the palms.

T2 - Intermediate between T1 and T3.

T3 - Thumbs abducted and the hand partly open, with the baby at rest.

In a number of babies, the thumbs were in the adducted position at rest but opened when the Moro reflexes were elicited. These babies were included in group T2, which is the position adopted by most babies.

	Number	Percentage
T1 (adducted)	17	14.6%
T2 (intermediate)	84	73.3%
T3 open	14	12.1%

Examination of the results showed a definite increase in CNS abnormality in group T1 and a significant decrease in group T3.

CNS Abnormality

	Number	Percentage
T3	1	7.3
T2	19	22.6
T1	12	70.6
Total	32	27.8

T1	$\bar{v}$	Total	$P < .001$
T1	$\bar{v}$	T3	$P < .001$
T3	$\bar{v}$	Total	$P < .001$

This association will also be discussed when the "placental insufficiency" babies are considered.

(5) Meconium Staining

Meconium staining of the liquor occurred in 30 patients. In this group there were 14 babies (i.e. 45%) who showed signs of CNS abnormality on the first day (including one neonatal death). 13 of these 30 babies had meconium staining of the nails, umbilical cord and skin, and only 4 were considered otherwise normal:

i.e. 1 neonatal death
8 abnormal CNS on first day
4 normal

Staining of the nails and adduction of the thumbs occurred together in 7 babies, all of whom showed signs of CNS abnormality on the first day.

In 4 cases this abnormality was severe and associated with moderate to severe wasting. With one exception, meconium staining occurred only in babies with moderate or severe wasting so this will be discussed in greater detail in that section (page 140).

(6) Other Morbidity

The following conditions were associated with meconium staining of the liquor.

Pneumonia:

Two babies developed pneumonia within 48 hours of birth, both responding readily to simple measures (antibiotics and general nursing care).

Bransilver (1970) found massive aspiration associated with postmaturity to be an important cause of perinatal death.

Chemosis:

One baby had oedematous eyelids, reddened conjunctivae and chemosis, present at birth and resolving within a few days - possibly a direct result of the chemical irritation of the meconium.

Nasal Obstruction:

Two babies had nasal obstruction at birth causing snorting respirations, and interfering with feeding during the first few days of life, with gradual resolution. Once again meconium irritation could be incriminated.

Cardiac Irregularity:

One baby had a slow irregular heart rate (64 to 80 per

minute) persisting during the first week and not associated with any other evidence of cardiac disorder. The rate was normal and regular (130 per minute) at the six week examination.

Ackerman and O'Loughlin (1970) found abnormal electrocardiographic patterns in postmature infants.

Cyanotic Attack

An isolated severe cyanotic attack lasting several minutes occurred in another baby on the fifth day. Investigation failed to elucidate the cause. His social quotient was low at one year.

Fourth Day Examination

C.N.S. Abnormality

Six babies were considered to show signs of abnormality at this examination.

	S.Q. at One Year
Baby B. Sucking poorly Lost to follow-up	-
Baby V. Sucking poorly	96
Baby H. Sucking poorly	98
Baby E. Sucking poorly	89

	S.Q. at One Year
Baby F. Irritable	106
Baby P. Not sucking Irritable	83

Six Weeks Examination

At this examination, ten babies were thought to have abnormal neurological signs.

	S.Q. at One Year
Baby B. Twitching of left arm and leg Referred for investigation	83
Baby P. Right thumb adducted Late smiling	83
Baby K. Poor head control	100
Baby H. Excessive irritability	98
Baby E. Increased tone	89
Baby M. Increased tone Squint	100
Baby I. Floppy infant	89
Baby M. Not smiling or following	99
Baby M. Irritable	96
Baby M. Not smiling	100

It can be seen that four of the ten babies had an abnormally low Social Quotient at one year, making the six weeks examination a useful screening test.

Examination at One Year

(a) Low S.Q.

The social quotient (S.Q.) was considered to be low if below 93, i.e. less than 2 standard deviations from the mean for the control babies (Mean 104, S.D. 5.5).

Controls 106 Babies

Postmature 104 Babies

Postmaturity	Low S.Q. 14	i.e. 13.4%	
Controls	Low S.Q. 2	i.e. 1.9%	$P < .001$

Group A (42-43 weeks) 67 Babies

Group A Low S.Q.	4	6%
Controls	1	1.4%

Group B (> 43 weeks) 37 Babies

Group B Low S.Q.	10	27%
Controls	1	2.8%

There is a highly significant increase in the percentage of babies with a low S.Q. as the gestation increases beyond 43 weeks.

Group A 6% $\bar{v}$ Group B 27% $P < .001$

When subdivided into wasted and non-wasted groups the following results were obtained.

		Low S.Q.	
Not Wasted	(52)	5	9.6%
Wasted	(52)	9	17.3%

9.6% $\bar{v}$ 17.3% $.002 < P < .01$

Summary of Neonatal Histories of Babies with a Low Social Quotient at One Year

Baby P.

Mother 19 years. Gravida 1. Term + 24 days. Foetal distress. Caesarean section. Meconium in liquor. Birth weight 4,820 gm. Male D8 W2. Apgar 3-7. E.R. 5 minutes. Intubation. Asphyxia pH 6.97. Intravenous therapy. One year S.Q. 83.

Baby B.

Mother 36 years. Gravida 3. Term + 21 days. Normal delivery. Meconium in liquor. Birth weight 3,320 gm. Male. D2 W2. Apgar 8. E.R. 1 minute. Aspiration. Six weeks twitching. One year S.Q. 83.

Baby M.

Mother 23 years. Gravida 1. Term + 17 days. Caesarean section. Birth weight 4,100 gm. Female. Apgar 2-6. E.R. 6 minutes. Intubation. Sleep poor. S.Q. 85.

Baby H.

Mother 20 years. Gravida 1. Term + 20 days. Normal delivery. Birth weight 3,870 gm. Female. Apgar 9. E.R. 1 minute. Aspiration. S.Q. 89.

Baby T.

Mother 36 years. Gravida 4. Term + 17 days. Normal delivery. Birth weight 3,830 gm. Female. Meconium in liquor. Apgar 9. E.R. 1 minute. Aspiration. S.Q. 84.

Baby S.

Mother 30 years. Gravida 4. Term + 32 days. Normal delivery. D8 W5. Birth weight 3,570 gm. Male. Meconium in liquor. Apgar 9. E.R. 1 minute. Aspiration. Cyanotic attack on 4th day. S.Q. 91.

Baby R.

Mother 37 years. Gravida 4. Term + 20 days. Normal delivery. Birth weight 3,210 gm. Male. Meconium in liquor. Apgar 8. E.R. 1 minute. Aspiration D4 W5. S.Q. 91.

Baby U.

Mother 19 years. Gravida 2. Term + 28 days. Normal delivery. Birth weight 3,830. Male D7 W5. Apgar 9. E.R. 1 minute. Aspiration. Illness - Bronchiolitis. S.Q. 98.

Baby A.

Mother 27 years. Gravida 3. Term + 22 days. Normal delivery. Birth weight 3,400 gm. Male D4 W4. Apgar 9. E.R. 1 minute. Aspiration. Illness - Pneumonia. S.Q. 71.

Baby I.

Mother 29. Gravida 2. Term + 21 days. Meconium in liquor. Caesarean section. Birth weight 3,010. Male D5 W6. Apgar 1-8. E.R. 4 minutes. Intubation. S.Q. 89.

Baby D.

Mother 30 years. Gravida 1. Term + 25 days. Instrumental birth. Birth weight 2,980. Female D2 W3. Apgar 8. E.R. 1. Bag and Mask. S.Q. 87.

Baby C.

Mother 21 years. Gravida 2. Term + 26 days. Normal delivery. Meconium in liquor. Birth weight 3,340 gm. Female D4 W4. Apgar 7. E.R. 2 minutes. Bag and Mask. Meconium stained nails. S.Q. 77.

Baby S.

Mother 32 years. Gravida 2. Term + 37 days. Instrumental. Meconium in liquor. Birth weight 3,500 gm. Female. D5 W7. Apgar 1-1. E.R. 4 hours. Intubation. Intravenous therapy. S.Q. 79.

Baby E.

Mother 30 years. Gravida 2. Term + 28 days. Normal delivery. Meconium in liquor. Birth weight 3,100 gm. Male. D5 W6. Apgar 1-1. E.R. 11 minutes. Intubation and intravenous therapy. S.Q. 89.

Sleep Disorders (see also page 218).

Postmaturity	(104)	13	=	12.5%
Controls	(106)	3	=	2.8%

This increase in sleep disorders is highly significant: $P < .001$.

Illness During First Year (see also page 219).

Postmaturity	(104)	13	=	12.5%
Controls	(106)	0		

This increase in illness during the first year is highly significant. $P < .001$.

Summary of Significant Findings

Group A - 42-43 weeks gestation

Group B 43 weeks gestation

Perinatal Period

Foetal distress

Increased in Group B — P <.001

Meconium stained liquor

Increased in Group B — P <.001

Placenta

Increased number of unhealthy placentas - postmature compared with controls — P <.001

Caesarean section rate

Increased in Group B — P <.001

Birth Asphyxia

(a) Low Apgar scores
at 1 minute
Increased in Group B — .02 < P < .05

At 5 minutes
Increased in Group B — P <.001

(b) Time to establish respirations
Increased in Group B — .02 < P < .05

(c) Resuscitation
Need for intubation
Increased in Group B — P <.001

Intravenous therapy
Increased in Group B — P <.001

Central nervous system abnormality

Severe degree
Increased in Group B — P <.001

Wasting

Increased in Group B — .02 < P < .05

Wasting and Desquamation Scores

Significant correlation between the two	$r = .68$ $P < .001$

One Year Examination

Low S. Q.

Total increase c.f. control group	$P < .001$
Increased in Group B c.f. A	$P < .001$

Sleep Disorders

Increased c.f. control group	$P < .001$

Illness during First Year

Increased c.f. control group	$P < .001$

PART IV

B. PLACENTAL INSUFFICIENCY

Selection of Cases

As discussed in the section on terminology (page 1) considerable confusion has existed over the best classification of babies described under the broad heading of placental insufficiency.

For this thesis, all babies over 38 weeks gestation were examined and included in the survey if they met either of the following criteria:

(a) Wasted Babies: a score of 3 or more according to the method described on page 13.

(b) Small for Dates: a birth weight less than 2 standard deviations from the mean for gestational age (Gruenwald's curve).

A number of babies fell into both groups, and some were also postmature. They have been included in the statistical analysis of each group in which they occur. The wasted babies will be discussed in detail first, because this is the largest group and the one about which little has appeared in the literature.

(a) Wasted Babies

Incidence

During the period 1.9.68 to 30.7.69, all babies born at the Queen Victoria Hospital (over 38 weeks gestation) were examined by me for signs of wasting and desquamation. The "Griffiths score" was applied and those babies with a wasting score of 3 or more were included in the survey.

163 babies were selected.

147 babies were selected for follow-up until one year old.

16 babies were for adoption - their neonatal details were studied but follow up at one year was omitted.

These babies were further graded according to the severity.

	Wasting	Score	Number
Group 1	Moderate	3-5	136
Group 2	Severe	6-9	27

Incidence of wasted babies = 9.6%.

Moderate	8%
Severe	1.6%

Lanman (1968) said:

"Dysmaturity (placental insufficiency) is not a sharply defined syndrome and there are no reliable

figures on its incidence."

Thalhammer (1964) graded 1300 newborns according to Clifford's method and found an incidence of 7.7% which is similar to that of this survey.

Pregnancy and Labour

Usher (1966) found no tendency for the incidence of foetal malnutrition to change with increasing gestational age, but he used different criteria for the selection of his infants, i.e. some were included purely on the basis of a birth weight below the tenth percentile irrespective of the presence of a clinical wasting.

Griffiths (1966) found an increase in wasting from 12.5% before 39 weeks to 19% after 42 weeks.

Betheras et al. (1969) showed a definite increase in the incidence of "placental insufficiency" as gestation increased, e.g. 19% at 38 weeks, 37% at 42 weeks and 75.8% at 44 weeks.

In this survey, a marked increase in the percentage of wasted babies occurred as pregnancy was prolonged beyond term.

Gestation (weeks)	Number
38 - 40	30
40 - 42	70
> 42	63

Selander (1954) found that 12% of babies past term had signs of placental insufficiency.

Georgiades et al. (1963) referred to the increased incidence of Clifford's syndrome in post-term babies.

In 1949 McKiddie summed up the general concensus of opinion with the following statement:

> "It is possible, that once a maximal size has been reached, the child, unable to get the extra uterine nourishment to which it is entitled, and unable to get the correct quantitive and qualitative nutriment by placental diffusion, is thrown back on its own resources. Under such circumstances an increasing degree of postmaturity would be associated with an increasing foetal inanition and loss of weight."

(1) Maternal Factors

Age

< 18 years	17	10.3%
18-30	110	73%
>30	27	17%

Race

	Australian and United Kingdom	European
Survey	92 = 56.1%	72 = 43.9%
Hospital	63.3%	33%

There is a significant increase in the number of wasted babies born to European mothers, P .001.

Parity

Parity	Number	Percentage	Hospital
1	76	46.3	43.3%
2-4	72	43.9	48.3%
5 or	16	9.8	8.4%

(2) Foetal Distress During Labour

Foetal distress occurred in 14 cases, i.e. 8.6%.

