# CONGENITAL PNEUMONIA

A MORPHOLOGICAL STUDY OF
INFLAMMATORY CELLS IN FOETAL LUNGS
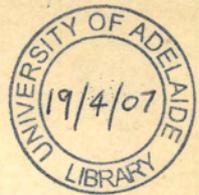
A thesis submitted for the degree

of

Doctor of Medicine

in the

University of Adelaide

by

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PART 1V

APPENDICES

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INTRODUCTION: AN HISTORICAL SURVEY
OF WRITINGS ON CONGENITAL PNEUMONIA
AND SOME RELATED CONDITIONS.

Congenital pneumonia is not a well known condition
although it has been described in the literature periodically for
over fifty years. Mostly it is described by workers in foetal and
neo-natal mortality studies and then only as one of the conditions
which may be responsible for foetal death. Various reports from
pathologists and clinicians at clinical obstetrical meetings, from
time to time, have to some extent aroused interest among practit-
ioners in the possibility of foetal infection acquired in utero or
intra-natally. Certain complications of labour have been held to
be responsible factors in its causation and now with an elaborate
chemotherapeutic armamentarium the interest of obstetricians in
combating intra-natal infection is to some extent renewed.

From the cases reported in the literature, two
forms of congenital pneumonia may be recognised from an aetiological
standpoint. Those which appear obviously to be of septicaemic
origin (mentioned by Ballantyne in 1902, in which the foetal and
maternal diseases are similar) have been reported sporadically as
records of single cases. The other group to be dealt with more
fully are those cases to which Ballantyne referred as occurring
mainly as a complication of labour. In the former group, which is
taken here to be those cases corresponding to Ballantyne's criteria
for transmitted infection, cases have been reported by Gordon and
Lederer, Ballantyne, Strachan and others. In a case recorded by
Gordon and Lederer (1928) the mother had had lobar pneumonia at
four months gestation and again two days before delivery, this second
time complicated by acute follicular tonsillitis. Blood culture
yielded a Type IV pneumococcus. Premature labour resulted in the

birth of a five pound male infant which died in convulsions on the third day. At post-mortem there were signs of a generalised septic-aemia with lobar pneumonia, pleurisy and empyema. Type 1V pneumococci were isolated from several situations. The baby had been bottle fed and at no time was it brought in contact with the mother, who subse-quently twice had an empyema drained of large amounts of pus.

Strachan in 1886 wrote from Jamaica giving details of a woman eight months pregnant who developed acute pneumonia four days prior to admission to hospital at which latter time her temper-ature was 103.6°F. She was delivered of a female infant which died in less than twenty-four hours with symptoms of acute pneumonia and consolidation of the whole of the left lung at post-mortem.

Strachan concluded his brief letter to the Clinical Memoranda Column of the British Medical Journal by stating that "whilst there is ample evidence that the other acute specific diseases (so-called "fevers") are capable of being transmitted by the pregnant woman to her offspring yet in utero, this is the first time I have had any evidence that the "acute pneumonic fever" could also be so transmitted".

Numerous other similar cases to the two just quoted have been reported in the literature.

Hess Thaysen, quoted by Johnson and Meyer (1925), Hook (1927), Macgregor (1939), Snyder (1949) and many others, report-ed on cases of neo-natal pneumonia in 1914 from a series gathered between 1901 and 1910 and another between 1910 and 1911. As quoted by Johnson and Meyer he was not of the opinion that aspiration of liquor was responsible for inflammatory lesions in the lungs but that the foetus aspirated virulent organisms from the birth canals of mothers apparently uninfected by these organisms. These writers state that failure to examine the placenta and membranes for evidence of

inflammation led Hess Thaysen to this false conclusion. Nor, they state did his autopsies include microscopic examination of the lungs in cases of stillbirth.

Quoted at some length by Snyder, Hess Thaysen's survey in neo-natal cases was done in considerable detail. Organisms were found in fifteen out of eighteen cases, aspirated material was described and note made of the often minimal inflammatory changes caused. Further, Snyder quoted him as regarding the emigration of leucocytes into the alveoli as being the best criterion for the early recognition of pneumonia (this, it will be remembered, of possible neo-natal origin).

The following classification was put forward by Hess Thaysen for the aetiological basis of neo-natal pneumonia:-

(1) Diaplacental infection.

(2) Aspiration pneumonia (a) contents of a pathologically infected uterus or vagina (b) secretion of a normal birth canal (c) food or secretion in the nose or mouth of the baby, aspirated after birth.

(3) Aerogenous infection after birth.

(4) Metastatic pneumonia from navel or intestine.

In an opening address to the Section of Obstetrics and Gynaecology in Glasgow in 1922 Ballantyne in a survey of ante-natal, intra-natal and neo-natal death gave excellent accounts of the natural histories of some foetal hazards and, at some length, attemp -ted to define more concisely the meaning of some of the more common-ly used obstetrical terms in relation to the foetus. He referred to the last of such meetings in Glasgow thirty-four years previously and remarked on the fact that, in spite of some of the best represent-ations from England and America, little attention had been paid to

the foetal side of Obstetrics. But Ballantyne in the years leading
up to 1902 had not been idle in this direction himself for in that
year he published two large volumes on "Ante-natal Pathology and
Hygiene" which remain masterpieces in scientific investigation
and literary skill.

He went on to discuss foetal death at all periods
of intra-uterine existence and under ten headings covered very adequ
-ately all the morbid states which, past or recent, might cause foetal
damage. Amongst the conditions with which he dealt, he mentions in-
fections and diseases transmitted from the mother, including "small-
pox, measles, scarlet fever, malaria, pneumonia, tuberculosis (very
rarely), cerebro-spinal meningitis and typhoid fever" and states
that these, in particular, appear in the same form in the foetus as
in the mother. In the second of his volumes he deals with foetal
pneumonia and quotes cases in which similar conditions were found
to be present in the foetus as the known lesions which were present
clinically in the mother. He quotes Hirst's observations in 1887
of a premature infant which lived twenty hours and showed marked
double catarrhal pneumonia which the author ascribed to the inhal-
ation of meconium from making intra-uterine respiratory efforts.
The mother in this case did not have pneumonia but a large lumbar
abscess and it seemed to Ballantyne in quoting the case that the
pneumonia was septic in origin. He quoted two cases reported by
Foa and Bordoni - Uffreduzzi in which the mothers had epidemic cere
-bro-spinal meningitis and pneumonia and both premature foetuses
showed in their blood and livers "the characteristic diplococcus of
pneumonia".

But Ballantyne in 1902 went further than recording
cases of transmitted specific infectious conditions and mentions the

possibility of aspiration of infected material into the lungs of
the foetus in cases of long rupture of the membranes. In this matter
of foetal pulmonary infection it seems best to quote him: "A refer
-ence to the general principles which have been laid down with
regard to foetal diseases will make it plain why the lungs are nei-
ther often nor exclusively affected in these cases; the organs are
not in the direct line of the circulation, and are not supplied with
a large amount of blood. Of course, it is not always possible to
exclude infection of the foetal lungs, which has occurred during
the progress of labour, for, when early rupture of the membranes
takes place, infected liquor amnii or vaginal secretion may be suck-
ed into the mouth of the infant, and reach the pulmonary tissues,
setting up inflammatory processes in them".

Ballantyne, then, in 1902 had remarked on the poss
-ibility of foetal pulmonary infection as a complication of birth
and prolonged rupture of the membranes. Twenty years later he ag-
ain referred to the possibility and to the work of F. J. Browne,
who at that period, was writing of neo-natal pneumonia and analy-
sing the causes of stillbirth and neo-natal death.

Browne, then a research pathologist in Edinburgh,
published an article on Pneumonia Neonatorum in 1922 which gave sub-
stantial impetus to the recognition of this disease in both full-
term and premature babies. The latter, he calculated, were fourteen
times more liable to contract the disease and die from it. His
series consisted of 80 cases of infantile death of which 21 (26.5%)
showed what he described as pneumonic lesions. In two cases which
he describes, long rupture of the membranes before delivery is held
to be a pre-disposing factor in infection not only of the amniotic sac
but also of the lungs and, writing in another place, of the middle ear
and accessory

nasal sinuses. His first case, in which the membranes had been rup-
tured for a long time before coming to hospital, had lived in a poor
condition for eight hours. At post-mortem, pneumonia had advanced
to the stage of grey hepatisation and the lungs on squeezing exuded
a yellowish frothy fluid. Each pleural cavity contained about two
ounces of thin blood stained serum. The alveolar exudate, which con-
sisted mainly of granular debris, contained some pigment containing
epithelial cells, a few polymorphs, lymphocytes and an occasional dis
-integrating red cell with some fibrin. Other parts of the lung
showed the lung tissue to be a necrotic mass "in which even the alveolar
walls could scarcely be made out". On culture of material from the
lungs an organism of the pneumo-bacillus group was isolated. Browne
comments that "it is impossible that such an advanced degree of grey
hepatisation could have been reached in the eight hours during which
the child lived, and its blueness and difficulty in breathing at
birth are strong evidence in support of ante-natal pneumonia".

In the second case quoted early in the article, in
which there had been long rupture of the membranes and the insertion
of gauze into the lower uterine segment, B. coli was cultured from
the lungs of the infant which had lived three days. Pneumonic changes
in this case were advanced and there were vegetations present on the
tricuspid valve of the heart and an empyema. The mother in this case
had a normal puerperium. On the grounds that the respiratory condition
of the infant was poor at birth, that the illness was short and the
organism cultured from three sites was B. coli, Browne concluded that
infection had occurred ante-natally.

Much of his article deals with the condition of acute
haemorrhagic pneumonia, which, while of doubtful bacterial causation,
comes on suddenly like an overwhelming infection.

In considering his cases, Browne determined that prolonged rupture of the membranes was injurious to the foetus, resulting in a pneumonia which may make its appearance some time after birth without any premonitory signs.

Later, in 1924, he published the results of a detailed survey into the causes of stillbirth and neo-natal death. This paper covered admirably many foetal conditions and, in particular, syphilis, intra-cranial lesions, maceration changes and the fallacy of the hydrostatic test for live-birth. A separate chapter was devoted to intra-natal pneumonia and, further to the cases quoted in 1922, another five stillborn cases showing catarrhal changes in the lungs were added. A sixth case gave only a few breaths and was included. One case Browne described in detail as exemplifying the lesions. Craniotomy had been performed 56 hours after rupture of the membranes, the child having breathed after delivery. The lungs were partly aerated and otherwise appeared normal to the naked eye. They showed cararrhal pneumonia in a fairly advanced stage, the alveoli being filled with polymorphonuclear leucocytes, endothelial cells and granular debris. These changes were seen throughout the portion of lung examined and Browne states "the pneumonia .... was passing over into the stage of grey hepatisation". In this matter of an attempted parallelism between the successive stages in congenital pneumonia and lobar pneumonia of adult type in pre-chemotherapeutic days one might take issue with Browne (but the matter is not of great importance) since the analogy appears to be unnecessary although perhaps not altogether unreal.