Wasting	Number	Percentage
Moderate (136) Group 1	8	5.9%
Severe (27) Group 2	6	22.2%

This increase in the incidence of foetal distress in the more severely wasted group is highly significant:

Group 1		Group 2	
Moderate	$\bar{v}$	Severe wasting	$P < .001$

Similar findings were reported by Scott and Usher (1966) i.e. foetal distress in utero occurred twice as commonly in wasted infants as in normal controls ($P = <.001$). They pointed out that this increase did NOT occur in infants who were underweight but not wasted. This suggests that selection according to the degree of wasting, as in this survey, is a more satisfactory method of selecting the at-risk group of infants than by birth weight.

Gruenwald has outlined his broad concept of foetal distress in a number of publications. This is summarized in Section IV.

(3) Liquor

Meconium staining of the liquor occurred in 60 deliveries, i.e. 36.9%.

Wasting	Number	Percentage
Moderate 136	45	33.1
Severe 27	15	55.6

There is a significantly increased percentage of meconium staining associated with the more wasted group.

The importance of meconium stained liquor is stressed in Chapter V and the increased perinatal morbidity is shown in Chapter IV B.

(4) Method of Delivery

There is a significant increase in the emergency Caesarean section rate in wasted babies (11.1%) compared with the hospital rate of 4.9%.

Method	Number	Percentage
Normal	122	74.8
Instrumental	23	14.1
Caesarean	18	11.1

This difference in percentages is even greater when the 2 wasted groups are considered separately.

	Wasting	
Delivery	Moderate %	Severe %
Normal	77.9	59.3
Instrumental	12.5	22.2
Caesarean	9.6	18.5

Caesarean Section

Group 1		Group 2
Moderate	v.	Severe wasting

9.6% Compared with 18.5% $.001 < P < .002$

The instrumental delivery rate is also significantly greater in the more wasted group. $.01 < P < .02$.

The Placenta

The placentas were weighed and examined for calcification and infarction as described on page

There was no difference in the percentage of healthy placentas in the wasted babies compared with controls.

Healthy Placenta

	Number	Percentage
Wasted group	69	42.4
Controls	75	45.4

Other workers confirm that an estimate of placental function is not possible from simple macroscopic or microscopic examination of the placenta.

Gibberd (1952) stated:

"But we know from experience, that, apart from very gross disturbances of normal anatomy, it is not possible to judge the functional capacity of the placenta from its structural appearance."

Wong and Latour (1966) after microscopic examination of the placentas of 30 malnourished babies and 30 controls concluded:

> "We feel that it is not possible in practice to differentiate the placentas of the 2 groups by means of the microscopic measurements which were undertaken in this study." (Microscopic measurements of the villous area, villous diameter and the total amount of syncytial trophoblast).

There was no significant difference in the mean weights of the placentas of the wasted group compared with the controls.

	Mean Weight (Gm)
Wasted group	495
Controls	460

Thompson et al. (1969) in their study of the relationship between placental and birth weights concluded that weight was a poor indicator of placental adequacy.

The Baby

Sex Ratio

A striking increase in wasted males occurred in this survey:

Total	163
Female	63
Male	100

This sex difference was apparent in each group.

Wasting

	Moderate	Severe
Male	82	18
Female	54	9

This difference is statistically significant $.02 < P < .05$

Scott and Usher found no increase in soft tissue wasting amongst boys but the findings of Sjostedt et al. (1958) were similar to those in this survey. They stated:

> "With advancing stage of dysmaturity, the frequency of boys dominates over that of girls."

Birth Weight (Mean weight (gm).

				Total
Gestation (weeks)	38-40	40-42	42	
Wasted Babies	2890	3140	3320	3160
Controls	3430	3460	3530	3440

The mean birth weight for each gestation group is lower in the wasted babies than in the controls.

Betheras et al. (1969) examined a large series of babies in their private neonatal practice taking measurements of birth weight and head circumference and recording the presence of placental insufficiency (as described by Clifford). They observed that although the placental insufficiency syndrome is the most common condition affecting foetal weight, none of the published series of intrauterine growth charts excluded this category.

Kitchen (1968) also determined standard of intrauterine growth and although his results were based on a population in a lower socio-economic group than the private practice of Betheras et al., there was a close similarity between their results, particularly at the 50th percentile level. The following table shows that their results are also similar to those in this survey.

	Betheras et al.	Kitchen	Lovell
40 weeks	3446	3430	40-42 weeks
41 weeks	3527	3470	3460
42 weeks	3619	3570	

FIGURE 1

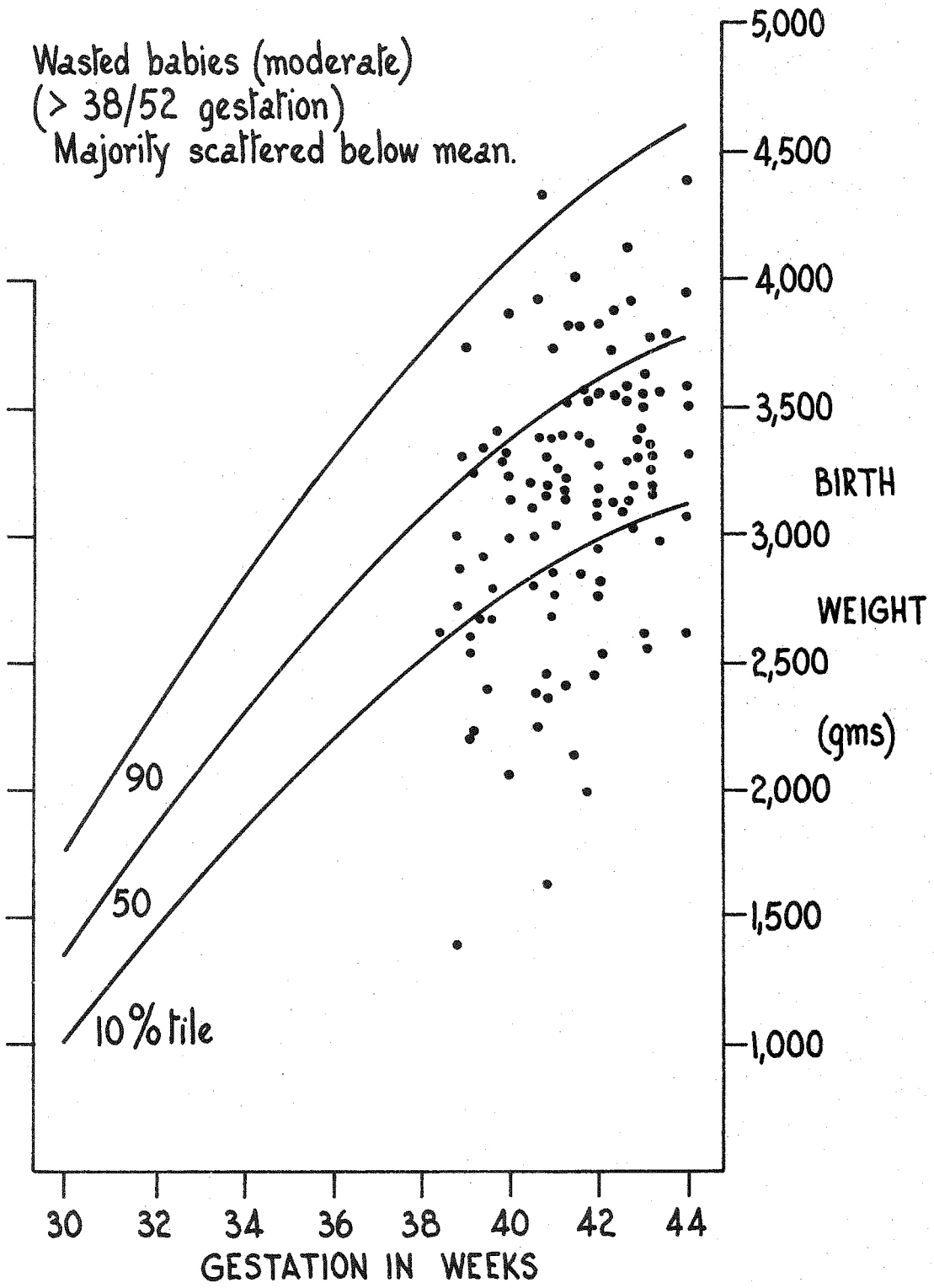
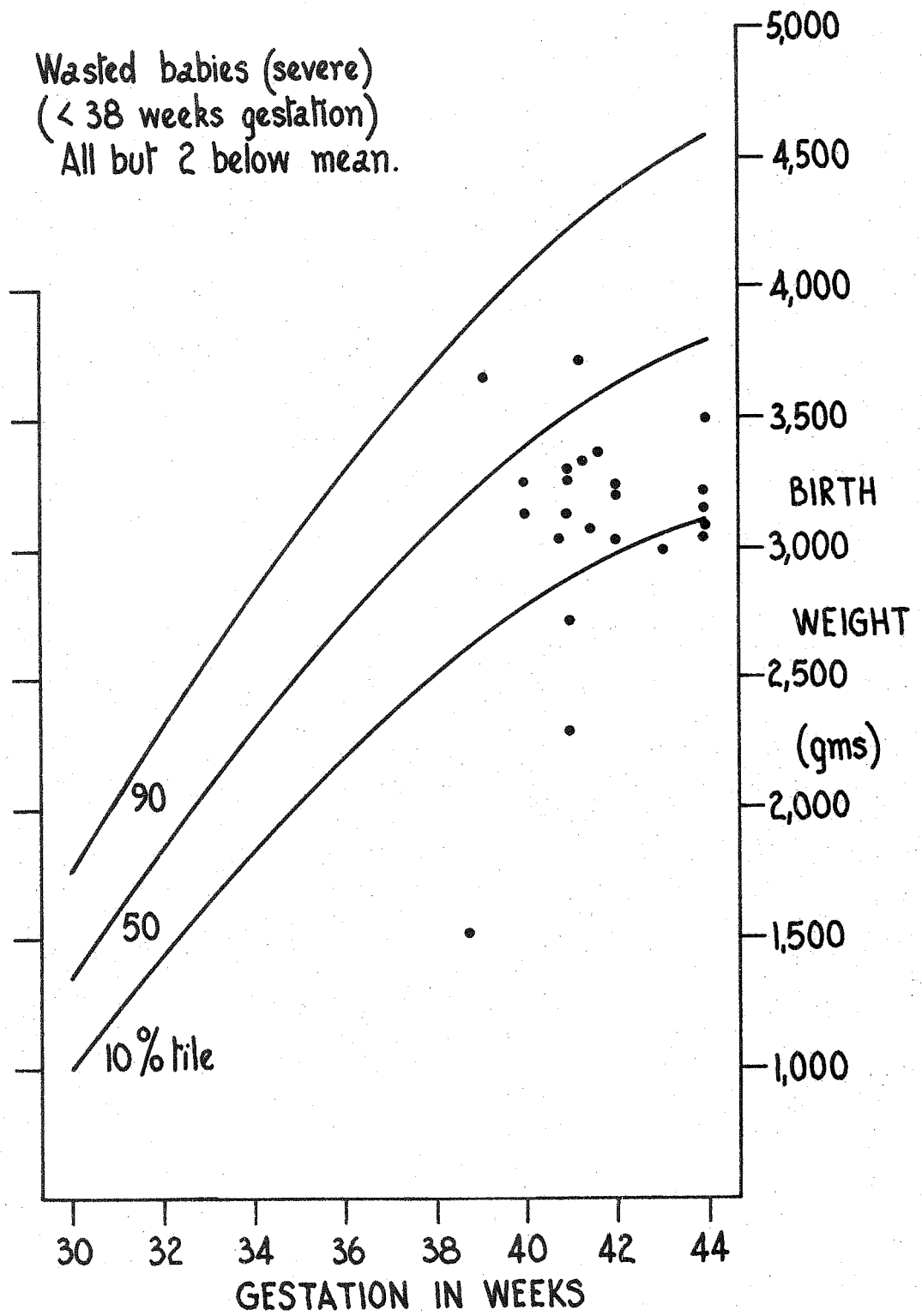

Wasted babies (moderate)
(> 38/52 gestation)
Majority scattered below mean.
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
BIRTH
WEIGHT
(gms)
90
50
10% tile
30
32
34
36
38
40
42
44
GESTATION IN WEEKS

FIGURE 2


Wasted babies (severe)
(< 38 weeks gestation)
All but 2 below mean.
5,000
4,500
4,000
3,500
BIRTH
3,000
WEIGHT
2,500
(gms)
2,000
1,500
1,000
90
50
10% tile
30
32
34
36
38
40
42
44
GESTATION IN WEEKS

Kitchen's results included babies with placental insufficiency whereas the other two did not, and this could explain the slightly lower mean in each of his groups. There was also a difference in the method of rounding off gestation in the two studies.

Taking only the babies with placental insufficiency there is a similarity between the findings of Betheras et al. and my wasted group. (See Figures 1 and 2).