In the six cases there was a prolonged interval between rupture of the membranes and delivery and, in two, forceps delivery had been attempted without success prior to admission to

hospital. In only three out of the six cases was the exact interval known. There was no apparent illness in any of the mothers in these particular cases.

In outlining the course of infection of the lungs Browne made three points. Firstly, the fact that the pneumonia had a patchy distribution and, in one case, the inflammatory process was still confined to areas around bronchioles. Secondly, that the mothers were well and at no time had showed any evidence of having had blood infection and thirdly, that in cases in which there was a long period of ruptured membranes prior to delivery, organisms could be found in swabs taken from the naso-pharynx. These, he found in some cases, corresponded to the organisms in the mothers vagina and postulated that they reached the foetal lungs by aspiration or by surface growth. He maintained that asphyxia was a factor in causing inspiratory move-ments responsible for carrying the material into the lungs and observed violent respiratory movements in foetal rabbits after stripping the placenta with the amnion intact.

Browne, then, had confirmed the bronchogenic nature of intra-natal pneumonia, stressed the clinical importance of pro-longed rupture of the membranes, correlated the clinical picture (such as it appeared to be) with the lesions and showed, experiment-ally, the effect of asphyxia on the unborn foetus.

In 1925 Johnson and Meyer published their findings in the lungs of stillborn and newborn infants in a series of 500 autopsies from the Sloane Hospital for Women, New York City, over a period of slightly more than five years. Pneumonia was found in 19.4%. For their purposes, classification was based on the time of occurrence of the infection and they recognised four groups. The first group were those due to antenatal infection with antenatal or

intranatal death (30 cases). The second, probable antenatal or intra-partum infection in which the infant lived less than 3 days, comprised 38 cases. The third, pneumonia with hyaline membrane (type of asphyxia neonatorum), comprised 8 cases and the fourth, those cases of obvious postnatal infection, numbered twenty-one. Congenital pneumonia in their series are cases belonging to the first and second groups ment -ioned. The time limit of three days seems far too long to be certain that any pneumonia present was initiated or established before birth and these authors, apparently aware of this, point out the possibility that there are exceptions, but particularly as to even longer duration of life in the congenital cases. It would appear to be better to make the period much shorter and to substitute a separate group for those of possible intra-uterine origin. In the first group six weighed less than 1500 grams, two weighed between 1500 and 2500 grams and twenty-two more than 2500 grams. In their paper they do not state how many of the total were stillborn but this figure of 30 cases of pneumonia indicates a percentage of 6 in the whole series which is a rather low incidence of the condition. In their second group of 38 cases living up to three days twenty-three lived less than 12 hours. Like other writers they placed little use in the macroscopic characteristics of the lungs as a diagnostic aid and stress the different appearance of the micro-scopic lesions from those later in life. They conclude that the lesions are such as to differentiate the condition from any other. They described the lesions as being often diffuse throughout the whole lung so that practically all the alveoli contain inflammatory material including polymorphonuclear leucocytes, a few mononuclear cells and a variable number of red cells. Fibrin is absent or present in minimal amounts. As to the interstitial component Johnson and Meyer state that the framework of the lung is only slightly involved

and they do not remark on it as being any different in those cases belonging to their second group in which the infants may live up to three days. Concluding their description of the lesion they state that the bronchi usually contain a small amount of exudate.

Along with the inflammatory exudate they describe the associated presence of cornified squamous epithelial cells and earlier in their paper they set out their views on the significance of this finding, namely, that in small quantities, cornified partic-les probably have no significance but that more massive aspirations are brought about by antenatal or intranatal asphyxia. Other support-ive and controversial work on this matter appeared later and will be referred to subsequently.

Apart from the diffuse type of lesion described, Johnson and Meyer recognise a patchy type of lesion which they assume to be due to a more irregular and scantier aspiration of infected material.

In common with some writers they recognised the difficulty of making adequate bacteriological investigations but, after making Gram stained preparations of tissues, found no organisms in the majority of cases which led them to conclude that a chemical substance might provide the irritation in the lungs. However, in their second group eight positive results were obtained from twenty-five cases. The organisms found were cocci resembling staphylococci and streptococci and Gram positive and Gram negative bacilli. Pneum-ococci were not found in any of the congenital pneumonias.

Included in their investigation was an histological examination of the placenta for evidence of inflammation of the foetal surface. This was found in the great majority of pneumonia cases and in two, in particular, in which the membranes were ruptured for

less than an hour before delivery. This interesting fact is explained by them as being due either to small, so called "high ruptures" of the membranes or to the actual passage of infection from the cervix through intact membranes. They concede that in a few cases diaplacental infection is a possible occasional happening but do not agree with Hess-Thaysen in the probability of aspiration of vaginal secretions intranatally.

From the obstetrical point of view, Johnson and Meyer conclude that a major factor in the infection of the amniotic sac is premature or prolonged rupture of the membranes; and that pro-phylaxis might be effective in considering the condition of the cervix or vagina as possible infected sites.

In their third group these writers discuss the significance of what they so rightly cautiously described as the "hyaline membrane". This will be referred to again.

Hook and Katz in 1927 published the results of examination of the lungs in 73 cases and described the various forms of pneumonia acquired congenitally from the birth canal. The work done on the lungs was supplementary to a survey Hook (1927) had made on causes of death in the newborn. Cases of congenital syphilis were excluded and stains for spirochaetes done on some of the sections in the series if there was any suspicion of syphilis.

With few exceptions portions of tissue were taken from all lobes of the lungs and prepared by frozen section. Twenty-four of their cases were stillborn, three were taken from the uterus after maternal death, thirteen died immediately after birth, ten lived up to 24 hours and twenty-three lived for several days up to six weeks. These authors stress the necessity of excluding extra-uterine causes in the neo-natal cases and do not accept cases

after three hours from birth unless the lesions are very extensive.

Their series included forty-four cases either still-born or dying within a few hours of birth. Congenital pneumonia was found in 22 cases, eleven of which were stillborn, nine died immediately after birth and two lived less than two hours.

The macroscopic examination in their series was in-conclusive and they stress the need for microscopic examination but, however, diagnosed three cases out of the twenty-two by naked eye examination. In one of these the lung contained focal areas of thick-ening which on the cut surface had a whitish grey colour. Mostly the findings were somewhat varied. Features often seen were dark red colouration of the parenchyma, liver-like consistency of the lung and a tendency for these changes to be most marked para-vertebrally. The mucosa of the bronchi, and sometimes of the trachea, was often found to be reddened and a light yellow fluid or greenish yellow masses were sometimes found to be present in their lumens. Occasionally, the mucosa was quite pale and the lumens clear. More rarely, after pressure on the lung substance, small plugs of mucoid material were extru-ded from the cut surface. Sub-pleural haemorrhages were noted in all but two cases.

Hook and Katz remarked, apparently with some surprise, that the lungs were not always swollen but, on the contrary, some of the lungs, in which pneumonia was later diagnosed microscopically, were actually small. Nearly always they could describe them as completely atalectatic but they remarked on a proportion in which the lung tissue was air-containing along the free borders of the lower lobes. The lung tissue in this situation was of paler colour and crepitant, and some portions floated in water. They consider this as due to the attempts at artificial respiration, and not to putrefactive changes,

as post-mortem examinations were made soon after birth. In some of
the live-born cases which lived thirty minutes similar marginal aerat-
ion had occurred while in a few which had taken only one or two breaths
the lungs appeared to be, more or less completely expanded.

Hook and Katz described the microscopic lesions in
some detail and stated that they are varied. In the earliest stages
there is a diffuse or focal increase of inflammatory cells in the inter
-stitial tissues and commencing migration into the alveoli. From such
lesions all grades were seen up to completely confluent pneumonia of
single lobes or whole lungs. In one case abscess formation was com
-mencing. The alveolar constituents comprised polymorphonuclears,
alveolar epithelial cells loaded with fine droplets of fat, small
amounts of fibrin, contents of the amniotic sac and oedema fluid.
These authors noted the significance of desquamation of alveolar
epithelial cells associated with pneumonia as opposed to post-mortem
or maceration changes in the bronchial and alveolar epithelium. In
the inflammatory cases they describe the presence of fine fat droplets
in the cytoplasm. The alveolar capillaries were congested and occ-
asionally a few red cells were in the alveoli.

Hook and Katz consider that foci of haemorrhages,
in association with areas of the lung containing inflammatory infil-
trations, are to be regarded also as pneumonic. They state, however,
that haemorrhages in the vicinity of blood vessels and bronchi were
seen in nearly all of their cases.

The bronchi and bronchioli frequently showed hyper
-aemia and increase of leucocytes in the mucous membrane. Almost
always the epithelium in these structures was well preserved. In
some cases, they state that bronchitis and bronchiolitis were the
most pronounced findings.

Bacteria were found in the exudate masses in twelve cases. The organisms present were streptococci, staphylococci and Gram positive and negative bacilli. In some cases there was a mixed infection.

They describe as a peculiar finding the association of interstitial infiltrations limited to those regions where aspirated material is present. Further, that in a few lungs pneumonia was associated with aspirated material while in others, where aspirated material was abundant, there were no migrating leucocytes.

This survey by Hook and Katz makes a very valuable contribution to the knowledge of the types of lesions seen in congenital pneumonia and indicates a very thorough analysis of their material. The high incidence of the lesions found is rather surprising in that eleven out of twenty-four stillborn foetuses were affected.

Cruikshank in a valuable report to the Medical Research Council in 1930 in which he presents his findings in 800 cases of neo-natal death stresses the importance of the previous state of the lung tissue in newborn infants in which congestion, lack of expansion and the presence of inhaled foreign substances render the respiratory system particularly liable to infection, but he makes no actual mention of the inflammatory lesions which may be already established at birth. He does, however, briefly describe the histology of pneumonia neonatorum and states that the lesions are essentially those of bronchopneumonia modified by atalectasis and congestion. Blood cells and an excess of endothelial cells and lymphocytes were also observed in the alveoli but he does not make mention of the features more commonly seen in the

early neo-natal period which probably arose before birth in some of his cases.

Farber and Sweet in 1931 published observations made on amniotic sac contents in foetal lungs in which they discussed the fate of liquor amnii in the upper respiratory passages and maintained that for several reasons the presence of amniotic material in the lungs is injurious to the foetus. This view, of which Farber is one of the best known proponents, seems to the present writer on morphological appearances to be correct. Hess-Thaysen (1914) and Browne (1922) followed later by Johnson and Meyer (1925) studied its importance in those cases where it was probably infected and, at any rate, led to pulmonary inflammation. Farber and Sweet found, on the whole, that is excited extraordinarily little reaction in the lungs and that at no time were there any active phagocytic phenomena observed in the cornified deposits. Even in a random case which died at three months after birth they found definite cornified epithelial cells in the lungs without evidence of any reactionary processes except that in a few places some phagocytosis was occurring. They found altogether in their series of 124 live-born infants that amniotic material was present in 88 per cent. Not only is the presence of this material indicative of pathological intra-uterine respiratory movements but it adds to the difficulty in gaseous exchange once respiration is established. Large amounts of sac contents were present in 15 per cent. of the cases studied and these lesions are beautifully illustrated in their paper.