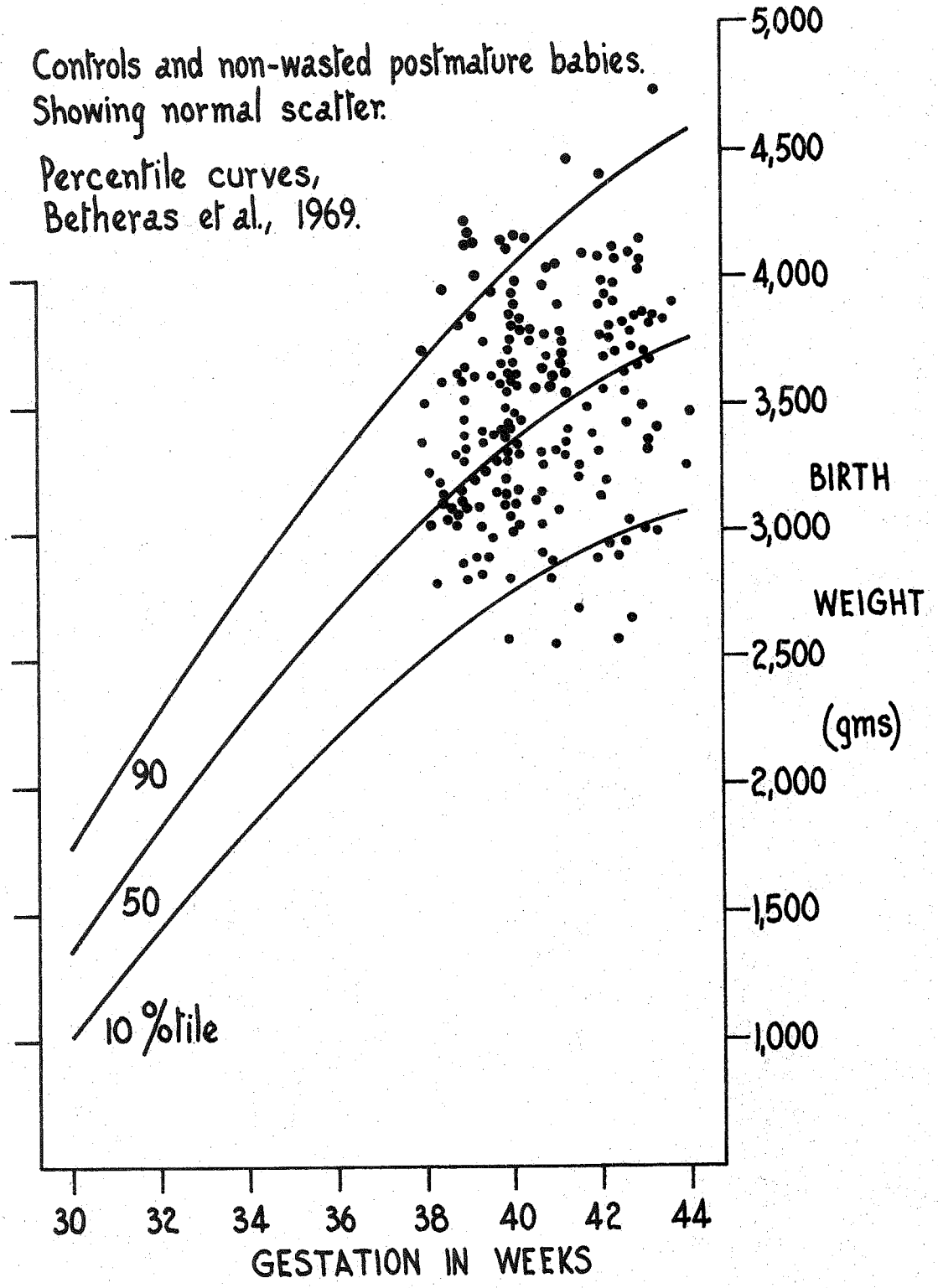
Mean Birth Weight (gm)

Weeks	Betheras et al. Placental Insufficiency	Lovell Wasted Babies
40-41	2996 - 3248	3140
42-42	3297 - 3300	3320
44	3375	Insufficient Number

Kitchen found a slowing of the intra-uterine growth rate after 38 weeks and an actual falling at 44 weeks. He stated:

> "It was common to find that infants born after 42 weeks are deficient in subcutaneous fat and have other stigmata of placental insufficiency which provide visual confirmation of a loss of weight before delivery."

FIGURE 3.


Controls and non-wasted postmature babies.
Showing normal scatter.
Percentile curves,
Betheras et al., 1969.
90
50
10 %tile
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
BIRTH
WEIGHT
(gms)
30
32
34
36
38
40
42
44
GESTATION IN WEEKS

Betheras et al. showed that:

"The exclusion of infants with placental insufficiency from the population and calculation of percentiles for the remaining normal infants alters the percentile curve beyond 34 weeks by causing a shift upwards to a higher weight level, the curve becomes more linear and closer to Gruenwald's concept of normal fetal growth (Gruenwald, 1966)." This applied in this survey also. See figure 3.

Other Measurements

Mean Head Circumference (cm)

Gestation	38-40	40-42	43 +
Wasted Babies	33.2	33.7	34.2
Controls	34.4	35.3	34.6

Mean Crown Rump (cm)

Gestation	38-40	40-42	43 +
Wasted Babies	32	32.5	33.1
Controls	32.5	33.9	33.2

Mean Length (cm)

Gestation	38-40	40-42	43 +
Wasted Babies	48.6	49.8	50.4
Controls	49.9	51.3	50.6

In each gestation group, the measurements of the control group are slightly greater than the group of wasted babies.

The means for both head circumference and length are similar to those derived by Kitchen (1968).

One must agree with his conclusion that the accuracy of measurements taken by the clinician is not great, but that despite this, the compiled charts are useful for the evaluation of an infant who has grown abnormally in utero.

(1) Apgar Scores

Wasting

Apgar	Moderate	Severe
0-4	11%	37%
5-7	22.3%	18.5%
8-10	66.7%	44.5%

There is a significant increase in the percentage of low Apgar scores in the more wasted group:

Apgar 0 - 4

Group 1		Group 2
Moderate (11%)	$\bar{v}$	Severe Wasting (37%)

$P < .001$

Apgar at 1 Minute	Wasted	Controls
0 - 4	24	1
5 - 7	36	26
8 - 10	102	136

Apgar rating at 5 minutes.

12 wasted babies, but no controls had an Apgar score below 7 at 5 minutes.

7 of these were moderately wasted (5.2% of total).

5 were severely wasted (18.5% of total).

This difference is highly significant $P < .001$.

(2) Time to Establish Respiration

Wasting

Time in Minutes	Moderate	Severe
0 - 2	80.2%	62.1%
3 - 5	15.4%	23.1%
5	4.4%	14.8%

In the more wasted group a significant increase occurred in the percentage of babies in whom the onset of respiration was delayed longer than 5 minutes.

Group 1		Group 2	
Moderate 4.4%	$\bar{v}$	Severe 14.8%	$P < .001$

Totals

Time	Wasted	Controls
0 - 2	126	155
3 - 5	27	8
5	10	0

The figures shown for resuscitation, Apgar scores and delayed respiration all reflect the increase in birth asphyxia in the severely wasted babies compared with both the moderately wasted babies and the controls. Scott and Usher (1966) found asphyxia neonatorum to be 3 times as common in wasted infants as in normal controls.

This increase did not occur in the underweight babies who were not wasted, thus confirming Usher's later suggestion that too many normal babies are included, if those below the tenth percentile are considered to be at risk.

(3) Resuscitation

	Wasted Babies	Controls
Aspiration	104	144
Bag and Mask	44	19
Intubation	15	0

The increasing need for active resuscitation in the wasted babies is apparent from the above figures.

When separated according to the degree of wasting there is a highly significant increase in the need for intubation in the severely wasted group.

Wasting

Resuscitation	Moderate	Severe
Aspiration	69.1%	37%
Bag and Mask	25%	37%
Intubation	5.9%	26%

Intubation:

Moderate (5.9%) $\bar{v}$ Severe wasting (26%) $P < .001$

Perinatal Mortality

There were two early neonatal deaths and one still-birth during the period of the survey, i.e. 1.9% of the wasted babies.

Stillbirth

This baby was not included in any of the previous statistics because of the impossibility of scoring the degree of wasting. However the pathologist commented on the apparent wasting of the subcutaneous tissues and the peeling skin, so it was considered justifiable to include it as a wasted baby.

Baby

Mother 19 years. Gravida 2. 12 days past term.
Breech presentation. Birth weight 2,835 gm.
Autopsy revealed no obvious cause for the stillbirth and the organs were unsuitable for further examination.

Organ Weights (gm)

Brain 370	Liver 135
Thyroid 1.0	Spleen 11.5
Thymus 5.0	Adrenals 11.5
Heart 16	Kidneys 23.5

The thymus gland was considerably reduced in weight.

Neonatal Deaths

Baby P.

Mother 37 years. Gravida 4. 11 days past term.
Foetal distress. Meconium stained liquor.
Normal delivery. Female. Birth weight 2,900 gm.

Apgar 5 at 1 minute. Apgar 6 at 5 minutes. Resuscitation - bag and mask. The baby was in respiratory distress from birth, her arms and legs were extended and the skin, nails and cord were meconium stained. Wasting was severe (6) and desquamation also (8).

Despite intravenous infusion of dextrose and bicarbonate, frequent aspiration, and high oxygen concentrations, the baby's condition deteriorated and she died at 11 hours.

Post mortem examination showed massive aspiration of meconium.

Microscopic examination of the lungs suggested a diagnosis of perinatal pneumonia.

Organ Weights (gm)

Brain 365	Liver 143
Thyroid 1.5	Spleen 10.5
Thymus 8.5	Kidney 24.5

The thymus was considerably reduced in weight.

Baby S.

Mother 31 years. Gravida 4. Normal delivery. 6 Days before term. No antenatal care.

Birth weight 3,130 gm. Apgar 1 at 1 minute. 1 at 4 minutes. Resuscitation - endotracheal intubation

and intermittent positive pressure ventilation.

An immediate infusion of dextrose and bicarbonate was started.

The baby was pale and inactive with a slow respiratory rate and absent reflexes. The arms and legs were extended, wasting was severe (6) and desquamation moderate (5).

He died at 8 hours.

After microscopic examination of the tissues, the cause of death was given as intra-uterine anoxia.

Organ Weights (gm)

Brain 462	Spleen 8.5
Thymus 7.5	Adrenals 7.5
Heart 18	Kidney 23
Liver 120	Thyroid 1

i.e. There is a reduction in the weight of all organs except the brain.

In each of the 3 perinatal deaths there was a reduction in the weight of the thymus gland.

Gruenwald (1964) found the thymus to be the only organ which decreased significantly in size after term, indicating involution as a result of chronic stress. When

considering dysmature (wasted) infants, he found the brain to be least affected and the heart somewhat more; some organs were retarded, and the thymus actually decreased in size. He considered "that the average fetus post term suffers some measure of deprivation and malnutrition as a result of subacute fetal distress."

Naeye (1967) in a necropsy study of 16 postmature newborn infants found the weights of the adrenals, liver, spleen and thymus to be disproportionately small, particularly in the 10 growth retarded infants. The organs had a subnormal number of parenchymal cells which had a subnormal mass of cytoplasm. He felt that these abnormalities resembled those encountered in undernutrition rather than chronic prenatal hypoxia. Changes due to intrauterine hypoxia were present in both stillborn and liveborn infants viz meconium staining, inhalation of amniotic debris multiple petechiae on the pleural and pericardial surfaces.

In this survey, each of the 3 perinatal deaths showed a reduction in the weight of the thymus and evidence of undernutrition, consistent with the findings of Gruenwald and Naeye. The 2 neonatal deaths had signs of intrauterine hypoxia.

Other Deaths

Two babies died soon after the neonatal period, and as they were also small for dates they will be discussed in more detail in that section (page 192). They showed signs of wasting, so a summary is included here.

Baby T.

Mother 17 years. Gravida 1 (single). 5 days before term. Foetal distress. Meconium stained liquor. Instrumental delivery. Apgar 5-8. Birth weight 2,180 gm. Moderate wasting (3). Mild desquamation (2). He was slow to thrive, developed cardiac failure and was transferred to the Adelaide Childrens Hospital where he subsequently died.

Diagnosis: Atrial septal defect. Agenesis of the corpus callosum. Pneumonia.

Baby V.

Mother 19 years. Gravida 1 (single). 8 days after term. Meconium in the liquor. Normal delivery. Apgar 7. Birth weight 1,650 gm.

There was meconium staining of the cord and nails, desquamation (3) and wasting (5). He failed to thrive, developed increasing head retraction and died at 2 months.

Perinatal Morbidity

(1) Congenital Abnormalities

A high incidence of congenital abnormalities was found amongst the wasted babies. Scott and Usher (1966) have also reported this.

Severe abnormalities - 6 babies (3.7%).

Baby K.

Birth weight 2,000 gm. (light for dates).

Cardiac failure.

Abnormality - Patent ductus arteriosus - ligated.

Baby T.

Birth weight 2,180 gm. (light for dates).

Atrial septal defect.

Abnormality - Agenesis of the corpus callosum.

Baby B.

Birth weight 3,290. Mother 16 years. Gravida 1. Meconium stained liquor. Normal delivery. Apgar 9. Meconium staining of the skin and nails. Severe desquamation (7). Moderate wasting (5).

Abnormality - Bilateral microphthalmia and corneal opacities.

Baby T.

Birth weight 3,410 gm. Mother 25 years. Gravida 6. Offensive liquor. Normal delivery. Apgar 9. Moderate desquamation (4). Moderate wasting (3). Abnormality - Congenital heart defect. ? ventricular septal defect. ? aortic stenosis.

Baby T.