It is pertinent to note that these workers state that inflammatory reaction was not seen, except in infected cases, but they do not indicate what their criteria of infection were. Either clinical or bacteriological evidence, one gathers as meant,

of which neither, nor the two together, are at all reliable.

Farber and Wilson (1933) and Wilson and Farber (1933) wrote two very useful papers on atalectasis of the newborn. In an aetiological survey they stress the importance of aspirated material, including mucus, blood and liquor, as a major factor in causing atalectasis; and, amongst others, cohesion between bronchiolar and alveolar walls in maintaining foetal atalectasis. In this latter, their views differ from those of Snyder (1937) to some extent, who claims to have proved a continuous amniotic circulation in and out of the foetal lungs. Wilson and Farber make the point that atalectasis from inhaled material is not as common in the premature baby as in the full-term and state that the lessened amount of vernix material in the immature accounts for much of this. It would appear to be only partly true, as large amounts can sometimes be seen in premature lungs (indicating that there is considerable epidermal desquamation) and, in any case, in the very premature cases the wide interstitial tissues not only prevent the alveolar walls from coming partly together but actually appear to hold the alveoli in a fully distended position. Farber and Wilson in another paper rightly draw attention to the width of the inter-alveolar tissues in premature lungs and point out that many structures seen are, in fact, not alveoli but dilated respiratory bronchioles.

Kaldor in 1932 published his findings from the post-mortem examination of 39 cases of stillbirths and early deaths of newborn children. Evidences of pneumonia were found in 12. (30%). In his series all cases showing inflammatory lesions were associated with aspirated material which included epidermal scales, fat and lanugo hairs. Kaldor, while briefly describing the microscopic findings, does not give any detailed description of the lesions

present except to indicate whether the lesion was present as collect-
ions of leucocytes in the alveolar spaces or as infiltrations in the
interstitial tissues. Nor does he indicate in some of the cases
described whether they were stillborn or liveborn but gives an illus
-tration described as congenital pneumonia in which the widened inter-
stitial tissues are infiltrated by polymorphonuclears, (a rather unusual
lesion).

In arguing for the bronchial method of entrance of
infection into the lungs, Kaldor points out that were spread by the
bloodstream it would be peculiar for the alveoli to assume the contours
of alveoli filled by air after breathing, and obviously referring to
the stillborn cases makes the point, which on it's own seems rather
insecure, that normal evolution of the alveoli could scarcely occur
by expansion in/ containing a cellular exudate poured out as a res
-ult of haematogenous infection. His other point is more in line with
the general consenus of opinion in which he agrees with Farber and
Sweet (1931) that conclusive evidence of a majority incidence of
aspiration of amniotic contents points to a bronchial pathway of in
-fection. However, in common with other writers he makes no mention
of lesions, which are not obviously of bronchial spread, such as those
seen in the very premature foetus which are mainly, if not entirely,
interstitial.

Kaldor mentions the fact that the larger bronchi
rarely show any evidence of inflammation and offers, as explanation,
the rapid passage of the material through them into the peripheral
portions of the lung. But, nor does he mention the lesions which
do occur in some cases around terminal bronchioles.

Finally, he states that in those cases of stillbirth
for which there is no obvious cause of death but there is evidence of

an inflammatory process in the lung then such a pneumonia "shall be accepted as the cause of fatality". Prior to this, Kaldor states that it cannot be determined to what degree the breathing surface can be impaired without becoming insufficient to maintain life. In this respect he seems to be somewhat confused, for surely only the toxic effects of such material can be a factor in absolutely preventing separate respiratory existence after birth since any respiratory effort, whatever the nature of obstruction to gaseous exchange, precludes establishment of a diagnosis of stillbirth. Moreover, although this will be referred to again, there are practically always other factors responsible for stillbirth in these cases.

Helwig in 1933 made a plea for more thorough microscopical examination of viscera from infant autopsy material so that the all too common pulmonary lesions described already might be recognised; thereby reducing the number of unascertained deaths previously described as due to "stillbirth" or "prematurity". He stated that the finding of amniotic material in so many lungs does not necessarily imply that such findings are not pathological and reiterated the view of Farber that, normally, amniotic fluid circulated only as far as the larynx. In a detailed table including 66 cases, which showed aspirated material in the lungs (out of a total of 159 autopsies), Helwig attempted to show what conditions might have been responsible for pathological foetal respiratory movements which led to the aspiration of varying injurious amounts of amniotic fluid into the lungs.

Helwig's series of 159 cases included 12 cases of pneumonia, five of which were stillborn, one lived one minute, another four hours and the rest longer. He made the important obser-

vation that material should be taken for section from several sites as the patchy nature of the lesions may otherwise render observations false. He then goes on to suggest the possibility of focal origin with subsequent spread by coughing. As so many lungs showed evidence of aspiration of amniotic fluid without there being an associated inflammatory reaction in most, Helwig found it difficult to explain the occurrence of acute inflammatory exudates into the alveoli in five cases of stillbirth in the absence of a demonstrable bacterial cause. He had thus in his series, apparently, been unable to detect the presence of any organisms in the lungs. Bacteria could be found in the lungs of those babies who had lived for some hours and Helwig suggested that the presence of aspirated fluid might render the lungs more vulnerable to bacterial invasion after birth. The presence of meconium in the fluid appeared to increase this susceptibility. In a large number of cases investigated, microscopical examination failed to reveal any evidence of inflammation of the placenta, thus differing from Johnson and Meyer (1925) who found an association in all but two cases of congenitally acquired pneumonia.