Birth weight 3,520 gm. Mother 34 years. Gravida 2. 2 days before term. Normal delivery. Desquamation moderate (4). Wasting moderate (3). Hypoglycaemia (blood glucose 23 mg.) Convulsions.
Abnormality - Down's syndrome.

Baby S.

Birth weight 3,420 gm. Mother 36. Gravida 4. 11 days past term. Normal delivery. Desquamation severe (6). Wasting moderate (3).
Abnormality - Phenylketonuria.

(2) Other Congenital Abnormalities

Baby Z.

Birth weight 4,330 gm. Mother 39 years. Gravida 5. 5 days after term. Meconium in liquor. Normal delivery. Moderate desquamation (5) and wasting (5).
Abnormality - Congenital dislocation of left hip.

Baby G.

Birth weight 3,920 gm. Mother 37 years. Gravida 6. Term + 3 days. Normal delivery. Moderate desquamation (4) and wasting (5).

Abnormality - Hypospadias.

Baby S.

Birth weight 3,190 gm. Mother 24 years. Gravida 2. Term + 5 days. Normal delivery. Meconium stained liquor. Desquamation severe (9). Wasting severe (6).

Abnormality - Glucose 6 phosphate dehydrogenase deficiency.

Baby H.

Birth weight 3,955 gm. Mother 24 years. Gravida 4. Term + 13 days. Normal delivery. Desquamation moderate (4). Wasting moderate (5).

Abnormality - Undescended testis. Accessory R auricle.

Baby B.

Birth weight 3,010. gm. Mother 23 years. Gravida 1. Caesarean section. Desquamation severe (6). Wasting severe (6).

Abnormality - small right hand. Syndactyly of second and third fingers.

C.N.S. Abnormality - 1st Day

Major central nervous system abnormality was present in 16 babies (9.8%). 8 were severely wasted (30%) and 8 were moderately wasted (5.9%).

The increase in the severely wasted group is highly significant. $P < .001$

Summaries of Neonatal Histories

Major control nervous system abnormality.

Baby S.

This baby died at 8 hours and his clinical condition is described in the section on perinatal mortality.
Wasting 6. Desquamation 5.

Baby P.

This baby died at 11 hours and her condition is discussed in Section IV B.
Wasting 6. Desquamation 8.

Baby G.

Mother 30 years. Gravida 1. 1 day past term. Instrumental delivery. Birth weight 3,200. Apgar 1 at 1 minute. 8 at 5 minutes. Resuscitation - intubation and intermittent positive pressure.
Wasting 7. Desquamation 8.

The baby was irritable with increased muscle tone. The Moro grasp and sucking reflexes were poor and his right arm and leg were twitching. He had proptosis and hyphaema of the right eye and bilateral corneal opacities were present. The linear opacity on the l eft eye healed in one week but the cornea on the right eye remained opaque. Due to the proptosis, the cornea was exposed to direct pressure in utero and a linear scar was still present at one year. On the fourth day he began to suck, but the Moro grasp reflexes were still poor and muscle tone was still increased.

Social Quotient at one year 89.

Baby C.

Mother 21 years. Gravida 1. 13 days before term. Meconium stained liquor. Normal delivery.

Birth weight 1,500 gm. i.e. light for dates.

Apgar at 1 minute 5. At 5 minutes 8. Wasting 9. Desquamation 7.

The Moro grasp and sucking reflexes were absent, the arms tightly flexed, the thumbs adducted across the palms, the cord and nails were meconium stained and coarse tremors of the limbs were apparent. The blood glucose level was 26 mgm.% and the serum calcium normal.

Intravenous dextrose was given for 48 hours but eventually steroids and prolonged intravenous therapy were necessary to maintain the blood glucose level. On the fifteenth day his general condition deteriorated due to septicaemia (E. coli) which responded to Kanamycin. He was discharged at 6 weeks.

Social Quotient at one year 70.

Baby S.

Mother 32 years. Gravida 2. 37 days past term. Birth weight 3,500 gm. Wasting 7. Desquamation 5. This baby's extraordinary behaviour during the first few hours of life is described elsewhere (see page 109).

Summary: Apgar 1-1.
Respirations established at 4 hours.
Absent reflexes.

Social Quotient at one year 79.

Baby K.

Mother 28 years. Gravida 1. 12 days overdue. Surgical induction. Meconium stained liquor. Long labour, disproportion. Caesarean section for foetal distress. Apgar at 1 minute - 1. At 5 minutes - 6.

He was intubated immediately after birth but respirations were not fully established until 6 minutes.

Wasting 3. Desquamation 3.

The Moro grasp and sucking reflexes were poor, muscle tone was increased and coarse tremors were present. The skin, nails and cord were meconium stained. The thumbs were adducted across the palms. A routine dextrose test showed a blood glucose below 40 mgm.%, so an intravenous infusion of dextrose was commenced. Acidosis was corrected with sodium bicarbonate. His condition gradually improved during the next 5 days. Social Quotient at one year 90.

Baby A.

Mother 21 years. Gravida 1. 9 days past term. Instrumental delivery. Birth weight 3,170 gm. Apgar at 1 minute 4. At 5 minutes 5. The baby was intubated and required intermittent positive pressure for over 12 hours. Intravenous dextrose and bicarbonate was given soon after delivery. Wasting 5. Desquamation 5. The Moro grasp and sucking reflexes were absent, tone was increased and the thumbs were adducted across the palm.

He seemed normal on the fourth day.

Social Quotient at one year 104.

Baby B.

Her clinical condition is described on page 105.

Summary - Gravida 2. 25 years. Term + 17 days. Normal delivery. Meconium in the liquor. Apgar 8. Birth weight 3,230 gm. Wasting 4. Desquamation 7. Absent reflexes, increased tone, adducted thumbs. Meconium staining.

Social Quotient at one year 118.

Baby S.

Described in detail on page 108.

Summary - Gravida 2. 29 years. Term + 32 days. Normal delivery. Meconium in liquor. Apgar 5-7. Birth weight 3,500 gm. Wasting 3. Desquamation 4. Depressed reflexes, H 7.2. Blood glucose 23 mgm.%. Meconium stained nails, adducted thumbs, pneumonia.

Social Quotient at one year 114.

Baby E.

Described in detail on page 106.

Summary - Gravida 2. 30 years. Term + 28 days. Normal delivery, meconium in liquor. Apgar 1 to 1. Intubated. Birth weight 3,100 gm. Wasting 6. Desquamation 5. Depressed reflexes, increased tone, adducted thumbs. Meconium staining, inhalation of meconium.

Social Quotient at one year 89.

Baby R.

Mother 38 years. Gravida 8. 9 days past term.
Meconium stained liquor. Normal delivery.
Birth weight 3,690 gm. Apgar at 1 minute 5.
at 5 minutes 9. Resuscitation - bag and mask.
Wasting 6. Desquamation 6.
The Moro grasp and sucking reflexes were depressed, tone was increased with adduction of thumbs across the palms, and the nails and cord were meconium stained. His condition improved gradually during the first week and he was discharged on the 9th day.
Social Quotient at one year 87.

Baby T.

Mother 34 years. Gravida 2. 2 days before term.
Meconium stained liquor. Normal delivery.
Birth weight 3,520 gm. Apgar 7. Wasting 4.
Desquamation 4.
The baby showed the classical signs of Downs syndrome but is included here because of the associated central nervous system disorder. There was meconium staining of the cord and nails. He had several convulsions mainly involving the right arm and leg. These continued intermittently for 4 days despite intravenous correction of his biochemical abnormalities (blood glucose 23 mgm.%, serum calcium 7.7 mg.%). On

the fourth day there was still occasional twitching and some head retraction, but thereafter he improved quickly.

Baby D.

Mother 24 years, Gravida 1. 1 day after term. Meconium stained liquor. Normal delivery. Birth weight 2,380 gm., i.e. light for dates. Apgar at 1 minute 4. At 5 minutes 8.

Resuscitation - intubation and intermittent positive pressure. Respirations were established at 5 minutes. Wasting 5. Desquamation 5.

She had intravenous correction of her acidosis (pH 7.20). Her muscle tone was increased, reflexes were depressed and she had a period of apnoea 4 hours after birth. She improved gradually and seemed normal on the fourth day.

Social Quotient at one year 77.

Baby M.

Mother 24 years. Gravida 3. 13 days after term. Normal delivery, born before admission. Birth weight 2,180 gm. Apgar at 1 minute 1. At 5 minutes 1. Wasting 3. Desquamation 1.

His acidosis (pH 7.15) was corrected with intravenous alkali with dextrose. His reflexes remained sluggish during the first day after which rapid improvement

occurred. He seemed normal on the fourth day.
Social Quotient at one year 86.

Baby E.

Mother 24 years. Gravida 2. 7 days past term. Meconium stained liquor. Caesarean section for foetal distress. Birth weight 3,340 gm. Apgar at 1 minute 1, at 5 minutes 8. Intubated, intermittent positive pressure resuscitation. Wasting 6. Desquamation 6.
His reflexes were absent and he was sluggish and hypertonic. There was meconium staining of the skin, nails and cord. His condition improved rapidly after correction of his acidosis and he seemed normal on the fourth day.
Social Quotient at one year 120.

Baby T.

Discussed in detail on page 192.
Summary: Mother 17 years. Gravida 1. 5 days before term. Foetal distress. Meconium stained liquor. Apgar 5 to 8. Birth weight 2,180. Wasting 3. Desquamation 2. Cardiac failure. Died at 6 weeks. Diagnosis: Atrial septal defect. Agenesis of corpus callosum. Pneumonia.

Minor Central Nervous System Abnormality

Key: B.W. = Birth weight.
E.R. = Time to establish respiration
D = Desquamation score
W = Wasting score
S.Q. = Social Quotient at 1 year

Summary of Neonatal History

Baby S.

Mother 24 years. Gravida 2. Term + 5 days. Meconium in liquor. B.W. 3,190. Apgar 6-9. E.R. 4. Bag and Mask. D6 W9. Increased tone. Sucking poorly. S.Q. 108.

Baby K.

Mother 33 years. Gravida 2. Term + 8 days. Meconium in liquor. B.W. 3,370. Apgar 3-8. E.R. 4. Aspiration D4 W6. Not sucking. S.Q. 91. Poor sleeper.

Baby T.

Mother 29 years. Gravida 1. Term - 4 days. Clear liquor. B.W. 3,680. Apgar 10. E.R. 1. Aspiration D6 W6. Tremors. Increased tone. S.Q. 95.

Baby C.

Mother 20 years. Gravida 1. Term - 6 days. Clear liquor. B.W. 2,540. Apgar 9. E.R. 1. Aspiration.

D4 W3. Hypoglycaemia. Blood glucose 21 mgm.%. Thumbs adducted. Irritable. S.Q. 104.

Baby A.

Mother 28 years. Gravida 1. Term + 8 days. Clear liquor. B.W. 3,260. Apgar 8. E.R. 2. Aspiration. D4 W4. Not sucking. S.Q. 98. Poor sleeper.

Baby W.

Mother 22 years. Gravida 1. Term - 12 days. Meconium in liquor. B.W. 2620. Apgar 9. E.R. 1. Aspiration. D4 W5. Not Sucking. Hypoglycaemia. S.Q. 100.

Baby L.

Mother 24 years. Gravida 1. Term + 13 days. Clear liquor. B.W. 3,530. Apgar 9. E.R. 1. Aspiration. D3 W3. Sucking poorly. S.Q. 115. Adelaide Childrens Hospital - Gastroenteritis.

Baby M.

Mother 23 years. Gravida 2. Term - 1 day. Clear liquor. B.W. 3,300. Apgar 7. E.R. 2. Aspiration. D3 W3. Sluggish. Poor sucking and grasp. S.Q. 98. Sleep poor.

Baby D.

Mother 24 years. Gravida 4. Term + 13 days. Clear liquor. B.W. 3,410. Apgar 10. E.R. 1. Aspiration D8 W8. Increased tone. Sucking poorly. S.Q. 95.

Baby I.

Mother 32 years. Gravida 3. Term - 1 day. Clear liquor. B.W. 3,320. Apgar 9. E.R. 1. Aspiration. D4 W4. Increased tone. Tremors. S.Q. 100.

Baby H.

Mother 23 years. Gravida 2. Term + 6 days. Clear liquor. B.W. 2,850. Apgar 9. E.R. 1. Aspiration. D2 W4. Tremors. S.Q. 88.

Baby B.

Mother 16 years. Gravida 1. Term + 7 days. Meconium in liquor. B.W. 3,290. Apgar 9. E.R. 1. Aspiration D4 W6. Increased tone. Not sucking. Microphthalmia. S.Q. 48.

Baby R.

Mother 27 years. Gravida 1. Term - 5 days. Clear liquor. B.W. 2,899. Apgar 6-8. E.R. 2. Aspiration D4 W4. Sucking poorly. S.Q. 97. Adelaide Childrens Hospital - Bronchitis.

Baby B.

Mother 18 years. Gravida 1. Term + 7 days. Meconium in liquor. B.W. 3,020. Apgar 7. E.R. 1. Aspiration D4 W5. Increased tone. Tremors. S.Q. 104.

Baby C.

Mother 32 years. Gravida 2. Term - 2 days. Meconium in liquor. B.W. 2,940. Apgar 9. E.R. 1. Aspiration. D2 W5. Irritable. Adelaide Childrens Hospital - Gastroenteritis. S.Q. 91.

Baby C.

Mother 24 years. Gravida 1. Term - 8 days. Clear liquor. B.W. 2,710. Apgar 9. E.R. 1. D3 W4. Hypoglycaemia. Blood glucose. 27 mgm.%. Tremors. S.Q. 89.