Warwick in 1934 writing from the Millard Fillmore Hospital, Buffalo, New York, described the findings in 240 consecutive autopsies upon infants either stillborn or dying within the first two weeks of life. Forty-three cases (18%) were found to have pneumonia. Ten of the cases were stillborn and eight lived less than 12 hours. This writer states that pneumonia in the newborn does not receive the attention it deserves and may even be overlooked at autopsy, regarding which she says that a diagnosis cannot be made with certainty macroscopically at post-mortem and apparently meant this to apply even to those dying two weeks after birth. Unfortunately, in her series, a sharp division is not made between the stillborn and

liveborn cases as she considers that for at least up to three or four days the condition was probably of intra-uterine origin and only seven of her cases were outside this group. Warwick only briefly describes the lesions microscopically and states that the lumens of the alveoli contained polymorphonuclear leucocytes in variable numbers and that sometimes these cells infiltrated the thickened alveolar walls. There were often numerous red blood cells, desquamated endothelial cells and frequently the contents of amniotic fluid which had been aspirated into the lungs. The inflammatory exudate was formed around the constituents of the amniotic fluid in the majority of cases and further, these two lesions were often present in an area of atalectasis.

Most of the rest of Warwick's article deals with the significance of aspiration material in the lungs and refers to the views of Hess-Thaysen, Johnson and Meyer, Von Reuss, Hook and Katz, Cruikshank and Pearson. Her own views in the generation of foetal and neo-natal pneumonia are that bacteria are usually the cause of exudation into the alveoli but that uninfected amniotic material and chemicals may cause pulmonary irritation. She suggests that the condition might be due to more than one factor and cites the causation of adult pneumonia by different strains of bacteria as well as by different varieties; and that bile salts which are irritating to adult tissues are probably doubly so in the sensitive lungs of a premature or newborn baby. Further, she states that some of the pneumonia cases occur in groups during the months in which respiratory infections are the most prevalent, but except in the cases of neo-natal infection (and having regard to the suggested modes of infection which she favours) seems to be somewhat coincidental.

Macgregor in a very thorough investigation of 541 consecutive autopsies on infants up to twenty-eight days old found that 177 (32%) presented inflammatory changes in the lungs. In her series 11 were stillborn (in the series examined only 93 of the total were born dead, which accounts for the lower over-all incidence). Every case was subjected to microscopic examination as she stresses that the macroscopic diagnosis of pneumonia is uncertain in the presence of atalectasis, congestion and haemorrhage. Bacteriological examinationswere made in the majority of cases including 150 of the 177 cases of pneumonia. Of the stillborn pneumonia cases which were examined for organisms, B. coli was found to be the causative organism in one case in which there had been a long, dry labour. In three the results were inconclusive and in the remaining six, direct smear examinations of the lung juice and cultures were negative.

Macgregor separates pneumonia in association with aspiration of contents from the amniotic sac or vagina from that associated with other pulmonary conditions due to stress of birth or conditions otherwise peculiar to the newborn. In the former group there were 44 cases in which 11 were stillborn and 33 liveborn. Mostly those found in this latter 33 cases lived less than four days. In her other two groups - bronchopneumonia and allied types and septicaemia with involvement of the lungs - there were 100 cases which she considers were due to post-natal infection.

All the stillborn cases showed evidence that an excessive quantity of liquor amnii had been drawn into the lungs for which the evidence is found in epidermal particles, amorphous

vernix material and lanugo hairs. Meconium was found in some. Macgregor claims that this latter may be obvious macroscopically from the bile staining of the lungs. Like Johnson and Meyer she found that the pneumonia was either diffuse or patchy and that it was accompanied in all cases in the first two groups, by evidence of congestion, collapse and haemorrhage. Much of the rest of her first paper in this publication deals with the morphological aspects of the vernix membrane and with a discussion of aspirated material in the lungs. Apart from an occasional illustration, she does not describe the actual lesions present in the pneumonia cases.

Thaisz in 1939 published an article in which he described five cases of congenitally acquired pneumonia, two of which were stillborn and the other three lived for a few hours. In an admirable short review he discussed the nature of the condition but, again, does not give detailed descriptions of the lesions encountered. Referring to the work of Hook and Katz (1927), Thaisz emphasised again, probably with reference to neo-natal cases, the necessity of examining the lungs microscopically in any baby where no certain cause of death is known and quotes Stork (1934) in whose series 72% of cases with pneumonia had died.

Thaisz divided congenital pneumonia into two types; those in which the inflammatory process commenced in the lungs before birth and those which acquired some noxious substance from the uterus or birth canal and developed the lesions after birth. Both these being due to aspiration. Of the second type he stressed that a case can be regarded as congenital which has lived for a period of some hours, only if all extra-uterine causes can be excluded and, therefore apparently did not consider any particular lesion or lesions to be pathognomonic of the condition. Thaisz's own

opinion apparently is that cases dying from pneumonia in the first twenty-four hours can probably be regarded as of congenital origin but refers to Bauereisen (1938) who accepts thirty-six hours, and Johnson and Meyer (1925), three days.