Baby M.

Mother 22 years. Gravida 1. Term + 8 days. Clear liquor. B.W. 3,280. Apgar 3-6. E.R. 5. Intubation D4 W4. Increased tone. Tremors. S.Q. 115.

Baby E.

Mother 19 years. Gravida 1. Term - 5 days. Clear liquor. B.W. 2,610. Apgar 6-7. E.R. 7. Bag and Mask. D3 W5. Increased tone. S.Q. 99.

Baby S.

Mother 36 years. Gravida 4. Term + 11 days. Clear liquor. B.W. 3,420. Apgar 8. E.R. 1. Bag and Mask. D6 W3. Sucking poorly. Guthrie test positive. S.Q. 100. Sleep poor.

Baby G.

Mother 37 years. Gravida 6. Term + 3 days. Clear liquor. B.W. 3,920. Apgar 5-10. E.R. 1. Bag and Mask. D4 W5. Sucking poorly. Mild hypospadias. S.Q. 106. Adelaide Childrens Hospital - Broncho-pneumonia.

Baby R.

Mother 24 years. Gravida 4. Term + 6 days. Clear liquor. B.W. 3,425. Apgar 8. E.R. 1. Aspiration. D2 W5. Sucking poorly. Irritable. S.Q. 106. Sleep poor.

Baby V.

Mother 23 years. Gravida 1. Term + 9 days. Clear liquor. B.W. 3,530. Apgar 9. E.R. 1. Aspiration. D6 W3. Not sucking. Tone increased. S.Q. 102.

Baby P.

Mother 33 years. Gravida 4. Term + 3 days. Meconium in liquor. B.W. 3,000. Apgar 6-10. E.R. 1. Bag and mask. D6 W4. Sucking poorly. S.Q. 108.

Baby T.

Mother 18 years. Gravida 1. Term + 5 days. Clear liquor. B.W. 2,900. Apgar 7-10. E.R. 2. Bag and mask. D1 W5. Blood glucose 31 mg.%. Increased tone. Sucking poorly. S.Q. 111.

Baby T.

Mother 17 years. Gravida 1. Term + 7 days. Clear liquor. B.W. 3,500. Apgar 4-6. E.R. 8. Bag and mask. D7 W5. Increased tone. S.Q. - did not attend.

Baby W.

Mother 16 years. Gravida 1. Term + 16 days. Clear liquor. B.W. 3,820. Apgar 9. E.R. 1. Aspiration. D5 W4. Not sucking. S.Q. 97. Sleep poor.

Baby P.

Mother 23 years. Gravida 2. Term + 7 days. Meconium in liquor. B.W. 3,910. Apgar 9. E.R. 1. Aspiration. D6 W3. Tremors. Not sucking. S.Q. - did not attend.

Baby V.

Mother 16 years. Gravida 1. Term - 7 days. Clear liquor. B.W. 2,870. Apgar 4-9. E.R. 2. Bag and mask. D3 W3. Increased tone. S.Q. - did not attend.

Baby G.

Mother 19 years. Gravida 1. Term + 15 days.

Meconium in liquor. B.W. 2,540. Apgar 2-6. E.R. 4. Bag and mask. D1 W4. Not sucking. S.Q. 106. Overactive child.

The summaries of 26 postmature and 7 small for dates babies with C.N.S. abnormality who were also wasted will be found in the appropriate section.

(3) Desquamation

Ballantyne (1902), Ley (1953) and Clifford (1954) all regarded desquamation as a sign of postmaturity. Clifford considered it to be due to the loss of protection by the vernix resulting in maceration of the horny layer of the epidermis. Blystadt et al. (1951) showed a marked increase in the squamous cell count of the amniotic fluid after term from 2,000 cells/ml. to 40,000/ml. Ley (1953) demonstrated the association between skin desquamation and gestational length.

In a comprehensive survey, Griffiths (1966) reached the following conclusions:

(a) There was a significant association between skin desquamation and gestational age.

(b) There was a close association between desquamation and wasting, and in wasted infants desquamation

was not influenced by the length of gestation.

(3) Skin desquamation was only a valid index of postmaturity in well-nourished infants and in wasted infants it is an integral part of the placental insufficiency syndrome.

Because of these conclusions, it was decided to use only the wasting score as the criterion for admission to the placental insufficiency survey.

The method of scoring the degree of desquamation is described on page 15.

Results

Mild	0.2	32	19%
Moderate	3-6	110	69%
Severe	7-9	28	13%

The severest degree of desquamation occurs after 42 weeks gestation.

Gestation (weeks)	Number	Mild	Moderate	Severe
38-40	33	15	82	3
41-42	62	18	70	12
42-43	40	22	55	22
43	27	21	63	16

Desquamation and Wasting

A highly significant correlation was found between desquamation and wasting, as in the wasted postmature babies. (Page 122).

$$r = .60 \qquad P < .001$$

(4) Position of Thumbs

The correlation between the position of the thumbs in the palm and the central nervous system abnormality was discussed in the section on postmaturity.

This group of babies with adducted thumbs also shows the same significant increase in nervous system abnormality.

T1 - thumbs adducted across the palm

T2 - intermediate

T3 - hands open, thumb abducted

	Wasted	Postmature
T1	14.1%	14.6%
T2	76%	73.3%
T3	9.8%	12.1%

Only 13% of the babies whose thumbs were adducted were considered to be normal on the first day compared with 75% of those with open hands and 58% of those with the

intermediate position.

These findings are statistically significant.

Normal C.N.S. T1 compared with T3 $P < .001$

T1 compared with T2 $P < .001$

39% of babies with adducted thumbs were considered to have severe abnormality of the central nervous system on the first day compared with 5 in the intermediate position and none in the open position.

Severe C.N.S. abnormality T1 $\bar{v}$ T3 $P < .001$

T1 $\bar{v}$ T2 $P < .001$

(5) Meconium Staining

Meconium staining of the nails and umbilical cord occurred in 29 babies (17.2%). As these babies also showed either moderate or severe wasting, they fit into the group "placental insufficiency syndrome Stage 2", as described by Clifford.

Clifford (1945) described 57 living infants with staining of the vernix skin, nails and cord at birth and considered it resulted from episodes of foetal asphyxia days or weeks before the onset of labour with the passage of meconium into the amniotic fluid. Desmond et al. (1955)

showed that staining of the nails began 4 to 6 hours, and the vernix 12 hours after exposure to meconium stained liquor, confirming Clifford's view that meconium had been in the liquor some time prior to the onset of labour in these cases.

Taylor et al. (1952) also reviewed babies born with yellow vernix and like Clifford found an increased neonatal mortality and morbidity and a high incidence of foetal distress and neonatal apnoea. Postmaturity was also a feature.

The findings of this survey closely follow the same pattern.

Maturity

Gestation (weeks)	Number
38-40	3
40-42	12
42-43	7
43	7

Of the 29 babies, 26 were beyond term and 14 were two weeks or more postmature.

There was a high incidence of foetal distress (25%) and the Caesarean section rate was increased (20.7%).

The increased asphyxia was also reflected in the figures for resuscitation, Apgar rating and time to establish regular respiration.

Apgar at 1 minute (0-4)	31%
Intubation	27.6%
Respirations established after 5 minutes	17.2%

Birth Weight:

6 of the babies were light for dates.

The mean birth weight was 240 gm. lower than the mean for the whole series.

i.e. 2,920 gm. compared with 3,160 gm.

Central Nervous System Abnormality:

Baby R. and Baby P. died during the first 24 hours.

Baby V. died at 2 months.

Of the 27 babies who survived the perinatal period, 8 (32.1%) showed severe abnormality and 15 (43.6%) moderate abnormality of the nervous system on the first day. Their clinical details have been given in another section (page 160).

When the wasted babies are divided into 2 groups, with and without meconium staining, the difference in nervous system abnormality is quite significant.

Wasted Babies

CNS	Meconium Stained		No Staining	
Normal	4	14.8%	83	61.5%
Moderate abnormality	15	45.6%	45	33.3%
Severe abnormality (excluding 2 deaths)	8	29.6%	7	5.2%

Meconium Stained $\bar{v}$ no Staining:

Severe CNS abnormality 29.6% $\bar{v}$ 5.2%

Significance $P < .001$

Other Neonatal Morbidity

Pneumonia:

Two babies had pneumonia which responded promptly to antibiotic therapy. In each instance the liquor had been meconium stained.

Hypoglycaemia:

Three babies had true blood glucose levels under 20 mg. and were given intravenous glucose. Their birth weights were: 2,910 gm. 2,540 gm. and 1,500 gm.

Orthopaedic Abnormalities:

Minor positional abnormalities of the feet occurred in thirty-three babies, the majority being in the

calcaneo valgus position. The only treatment required was simple manipulation by the mother during the first few weeks of life.

It is postulated that this high incidence is due to intrauterine pressure in the presence of a diminished amount of liquor amnii, which is a common finding in placental insufficiency.

Fourth Day Examination

Eight babies showed abnormal neurological signs at this time.

	S.Q. at One Year
Baby A.	
Sucking poorly	98
Baby C.	
Sucking poorly Poor reflexes	70
Baby R.	
Sucking poorly Poor reflexes	87
Baby S.	
Not sucking	114
Baby V.	
Irritable Head retraction	Died

		S.Q. at One Year
Baby G.		
	Sucking slowly Increased tone	89
Baby K.		
	Sucking poorly Depressed reflexes	90
Baby D.		
	Increased tone	95

Of the eight babies, five had a low S.Q. at one year and one had died.

Six Weeks Examination

At this examination, 16 babies were thought to be possibly abnormal:

		S.Q. at One Year
Baby S.	Not smiling	114
Baby M.	Not smiling or following	99
Baby A.	Increased tone, tremors of legs	104
Baby K.	Increased tone, squint, R. thumb adducted	90
Baby C.	Not smiling or following	70
Baby M.	Not smiling	86
Baby D.	Increased tone, adducted thumbs	95
Baby M.	Excessive irritability	96
Baby B.	Tone increased, late smiling	105

		S.Q. at One Year
Baby M.	Tone increased, squint	106
Baby V.	Extensor spasm of legs	-
Baby G.	Late smiling	-
Baby E.	Increased muscle tone	89
Baby I.	Not smiling, poor head control	89
Baby H.	Late smiling, poor head control	98
Baby M.	Late smiling	100

The Social Quotient at one year was low in five babies once again emphasizing the value of a screening examination at six weeks.

One Year Examination

Social Quotient

	Number	Low S.Q.
Wasted	131	28 = 21.4%
Controls	120	2 = 1.7%

There is a significant increase in low Social Quotients in wasted babies c.f. controls $P<.001$

Degree of Wasting

		Low S.Q.	
Moderate	111	20	18%
Severe	20	8	40%

There is a highly significant increase in the percentage of babies with a low S.Q. as the degree of wasting increases.

Low S.Q: Moderate 18% $\bar{v}$ Severe 40%

Significance $P < .001$

Summaries of Neonatal Histories of Babies with a Low Social Quotient at One Year

Wasted Babies:

Baby F.

Mother 28 years. Gravida 4. Term - 6 days. Normal delivery. Birth weight 3,280 gm. Male. Apgar 10. E.R. 1. Aspiration D3 W3. Illness: Bronchitis Pneumonia. S.Q. 87.

Baby G.

Mother 30 years. Gravida 1. Term + 1 day. Instrumental. Birth weight 3,200. Male. D6 W3. Apgar 1-8. E.R. 3. Intubation. S.Q. 89.

Baby W.

Mother 25 years. Gravida 3. Term + 11 days. Normal delivery. Birth weight 3,400 gm. Female. D8 W6. Apgar 9. ER. 1.Bag and Mask. S.Q. 85.

Baby J.

Mother 24 years. Gravida 3. Term + 7 days. Normal delivery. Meconium in liquor. Birth weight 2,990. Male. D5 W4. Apgar 8. E.R. 1. Aspiration. Illness: Heat Exhaustion. S.Q. 74.

Baby B.

Mother 16 years. Gravida 1. Term + 7 days. Meconium in liquor. Birth weight 3,290 gm. Male D4 W6. Apgar 9. E.R. 1. Aspiration. Meconium stained nails. S.Q. 48.

Baby L.

Mother 30 years. Gravida 4. Term + 12 days. Normal delivery. Birth weight 2,880 gm. Female D1 W3. Apgar 10. E.R. 1. Aspiration. Poor sleeper. S.Q. 90.

Baby T.

Mother 25 years. Gravida 6. Term + 60 days. Normal delivery. Offensive liquor. Birth weight 3,410 gm. Female. D4 W3. Apgar 9. E.R. 1. Aspiration. S.Q. 60.

Baby C.

Mother 24 years. Gravida 1. Term - 8 days. Normal delivery. Birth weight 2,710. Male. D3 W4. Apgar 9. E.R. 1. Aspiration. S.Q. 89.

Baby V.

Mother 24 years. Gravida 2. Term - 4 days. Normal delivery. Birth weight 3,000. Female. D3 W3. Apgar 8. E.R. 2. Aspiration. S.Q. 85.

Baby G.

Mother 27 years. Gravida 1. Term + 3 days. Caesarean section. Meconium in liquor. Birth weight 2,870 gm. Female. D6 W4. Apgar 5-8. E.R. 4. Intubation. S.Q. 90.

Baby C.