He mentioned the possibility of haematogenous trans -mission of infection and emphasised the several criteria necessary to establish such a route of infection. These are that the mother must be ill at the time, the infection must be of septic type in the foetus, it must be generalised and that the placenta must show inflammatory lesions. Finally, both mother and foetus should suffer from similar diseases. Thaisz referred to several reported cases and especially to those of the influenzal pandemic.

Of the bronchogenic origin he mentioned prolonged rupture of the membranes and accepted the view expressed by Hook and Katz (1927) and others that premature respiration is an abnormal feature necessary for localisation of noxious substances in the lungs. Thaisz was of the opinion that, while in most cases the liquor amnii is infected, inflammation can be initiated by a noxious amniotic fluid and referred to this as "amniotic fluid pneumonia" (after Hochheim). This, he said according to Lauche, can be deadly, but generally improves within a few days without leaving any trace of permanent injury. He quoted Szlavik (1932) who found inflammatory foci around sterile aspirated material.

In his own cases he gave details of the macroscopic findings in the lungs which in the two stillborn cases, were solid, dark red and exuded a thick yellow exudate from the bronchi on squeezing and apparently after microscopic examination gave, as a diagnosis, confluent bronchopneumonia and bronchitis; and in the second, aspiration bronchopneumonia. His illustrations, taken from

the three liveborn cases show extensive inflammatory cell deposits
in alveoli and bronchioles. Four of his cases had prolonged rupture
of the membranes.

In conclusion he remarked on the remarkable fact
of the widespread lesions sometimes found from congenital infection
in spite of an apparent high degree of immunity at this period of
life. As to the lesions, which he does not describe in detail he
emphasises their focal character and bronchial distribution and lack
of specificity otherwise.

Benner in an interesting paper (1940) described
the findings in the lungs, middle ears and accessory nasal sinuses
which result from aspiration of amniotic fluid. Her series of a
total of seventy cases included thirty-one stillborn infants exam-
ined post-mortem with material taken for histological section from
the lungs, middle ears and sinuses. In eight cases all or some
of these sites showed the presence of an inflammatory reaction.
Inflammatory changes were present in five cases in the lungs, absent
in one and doubtful in two. This incidence seems remarkably high.
Her findings are particularly interesting for several reasons. The
incidence of congenital pneumonia was highest in premature infants
in the stillborn group, only one out of the eight being at full-term.
Comparing this with other figures it is most unusual. In three
cases out of the whole group, amniotic material was found in the
upper respiratory tract but not in the lungs. This Benner construes
as some evidence (in the controversy over intra-uterine respiration)
in favour of the possibility of the glottis remaining closed in the
uterus and preventing entry of amniotic fluid into the lungs until
the glottis opens at birth. This will be discussed further later.
But the association of inflammatory changes in all three situations

is a major confirmatory fact in the aetiology of most of the
pulmonary lesions with inflammatory cells. Benner, however, gives
no great detail in describing the inflammatory lesions present and
makes no particular reference to the dense cellular inflammatory
exudate in the lung, sinus, and middle ear, which she illustrates.
In the two latter situations, there is only very slight inflammatory
infiltration of the submucosal tissues. It is suggestive that such
abundantly cellular material may have also been aspirated along with
the epidermal particles which she describes as being present. In
two cases Benner refers to a type of foreign body reaction in the
lung in which foamy mononuclear cells and giant cells were encountered.
These changes, again, are most unusual and the possibility that the
foamy monocytes were of epithelial origin seems considerable, except
for the likehood of their being specialised macrophage cells of the
alveolar lining. Bacteriological studies in her investigation gave
unsatisfactory results.

Douglas and Stander published the results of a large
bacteriological investigation of the foetus in 1943 with reference to
the effect of long labour on the incidence of puerperal infection,
total morbidity and maternal and infant mortality. The period under
investigation included 1,041 infantile deaths out of 25,574 births.
In 140 cases, with negative blood cultures in the foetus, an obvious
cause for death was found. In another 225 cases, positive blood
cultures were obtained from eighty-five. The mothers in these 85
cases showed a high incidence of fever, fifty-six being febrile,
three having a low grade fever and twenty-six having no fever at all.
Of the 85 babies examined, 83 were stillborn, one died neo-natally
and one survived. Fifty-five were delivered by operative procedures,
of which twenty-one were forceps extractions, thirteen were craniot-

omies and fifteen delivered as breeches. In the other thirty delivery was spontaneous. Labour lasted on average for sixty-two hours in 58 cases and was less than thirty hours in 27.

Amongst the autopsy findings there were 13 cases of pneumonia and the authors point out that the autopsy findings were to some extent spoilt by the fact that, in 47 cases, death had occurred on average 17 hours before delivery and there were considerable maceration changes.

The placenta was sectioned in 80 cases and in forty-four there was evidence of inflammation.

The organisms found showed considerable variation, and infection was mixed in 19 cases. Those found included anaerobic streptococci (25), anaerobic and aerobic diphtheroids (9), Streptococcus viridans (8), aerobic non-haemolytic streptococci (7), S. albus (6), B. coli (5), haemolytic streptococci (3), anaerobic staphylococci (2) and S. aureus (1).