Mother 32 years. Gravida 2. Term - 2 days. Normal delivery. Meconium in liquor. Birth weight 2,940. Female D2 W5. Apgar 9. E.R. 1. Aspiration. Sleep poor. S.Q. 91.

Baby K.

Mother 33 years. Gravida 2. Term + 8 days. Meconium in liquor. Caesarean section. Birth weight 3,370. Male. D4 W6. Meconium Stained nails. Apgar 3-8. E.R. 4. Aspiration. S.Q. 91.

Baby H.

Mother 22 years. Gravida 2. Term + 6 days. Normal Delivery. Birth weight 2,850. Male. D2 W4. Apgar 9. E.R. 1. Aspiration. S.Q. 88.

Baby R.

Mother 38 years. Gravida 8. Term + 9 days. Normal delivery. Meconium in liquor. Birth weight 3,690 gm. Male D6 W6. Apgar 5-9. E.R. 4. Bag and mask. Meconium stained nails. S.Q. 87.

Baby K.

Mother 28 years. Gravida 1. Term + 12 days. Caesarean section. Meconium in liquor. Birth weight 3,560. Male. D3 W3. Apgar 1-6. E.R. 6. Intubation and intravenous therapy. S.Q. 90.

Summaries of the wasted postmature babies with a low Social Quotient are found on page , and the wasted small for dates babies on page .

Sleep Disorders (see also page 218).

Wasted (131)	23	=	18.3%
Controls (120)	6	=	5.0%

The increase in sleep disorders in the wasted babies is highly significant $P < .001$.

Illness During First Year (see also page 219).

Wasted (131) 16 = 12.2%

Controls (121) 1 = 0.8%

This increase in illness in the wasted babies is highly significant $P < .001$.

Summary of Significant Findings

Significant Increase in Percentage of Wasted Babies as Pregnancy Prolonged Beyond Term

Group 1 Moderate wasting

Group 2 Severe Wasting

Perinatal Period

Foetal distress in labour
Increased in Group 2 $P < .001$

Meconium in liquor
Increased in Group 2 $.01 < P < .02$

Caesarean section rate
Increased in Group 2 $.001 < P < .002$

Asphyxia

(a) Low Apgar scores
At 1 minute
Increased in Group 2 $P < .001$

At 5 minutes
Increased in Group 2 $P < .001$

(b) Resuscitation
Need for intubation
Increased in Group 2 $P < .001$

(c) Time to establish respirations
Increased in Group 2 — P <.001

Sex Incidence

Significant increase in males.

C.N.S. Abnormality on First Day

Increase of severe abnormality
in Group 2 — P <.001

Desquamation and Wasting Scores

Significant correlation between these
2 measured scores — r = .60 P <.001

Adducted Thumbs

Increase in CNS abnormality — P <.001

Meconium Staining of the Baby

Significant increase in CNS
abnormality when compared with
non-stained babies — P <.001

One Year Examination

Low S.Q.

Total increase c.f. control group — P <.001

Increased in group 2 c.f. group 1 — P <.001

Sleep Disorder

Increased c.f. control group — P <.001

Illness During the First Year

Increased c.f. control group $P < .001$

(2) Small for Dates Babies

Selection of Cases

Babies qualified for this section if the following criteria were met:

(a) A birth weight below the third percentile for gestational age.

(b) A gestation period of at least 38 weeks.

So many factors influence intrauterine growth that it is most unlikely that a group of babies selected in this manner will be a homogeneous one. The reported high incidence of major congenital abnormalities in small for dates infants (Scott and Usher, 1966; Van den Berg and Yerushalmy, 1966; Drillien, 1970 and Usher, 1970) makes this the first group to be readily separated.

In this study, 33 babies were considered to be small for dates and of these 5 had major congenital abnormalities. Because the aetiology of their growth retardation was probably related to the cause of the abnormality, their case summaries will be given first and the remaining 28 babies will be discussed as a separate group.

Congenital Abnormalities

Baby O.

Mother 19 years. Gravida 2. Normal delivery. Term + 7 days. Birth weight 2,420 gm. Apgar 3 at 1 minute, 7 at 5 minutes. Respiration established at three minutes. Bag and mask resuscitation. Examination showed:

Ambiguous genitalia

Proptosis

Micrograthia

Cleft palate

Webbing of the neck

Hypotonia

Cubitus valgus

Left simian crease

Syndactyly of 2nd and 3rd toes of each foot

Chromosome studies showed a normal male karyotype and a diagnosis of the Smith-Lemli-Opitz syndrome was made.

He died at 5 weeks; the following internal abnormalities were found:

Atrial septal defect with a small coarctation of the aorta.

Pyloric tumour

Duplex left renal system

Absence of the posterior part of the corpus callosum.

Baby T.

Mother 17 years. Gravida 1. Term - 5 days. Instrumental delivery. Meconium stained liquor. Placenta infarcted. Foetal distress. Birth weight 2,180 gm. Male. Apgar 5 at 1 minute, 8 at 5 minutes. Bag and Mask resuscitation.

The skin was dry and moderate wasting was present. He was slow to thrive and at the age of one month was transferred to the Adelaide Children's Hospital in early cardiac failure.

He died at 6 weeks and an autopsy showed:

Atrial septal defect

Agenesis of the corpus callosum

Pneumonia

Baby C.

Mother 18 years. Gravida 1. Term + 2 days. Maternal rubella at 3 months gestation. Birth weight 1,960 gm. Female. Apgar 9 at 1 minute.

The baby had the clinical signs of the congenital rubella syndrome, in addition to the low birth weight for gestation.

Bilateral cataracts

Splenomegaly

Rubella rash

Radiological bone changes

Haemagglutination inhibition titre of 1 in 8,000

Baby K.

Mother 17 years. Gravida 1. Term + 12 days. Meconium in liquor. Birth weight 2,000 gm. Female. Apgar 5 at 1 minute, 8 at 5 minutes. Resuscitation Bag and mask.

The baby was covered with yellow vernix, the nails and umbilical cord were meconium stained and moderate wasting was present. X-ray showed both upper tibial and lower femoral epiphysis. At 18 days the classical murmur of a patent ductus arteriosus was heard. The ductus was subsequently ligated and the baby discharged well at 7 weeks.

Baby M.

Mother 21 years. Gravida 1. Single. Low urinary oestriol levels late in pregnancy. Term - 2 days. Birth weight 2,020 gm. Female. Meconium stained liquor. Apgar 8 at 1 minute.

The baby had an unusual face not fitting any known syndrome, but no other external abnormality.

She developed a systolic bruit, possibly due to a mitral valve abnormality. A pyelogram revealed an absent left kidney.

Maternal Factors

The following details are included for completeness but the numbers are too small for statistical comparison.

The five babies with congenital abnormalities have been excluded from these figures.

Length of Gestation

Weeks	Number
38-40	15
40-42	10
42	3

Maternal Age

Age	Number
18 years	1
18-30	22
30	5

Race

Australian	19
European	9

Parity

1	13
2 to 4	14
5	1

Maternal Height

5 ft.	6
5' - 5'6"	21
5'6"	1

Weight

50 Kg	2
50-75 Kg	22
75 Kg	4

Meconium Stained Liquor

Meconium stained liquor occurred in 11 (69%) of the wasted group and in 1 (8.3%) of the non-wasted group. This difference is highly significant ($P < .001$).

Type of Delivery

	Total	Wasted	Not Wasted
Normal	22	13	9
Instrumental	4	2	2
Caesarean Section	2	1	1

The large number of normal deliveries in this group is not surprising in view of the small size of the babies.

Wasting

The small for dates babies were also examined for the degree of wasting and scored as previously.

The 5 babies with congenital abnormalities were excluded leaving 28 for study.

Because of the small numbers, babies with moderate and severe wasting were included in one group as "wasted babies".

Wasted	Not Wasted
16	12

Sex

	Total	Wasted	Not Wasted
Male	15	10	5
Female	13	6	7

The increased numbers of wasted males is again apparent.

Measurements

	Total	Wasted	Not Wasted
Birth weight gm.	2250	2190	2330
Head Circumference	31.6	31.6	31.6
Crown Rump	30.0	29.7	30.5
Crown Heel	45.9	46.2	45.9

As shown in previous sections (page 120 and page 145) the mean birth weight of the wasted babies is lower than that of the non-wasted ones, although the difference is not great. There is no significant difference in the other parameters measured.

Gruenwald (1968) said:

"Since the brain of the growth retarded neonate is significantly larger than that of a normally grown infant of similar weight, one would expect to find considerable differences in head circumference. This however, is not true."

Resuscitation

Method	Total	Wasted	Not Wasted
Aspiration	18	7	11
Bag and Mask	7	6	1
Intubation	3	3	0

Time to Establish Respirations

Time (Minutes)	Total	Wasted	Not Wasted
0 - 2	20	9	11
3 - 5	6	5	1
5	2	2	0

Apgar at 1 Minute

	Total	Wasted	Not Wasted
0 - 4	6	5	1
5 - 7	6	5	1
8 - 10	16	6	10

Three babies had Apgar scores below 7 at 5 minutes and they were all in the wasted group.

The statistics all show a highly significant increase in the degree of asphyxia in the wasted babies, as reflected in the increased need for active resuscitation, the longer times to establish respirations and the lower Apgar scores both at 1 and 5 minutes.

Scott and Usher (1966) arrived at the same conclusion.

> "Fetal malnutrition infants who were underweight but not wasted did not have a higher incidence of fetal distress and asphyxia neonatorum than did normal controls."

Perinatal Mortality

Three deaths occurred in this group of babies, i.e. 9.1% of the small for dates babies. The two with severe congenital abnormalities have already been described (page 191). The third death occurred in a wasted baby at 11 weeks.

The high perinatal mortality in small for dates babies is now well documented (Dawkins 1961, Usher 1966, Walker 1967, Neligan 1967, Wigglesworth 1967).

Gruenwald (1968) said:

> "As an indication of the significance of fetal growth retardation, its contribution to perinatal death may be compared with that of Rh iso-immunization."

Infant Death

Baby V.

Mother 19 years. Gravida 1. Normal delivery. Male. Meconium stained liquor. Placenta - weight 390 gm. foetal/placental ratio = 4.2, grossly calcified and infarcted. Birth weight 1,650 gm. Apgar at 1 minute 7. Wasting and desquamation were moderate (D3 W5). The cord and nails were meconium stained. Severe right metatarsus varus which required splinting. Hypoglycaemia - his blood glucose was 28 mgm.%. and this was corrected with intravenous dextrose. Progress: He failed to thrive and gradually developed signs of spasticity with increasing head retraction, extension of the arms with fisting and scissoring of the legs. He died at 11 weeks.

Perinatal Morbidity

The 5 babies with severe congenital abnormalities have not been included in the following discussion.

Central Nervous System Abnormality

First Day

CNS	Total	Wasted	Not Wasted
Normal	7	1	6
Moderate	18	12	6
Severe	3	3	0

It can be seen that only 7 (25%) of the 28 were considered to be normal on the first day.

The non-wasted group was significantly less affected than the wasted.

Normal CNS: Non wasted 50% $\bar{v}$ Wasted 7%. $P < .001$

The 3 babies considered to be severely affected were all wasted, and their clinical condition is now summarized.

Major Central Nervous System Abnormality

Baby D.

Mother 24 years. Gravida 1. Term + 1 day.
Meconium stained liquor. Placenta: weight 255 gm. foetal/placental ratio = 9.4, slightly calcified.
Normal delivery. Female. Birth weight 2,380 gm.
Apgar 4 at 1 minute, 8 at 5 minutes. Resuscitation - intubation. She was moderately wasted (5) with peeling skin (5). Her reflexes were depressed.
She was acidotic (pH 7.20) and had a single period of apnoea. Intravenous therapy with dextrose and alkali was given.
Her condition improved rapidly and she seemed normal on the fourth day.
Social Quotient at 1 year 77.

Baby M.

Mother 24 years. Gravida 3. Term + 13 days.
Meconium stained liquor. Normal delivery before arrival at hospital. Baby was reported not to have breathed until 10 minutes after birth.
Birth weight 2,180 gm. Male.
Moderate wasting was present (3), and his thumbs were adducted and his rectal temperature was low (94^{o} F). His reflexes were depressed, tone was increased and tremors were present.
Acid base studies showed a pH of 7.15 which was corrected with intravenous dextrose and alkali. His blood glucose and calcium levels were normal.
His condition improved slowly during the next few days. At six weeks he was not smiling and his development was considered to be slow.
The following admission to hospital occurred during the first year of life:

Bronchitis - twice

Pneumonia - once

Dehydration - once

He slept poorly, requiring parental attention several times each night for the whole year.
His social quotient at 1 year was 86.

Baby C.

Mother 21 years. Gravida 1. Term - 13 days. Meconium stained liquor. Healthy placenta - weight 340 gm. Foetal placental ratio = 4.4. Normal delivery. Male. Birth weight 1,500 gm. Apgar 5 at 1 minute, 8 at 5 minutes. Resuscitation - bag and mask. Respirations established at 4 minutes. The baby had dry parchment like skin, with peeling (7) and wasting (9). His arms were flexed, his legs extended and his reflexes were poor. There was meconium staining of his cord and nails. Hypoglycaemia: his blood glucose was low (26 mgm.%) so he was given intravenous dextrose. On the third day his blood glucose was normal but fell to 10 mgm.% on the day after intravenous dextrose was discontinued. Further difficulty was encountered in maintaining the level, so hydrocortisonewas given and this treatment was continued until the 10th day. On the 17th day he developed a gram negative (E coli) septicaemia which responded rapidly to Kanamycin and Ampicillin. The organism was grown from the blood, cerebrospinal fluid and urine. He was discharged at 6 weeks. His social quotient at 1 year was 70.

Minor Central Nervous System Abnormality

Summary of Cases (18)

Baby C.

Mother 21. Gravida 1. Term - 4 days. Clear liquor. B.W. 2,380. Apgar 8. E.R. 1. Aspiration D0 W3. Tremors. Serum Calcium 8.4 mgm. (N 9.0-10.5). S.Q. 83. Sleep poor.

Baby D.

Mother 33 years. Gravida 5. Term + 3 days. Clear liquor. B.W. 2,370. Apgar 9. E.R. 1. Aspiration D5 W2. Not sucking. S.Q. 100.

Baby M.

Mother 28 years. Gravida 2. Term + 1 day. Meconium in liquor. B.W. 2,060. Apgar 1-2. E.R. 30. Intubation D3 W5. Increased tone. S.Q. 106. Sleep poor.

Baby H.

Mother 22 years. Gravida 1. Term + 13 days. Meconium in liquor. B.W. 2,450. Apgar 9. E.R. 1. Aspiration D5 W2. Increased tone. Not sucking well. S.Q. 108.

Baby B.

Mother 30 years. Gravida 2. Term - 11 days. Meconium in liquor. B.W. 1,340. Apgar 6. E.R. 2.

Aspiration D2 W4. Cyanotic attack. Hypoglycaemia. Blood glucose 20 mgm. S.Q. 98.

Baby S.

Mother 30 years. Gravida 3. Term + 4 days. Meconium in liquor. B.W. 2,260. Apgar 9. E.R. 1. Aspiration D3 W5. Sucking poorly. Depressed Moro. S.Q. 100. Adelaide Children's Hospital - Gastro-enteritis.

Baby G.

Mother 20 years. Gravida 2. Term - 6 days. Clear liquor. B.W. 2,230. Apgar 9. E.R. 1. Aspiration D3 W3. Sucking slowly. S.Q. - did not attend.

Baby V.

Mother 19 years. Gravida 1. Term + 8 days. Meconium in liquor. B.W. 1,650. Apgar 7. E.R. 1. Aspiration D3 W5. Not sucking. Blood glucose 28 mg. Meconium stained. Failed to thrive. Died at 11 weeks (see page 200).

Baby M.

Mother 26 years. Gravida 4. Term + 21 days. Meconium in liquor. B.W. 2,500. Apgar 5-9 E.R. 2. Intubation D3 W3. Meconium stained. Not sucking until the fourth day. S.Q. at one year 106.

Baby C.

Mother 22 years. Gravida 1. Term - 2 days. Clear liquor. B.W. 2,480. Apgar 9. E.R. 1. Aspiration. D2 W2. Blood glucose 32 mgm. Not sucking until the fourth day. Did not report at one year.

Baby G.

Mother 19 years. Gravida 1. Term + 15 days. Meconium in liquor. B.W. 2,500. Apgar 2-6. E.R. 4. Bag and mask. D1 W4. Meconium stained. Very slow with feeds. S.Q. at one year 106. Hyperactive baby.

Baby C.

Mother 17 years. Gravida 1. Term + 16 days. Clear liquor. B.W. 2,310. Apgar 3-6. E.R. 4. Bag and mask. D2 W6. Not sucking. Increased tone. Not seen at one year (mother single).

Baby T.

Mother 26 years. Gravida 1. Term + 9 days. Clear liquor. B.W. 2,420. Apgar 7. E.R. 4. Bag and mask. Sucked poorly. Cyanotic attack on fifth day. Not seen at one year (Mother single).

Baby S.

Mother 25 years. Gravida 2. Term - 3 days. Clear liquor. B.W. 2,070. Apgar 8. E.R. 1. Aspiration.

D0 W0. Sucked poorly. S.Q. at one year 95.

Baby A.

Mother 34 years. Gravida 2. Term - 10 days. Meconium in liquor. B.W. 1,780. Apgar 8. E.R. 1. Aspiration. D0 W0. Meconium stained cord and nails. Sucked poorly for four days. S.Q. at one year 79.

Baby B.

Mother 25 years. Gravida 1. Term - 6 days. Clear liquor. B.W. 2,490. Apgar 9. E.R. 1. Aspiration. Do W1. Sucked poorly. S.Q. at one year 92.

Baby M.

Mother 28 years. Gravida 1. Term + 8 days. Clear liquor. B.W. 2,465. Apgar 9. E.R. 1. Aspiration. D2 W2. Sucked poorly. S.Q. at one year 100.

Baby A.

Mother 34 years. Gravida 4. Term - 7 days. Clear liquor. Low urinary oestriol levels. B.W. 2,330. Apgar 6. E.R. 2. Bag and mask. D0 W2. Not sucking. Tremors. Increased tone. S.Q. at one year 91.

Michaelis et al. (1970) also found abnormal neurological patterns in small for dates infants:

"In contrast to full term newborn infants of normal weight, small for gestational age infants more often have abnormal motor patterns, e.g. alteration in Moro reflex, marked asymmetrical tonic neck reflex, frequent windmill motions of arms, poor standing response and stepping movements."

Adducted Thumbs

Open T3	2	7.1%
T2	22	78.6%
Closed T1	4	14.3%

Of the four babies with adducted thumbs, one was considered to have a severe degree of C.N.S. disturbance on the first day and three a minor degree.

Meconium Staining

Meconium stained cord and nails	8 = 28.6%
Meconium stained, CNS abnormality 1st day	8/8 = 100%
Not meconium stained, CNS abnormality 1st day	13/20 = 65%

The numbers are rather small for statistical comparison. However of the 8 with meconium staining of the cord and nails, one died at 11 weeks, and of the 6 who were seen at

one year 3 had low social quotients and one was a poor sleeper.

Fourth Day Examination

C.N.S. abnormality (excluding five babies with congenital abnormality).

	S.Q. at One Year
Baby S. Not sucking	95
Baby C. Not sucking	-
Baby B. Increased tone	98
Baby C. Tremors	83
Baby D. Not sucking	100
Baby D. Sucking poorly	77
Baby A Not sucking	91
Baby C. Not sucking Depressed reflexes	70
Baby V. Head retraction Not sucking	Died

Four of the seven babies seen at 1 year had an abnormally low S.Q.

Six Week Examination

	S.Q. at One Year
Baby D. Not smiling	77
Baby C. Not smiling	70
Baby M. Not smiling	86
Baby M. Increased tone	106
Baby V. Failure to thrive Increasing head retraction	Died
Baby G. Not smiling	106

Three of the six babies had a low S.Q. at one year, and one had died.

One Year Examination

Number of Babies	20
Number of Controls	24

Low S.Q.

	Low S.Q.	
Small for dates	7	= 35%
Controls	0	0

Poor Sleepers at 1 Year

Small for dates	4	= 20%
Controls	1	= 4.2%

P <.001

Illness at 1 Year

Small for dates	4	= 20%
Controls	0	= 0

Summary of Neonatal Histories of Babies with a Low Social Quotient at one Year

Baby M.

Mother 24 years. Gravida 3. Term + 13 days. Normal delivery. B.W. 2,180 gm. Male. Apgar 1 to 1. Respiration established at 15 minutes. Tremors D1 W3.

One year examination: Poor sleeper. 3 admissions to Adelaide Children's Hospital. S.Q. 86.

Baby B.

Mother 25 years. Gravida 1. Term - 6 days. Instrumental delivery. B.W. 2,490 gm. Female. Apgar 9. Aspiration. Sucked poorly. D0 W1. S.Q. 92.

Baby D.

Mother 24 years. Gravida 1. Term + 1 day. Normal delivery. Meconium stained liquor. B.W. 2,380 gm. Female. Apgar 4 to 8. E.R. 5 minutes. Intubation Acidosis. Intravenous therapy. Increased tone D5 W5. One year examination: Sleep poor. S.Q. 77.

Baby C.

Mother 21 years. Gravida 1. Term - 13 days. Normal delivery. Meconium stained liquor. B.W. 1,500 gm. Male. Apgar 5 to 8. E.R. 4 minutes. Bag and mask. Tremors D7 W9. Meconium stained nails. Hypoglycaemia. Illness: Septicaemia.

One year: S.Q. 70.

Baby C.

Mother 21 years. Gravida 1. Term - 4 days. Normal delivery. Meconium stained liquor. B.W. 2,380 gm. Male. Apgar 8. E.R. 1 minute. Intra-nasal oxygen. Tremors D0 W3.

One year: Sleep poor. S.Q. 83.

Baby A.

Mother 34 years. Gravida 4. Term - 7 days. Caesarean section. B.W. 2,330 gm. Male. Apgar 6. E.R. 2 minutes. Bag and mask. Increased tone D0 W2.

One year: S.Q. 91.

Baby A.

Mother 32 years. Gravida 2. Term - 10 days.

Normal delivery. Meconium stained liquor.

B.W. 1,780 gm. Male. Apgar 8. E.R. 1 minute.

Aspiration. Meconium stained cord. DO WO.

Six weeks not smiling.

One year: S.Q. 79.

Summary of Significant Findings

A highly significant perinatal mortality occurred in this group - 9% of the 33 babies.

The incidence of major congenital abnormalities was also very high - 15.1% of the 33 babies.

The remaining babies were divided into wasted and non-wasted groups and the significant findings shown in the previous section (wasted babies) were also evident.

i,e.	Increased meconium in liquor	$P < .001$
	Increased birth asphyxia	$P < .001$
	Increased CNS abnormality	$P < .001$

At One Year

Low S.Q. Increased c.f. controls	$P < .001$
Sleep Disorder. Increased c.f. controls	$P < .001$
Illness during first year	$P < .001$

PART V - OTHER FINDINGS

Importance of Other Clinical Signs

During the survey it was apparent that the babies who appeared most severely affected in the neonatal period were those with meconium staining. Many of these babies had adducted thumbs.

The following tables show the correlation between these signs and the Social Quotient at one year:

(1) Meconium stained liquor.

(2) Meconium stained nails and cord.

(3) Adducted thumbs.

(1) Meconium Stained Liquor

Including the two groups of babies (postmature and placental insufficiency), meconium staining of the liquor occurred in 58 cases.

Liquor	Low S.Q.	
Meconium stained (58)	20	34.5%
Clear (134)	28	20.9%

The increase in the percentage of babies with a low S.Q. is significantly high in the group with meconium stained liquor.

Low S.Q. Meconium stained liquor 34.5% c.f.
Clear liquor 20.9%. $.001 < P < .002$

Meconium in the liquor is generally considered an indication for the induction of labour in postmaturity and placental insufficiency.

These figures support this and also illustrate the fact that the foetus has already been compromised in a high proportion of cases.

(2) Meconium Stained Nails and Cord

When meconium staining of the nails, umbilical cord

and skin occurred, the increase is also highly significant.

Meconium stained nails (23)	11	48%
No staining (169)	17	10%

Low S.Q.

Meconium stained nails (48%) $\bar{v}$ No staining (10%)

$P < .001$.

(3) Position of Thumbs

The thumbs were tightly adducted across the palms (T1) in 28 babies.

There was a significant increase in babies with a low S.Q. in this group.

		Low S.Q.	
T1	28	8	28%
T2+T3	164	27	16%

Low S.Q.

T1 (28%) $\bar{v}$ T2 + T3 16%. $.002 < P < .01$

There were 8 babies with both meconium stained nails and cords as well as adducted thumbs.

4 of these (50%) had a low S.Q.

Sleep Disorder at One Year

At one year each mother was asked "Does your baby sleep well?" If she answered yes, no further enquiry was made. If she answered no, she was asked to give more detail about the number of disturbed nights and the number of disturbances each night.

The baby was classed as having a major sleep disorder if he required attention at least once during the night for the majority of the first year (at least 9 months). Most of the babies included were quite bad sleepers completely disrupting the household with crying every night, usually on 3 or 4 occasions during the night.

Sleep Disorder

Postmaturity (104) Controls (106)	13 = 12.5% 3 = 2.8%
Wasted Babies (131) Controls (120)	23 = 18.3% 6 = 5.0%
Small for Dates(20) Controls (24)	4 = 20.0% 1 = 4.2%

In each group there is highly significant ($P < .001$) increase in the percentage of poor sleepers compared with controls.

Illness During the First Year

Only babies who required admission to the Adelaide Children's Hospital after discharge from the Queen Victoria Hospital were counted.

One baby was admitted for pyloric stenosis, one for investigation of vomiting and one for treatment of a dislocated hip - these were excluded from the following calculations.

Illness

Postmaturity	(104)	13	12.5%
Controls	(106)	0	0
Wasted Babies	(131)	16	12.2%
Controls	(120)	1	0.8%
Small for Dates	(20)	4	20%
Controls	(24)	0	0

In each group there is a highly significant ($P < .001$) increase in the percentage of babies admitted to hospital for a medical illness during the first year.

Zwerdling (1967) found the rate of hospitalization to be consistently higher for post-term children during the first 3 years.

The following babies were admitted to the Adelaide Children's Hospital during their first year.

Controls (2)	
Baby L.	Bronchitis
Baby G.	Pyloric stenosis
Postmature (9)	
Baby H.	Staphylococcal pneumonia septicaemia, pyo-pneumothorax
Baby P.	Pneumonia
Baby R.	Convulsion, viral meningitis
Baby D.	Twitching arm and leg
Baby S.	Respiratory infection, gastroenteritis
Baby B.	Croup, fractured skull
Baby R.	Croup
Baby B.	Heat exhaustion
Baby R.	Investigation of vomiting
Wasted Postmature (5)	
Baby M.	Jaundice at 6 weeks? Hepatitis
Baby U.	Bronchiolitis
Baby A.	Pneumonia
Baby R.	Pneumonia
Baby M.	Bronchopneumonia

Wasted (other) (12)

Baby M.	Pneumonia
Baby S.	Gastroenteritis
Baby M.	Bronchitis, pneumonia, dehydration. Several admissions
Baby B.	Bronchitis
Baby J.	Heat exhaustion
Baby E.	Bronchopneumonia
Baby G.	Bronchopneumonia
Baby F.	Pneumonia - 2 admissions
Baby R.	Bronchitis
Baby P.	Gastroenteritis
Baby P.	Undiagnosed pyrexia
Baby L.	Pneumonia - 5 admissions

The majority of the illnesses involved the respiratory tract. (18 out of 28 admissions).

Neurological Examination $\bar{v}$ S.Q. at 1 Year

All cases, i.e. postmaturity and placental insufficiency.

1st Day

C.N.S. Abnormality		Low S.Q.	
None	(120)	15	12.5%
Mild	(57)	12	21%
Severe	(12)	9	75%

C.N.S. Abnormality first day:

Low S.Q. None (12.5%) $\bar{v}$ Mild (21%) $.002 < P < .01$.

None (12.5%) $\bar{v}$ Severe (75%) $P < .001$.

4th Day Neurological Examination $\bar{v}$ S.Q. at 1 Year

26 babies were considered abnormal on the fourth day and 12 of these had a low S.Q.

At 1 year, i.e. 46.2% compared with 14.7% of those considered to be normal.

Low S.Q. No abnormality 14.7% $\bar{v}$ Abnormality 46.2%

$P < .001$.

Six Week Assessment $\bar{v}$ S.Q. at 1 Year

14 babies were considered abnormal at six weeks and 7 of these had a low S.Q. at 1 year, i.e. 50% compared with 16.6% of those considered to be normal $P < .001$.

Blood Pressure

The majority of babies in the survey had their blood pressure recorded during the first day of life using the flush method, with a 5 cm cuff on the right lower leg.

The results of the 3 groups are included in one table for convenience.

Results

Group	Mean B.P. mm
Postmature Babies:	
Total	45
Group A (14-20 days)	44
Group B (21 days)	47
Wasted Babies:	
Total	43
Moderate wasting	44
Severe wasting	41
Controls: (3,000 gm)	46
Small for Dates Babies (2,000 - 2,500 gm)	39

Kitterman et al. (1969) found the following mean aortic blood pressures for babies during the first 12 hours of life:

Birth weight	3,000 gm.	50 - 54 mm
Birth weight	2,000-3,000 gm.	41 - 45 mm

The survey babies show a similar difference (7 mm) in the mean blood pressures of the controls (over 3,000 gm) and the small for dates babies (less than 2,500 gm).

CONCLUSIONS

Postmaturity is associated with a high perinatal mortality rate and this is the usual reason advanced for regarding it as an obstetric problem. A few obstetricians have commented that the surviving baby might be adversely affected, but to my knowledge there are no published studies which have investigated this aspect.

In this survey the neonatal problems of the postmature infant have been studied and related to the Social Quotient at one year. The results clearly show that the central nervous system has been compromised and the general health affected in a significant proportion of infants.

This study also shows that babies with placental insufficiency have been affected in a similar manner. This applies whether they were selected because of soft tissue wasting or on the basis of a low birth weight for gestational age. The figures show that the majority of these babies were past term so it would seem that attention should be focussed on this group of mothers if the quality of survival is to be improved. As stated by Gruenwald (1964):

> The effects of prolonged pregnancy do not suddenly befall certain fetuses that remain in utero past term.

> Instead, the obvious changes are at one end of a spectrum of gradual and 'normal' decline in the placental adequacy and thriving of the fetus."

As all infants past term are not affected, obstetric guidance can only come after further research has determined the contributing factors.

In 1967, Dobbing reviewed the results of his animal experiments on the effects of undernutrition on the developing brain. He stated:

> "From the evidence presented here it may be that, towards the end of (human) pregnancy and soon after birth there is a vulnerable period in which quite minor restrictions can affect the rate and ultimate extent of growth of the brain rather than its shape."

Dobbing's findings are relevant to this thesis which clearly establishes a relationship between postmaturity and wasting and the Social Quotient of the wasted infants at the age of one year. Clinical wasting of the babies probably indicates a period of intra-uterine malnutrition late in pregnancy which, according to Dobbing, is the period of maximum brain growth and therefore a time of vulnerability. Dobbing's experiments further suggest that such malnutrition can have a permanent effect on the brain. Is this one of the factors responsible for the low Social

Quotients and increased irritability of many of the affected babies in this survey? Further research is needed to study the placental transfer of those nutrients essential for normal brain development.

Roux et al. (1964) found that postmaturity in rabbits reproduced the clinical findings observed in the post-mature human foetus. Harding (1970), using the postmature rabbit as an experimental model of chronic placental insufficiency, showed that the animals had reduced glycogen and lipid stores and increased blood and brain lactic acid, suggesting chronic hypoxia in utero. If these findings are applicable to the human foetus, does intra-uterine hypoxia, as well as malnutrition, contribute to the increased incidence of low Social Quotients?

Is the foetus less able to withstand a degree of hypoxia if he is also suffering from intra-uterine malnutrition?

If so, as suggested by the results of this survey, better methods of assessing foetal welfare and determining the length of gestation must be found. While concentration on clinical aspects and the use of current tests of placental function will improve results, greater knowledge of placental physiology is obviously needed if evaluation of its function is to be placed on a scientific basis.

An interesting observation in this survey was the significant increase in babies requiring hospital admission. Yeung and Hobbs (1968) and Ackerman et al. (1969) have reported altered immunoglobulin patterns in postmature babies and similar findings have been shown in small for dates babies. This aspect warrants further investigation.

There is also scope for further clinical research. More follow-up studies of infants are needed, particularly of selected at risk groups. Such studies should cover a long period, as exemplified by the British Perinatal Survey, which has revealed an increase in reading defects at six years of age, in postmature babies. For this reason it is intended to extend the period of the present survey to determine any other long term sequelae, and relate these findings to the neonatal records and the Social Quotients of the infants at one year. It is becoming increasingly clear that close cooperation between all of the disciplines responsible for his welfare, is essential if the foetus is to have the best chance of high quality survival.

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APPENDIX I

PREGNANCY RECORD

POSTMATURITY/CONTROL

Thesis No.

Case No.

Doctor

Name

Address

Age

Parity

Race

Medical History

Obstetric History

Family History

PRESENT PREGNANCY:

Gestation 40 + Number of Days

Toxaemia

Other Complications

Weight

Height

Labour

Spontaneous

Induced

Duration

Foetal Heart Rate

Foetal Distress

Anaesthesia: Local

General

Drugs

APPENDIX II

Neonatal Record

Code .....

DELIVERY: Date Time

- Normal
- Forceps
- Breech
- Caesarean Section
- Other
- Amniotic Fluid
- Placenta
- Abnormalities
- Placental Weight

IMMEDIATE STATUS OF INFANT:

- Name
- Birth Weight
- Sex
- E.R.
- Apgar Score: 1 minute
  5 minutes

RESUSCITATION:

- Aspiration
- Intranasal 02
- Bag and Mask
- Intubation

BLOOD: Mother Baby

- Group
- Rh
- Coombs
- Hb
- Bilirubin
- Haematocrit

APPENDIX III

FIRST WEEK

NAME:

	H.C.	C.R.	L.	B.P.
		1st 24 hours		4th Day
Weight				
Humid Crib				
Feeding				
Heart				
Colour				
Lungs				
Abdomen				
Activity				
Cry				
C.N.S:				
Moro				
Grasp				
Sucking				
Fontanelle				
Convulsions				
Tremors				
Stepping				
Tone				
Position of Thumbs				
Posture				
Desquamation				
Wasting				
Meconium Staining				
Orthopaedic Abnormalities				
Jaundice				
Anaemia				
Acid Base				
Blood Glucose				
Urine				

APPENDIX IV

SIX WEEKS

Name

Age

Weight — Weight Increase

Height

H.C.

Skin

Heart

Lungs

Abdomen

Hips

Eyes

Hearing

C.N.S:

- Moro
- Grasp
- Tonic neck
- Crossed Extension
- Smiling
- Head control

Feeding

Illnesses

Orthopaedic Abnormalities

Developmental Assessment

APPENDIX V

ONE YEAR OLD EXAMINATION

Name Code ....

Examination at: Thesis No.

1. Has baby suffered from any illness or accident since 6 weeks old?
2. Has baby had:
   - (a) Difficulty with feeding
   - (b) Vomiting
   - (c) Sleep
   - (d) Cough
   - (e) Stools
   - (f) Behaviour
   - (g) Any other condition
3. When did he:
   - Sit up
   - Crawl
   - Stand up
   - Walk
   - Any words

EXAMINATION

Weight

Height

Skull

Chest

Teeth

VINELAND

- Total score
- Social age
- Life age
- Social Quotient

APPENDIX VI

VINELAND SOCIAL MATURITY SCALE

Age Period 0 - 1

Item		Life Age Mean
1.	"Crows" laughs. Vocalizes inarticulately (other than crying or fretting). Spontaneously gurgles or coos with evident animation or satisfaction. Laughs spontaneously or when stimulated.	.25
2.	Balances head. Holds up head voluntarily (unassisted) with trunk erect for indefinite period (about a minute).	.25
3.	Grasps object within reach. Picks up or takes objects within arm's length.	.30
4.	Reaches for familiar person. "Asks to be taken", or shows desire for being picked up or held by mother, father, nurse or other familiar persons, or otherwise clearly indicates recognition.	.30
5.	Rolls over. Lying prone, rolls on back, or vice versa, unassisted.	.30
6.	Reaches for nearby objects. Attempts to obtain objects nearby but beyond reach.	.35
7.	Occupies self unattended. Plays with rattle or simple objects, or engages in other simple activities, for quarter hour or longer without need of attention.	.43
8.	Sits unsupported. Sits upright on hard, flat surface without support for indefinite period (about a minute). Balance may be unsteady, but body does not fall from erect spinal posture.	.45

Item		Life Age Mean
9.	Pulls self upright. Comes to standing position holding to some object (not a person), pulling self upright.	.55
10.	"Talks" imitates sounds. Babbles, or uses inarticulate speech which reveals apparent imitative or expressive attempts at words as something more than merely pleasurable vocalization.	.55
11.	Drinks from cup or glass unassisted. Uses cup or glass for drinking, assisted by someone holding or helping to hold cup or glass, and drinks without much spilling.	.55
12.	Moves about on floor. Gets around on floor by creeping or crawling, but may be watched while doing so.	.63
13.	Grasps with thumb and finger. Opposes thumb and finger in grasping or picking up as opposed to grasping with whole fist and palm.	.65
14.	Demands personal attention. Indicates desire to be "talked" to, or otherwise to be engaged in relation to some other person, such as directing interest towards self or own activities, beyond more handling or care for physical needs.	.70
15.	Stands alone. Stands unsupported on hard, flat surface, not holding on to object or person, for indefinite period (about a minute). Balance may be unsteady and foot movements may be present, but full upright posture is maintained.	.85
16.	Does not drool. Has established control of saliva so that mouth or chin does not ordinarily require wiping except when eating.	.90
17.	Follows simple instructions. Comes when called; goes short distances to particular points as directed; points to particular objects in pictures when asked; performs baby game pantomine on demand - ingeneral, co-operates on verbal request in very simple activities.	.93

Item	Life Age Mean
Age Period 1 - 2	
18. Walks about room unattended. Walks about room, not merely as motor act but as evidence of increasing personal responsibility. May require occasional admonition or watching.	1.03
19. Marks with pencil or crayon. Amuses self with crayon or pencil for brief periods; marks up and down, side to side, or with circling motion without breaking point or tearing paper. Does so spontaneously or on request as a means of self-occupation.	1.10
20. Masticates food. Chews solid or semi-solid foods before swallowing.	1.10
21. Pulls off socks. Removes socks, stockings, or shoes, unassisted if unfastened, as an act of undressing and not merely as a means of play.	1.13
22. Transfers objects. Pours from one vessel to another without messing; removes, transfers, replaces objects in somewhat purposeful manner; arranges objects in some pattern or order.	1.20
23. Overcomes simple obstacles. Opens closed doors; climbs up on chairs; uses stool for reaching; uses stick as implement; removes simple impediments; uses basket or receptacle for carrying things.	1.30
24. Fetches or carries familiar objects. Performs useful errands on request, such as taking or bringing named objects to or from nearby places, or carrying simple messages to or from nearby persons.	1.38
25. Drinks from cup or glass unassisted. Uses cup or glass, unassisted, for drinking, by grasping handle or by using either or both hands on sides of glass and without serious spilling.	1.40

Item	Life Age Mean
26. Gives up baby carriage. No longer rises in perambulator. Walks or uses go-cart when going out.	1.43
27. Plays with other children. Plays independently in company of others of approximately same age or social station without creating antagonism. Activity is individual rather than co-operative, but he "gets along" with other children.	1.50