From these interesting findings of Douglas and Stander in such a large series, it seems worthwhile to comment on certain of their figures. Firstly, that in spite of there being 85 cases with positive heart blood cultures and 44 cases among these showing, what they call, placentitis, there were only 13 cases diagnosed as having pneumonia. (They do not, however, mention the total number of the stillborn cases in the series which showed pneumonia). Secondly, while they found a high proportion of anaerobic streptococci in the foetal blood, B. coli was one of the rarer organisms found. Finally, the sharp separation between ante-mortem and post-mortem foetal bacteraemia must be appreciated and also the possibility of many of the foetuses being dead, in the large number of cases of placentitis, long before infection of the amniotic sac occurred.

Cornelison, Johnson and Fisher (1946) published the results of investigation of the bacteriological content of the oro-nasal cavity at birth. Material taken for examination was collected from the nasal orifices and pharynx before the oral and nasal cavit-ies were aspirated of mucus. They concluded that a similar flora was found in these situations to that present in the vagina but that E. coli was more prevalent in the infant, presumably due to contamination after birth of the head. The organisms found included Staphylococci (only two out of forty-four of which were coagulase positive), Streptococcus faecalis and Moniliae. The cases studied included two sets of investigations on 150 unselected births. Long rupture of the membranes was associated with a higher incidence of foetal oro-nasal contamination but the authors point out that, in many unselected cases, it is possible to have a minimum contamination of the foetus. Pneumococci and haemolytic streptococci of the puerperal fever type were not found.

Labate in 1947 published a study of the causes of foetal and neo-natal mortality over a ten year period during which time 868 autopsies were performed. In common with some other writers, Labate does not clearly indicate in any of his figures what number were born dead and to confuse matters somewhat more quotes Potter and Adair (1943) and D'Esopo and Marchetti (1942) in a table in which he gives maceration as a cause of neo-natal mortality. However, the whole is more a statistical analysis of the total of infant wastage rather than an attempt to discuss any of the conditions mentioned on a descriptive basis. He does, at the same time, discuss some aspects of asphyxia and of aspiration of amniotic fluid. He contends that aspiration of large amounts is due to intra-uterine asphyxia and discusses some physiological aspects of foetal anoxaemia. Thus, if

foetal anoxaemia progresses short of damage to the vital cerebral centres an amount of aspiration occurs which will aggravate and prolong the anoxic state after birth. Labate described the end result as similar to death by drowning. Such aspiration accounted for 60.2 per cent. of the lung lesions encountered in his series while pneumonia accounted for 27 per cent. In the whole series, this latter accounted for 8 per cent. of deaths in both premature and full-term babies. Twenty per cent. of the full-term babies and thirty-six per cent. of the viable premature babies, however, showed pneumonic lesions in the lungs; the majority not being severe enough, in association with other findings, to cause death.

He recognised three types of pneumonia: (1) congenital, (2) aspiration, and (3) pneumonia of undetermined origin. (Aspiration pneumonia is a term used by Labate to mean aspiration of vomitus or food). Congenital pneumonia he states is caused by the aspiration of amniotic fluid which has become infected, usually as a result of prolonged rupture of the membranes.

A great deal has been written in the literature on the vernix membrane, the peculiar eosinophilic lining of the alveoli and alveolar ducts in certain premature liveborn babies. It is probably better called "asphyxial membrane" until its structure is more accurately known. Farber and Sweet (1931) held that these membranes were truly of vernix nature and by using fat stains (Scharlach R in frozen sections) and haemotoxylin and eosin they showed that the membrane material was in part composed of vernix fat and epidermal particles. In a study of 124 liveborn infants, eighteen showed massive aspiration of amniotic material and some of this was in the form of membranes. They found little or no evidence of inflammatory reaction to the material but occasionally noticed phagocytosis to a small extent.

In a later paper (1932[a]), Farber and Wilson re-
iterate the vernix nature of the material and in another, which
describes an experimental study (1932[b]) they found that, with
correct mechanical conditions, the lesions could be produced in
the dead animal by injecting horse serum, India ink or fibrino-
purulent exudate intra-bronchially while performing artificial
respiratory movements on the chest. Also, that in anoxaemic
animals, forced to breathe deeply, there developed membranes, com-
posed of serum, against the alveolar walls; while with carbon dio-
xide lack and no deep breathing no membrane formation occurred in
spite of anoxaemia. Fat deposits were absent in these experim-
entally produced lesions.

Tregillus in 1951 opposed the views of Farber,
Sweet and Wilson and considers that the membranes are products
of necrosis and hyalinisation of bronchiolar epithelium due to o-
xygen deficiency. His post-mortem material included 244 cases of
which 124 were liveborn. Thirty-five showed the presence of mem-
branes in the lungs and, of these, 33 were premature. They were
all liveborn and showed, in the majority, limpness, cyanosis and
feebleness at birth with difficulty in establishing respiration
and recurrent attacks of cyanosis and dyspnoea. Mostly they
lived less than three days. Tregillus distinguishes between
vernix material in the lumen of the alveolus and membrane material
plastered against the wall. The former he describes as consist-
ing of round or oval masses which stain heavily with fat stains
while the membrane material stains weakly or not at all. His
views are that epithelial degeneration products make up most of
the material, with a small occasional mixture of vernix material
(while Farber et alia claim that the importance of the two

constituents are in reverse). He describes the apparent stages from early signs of degeneration of the bronchiolar epithelium to complete fusion of the free cytoplasm into structureless, eosinophilic, hyaline material. Nuclear remnants in various formations were found incorporated in the membrane. In Tregillus's series seven cases had associated congenital pneumonia but he does not describe the lesions seen.

There is almost certainly no relationship between the post-natal formation of asphyxial membranes in lungs and congenital penumonia but these two views are briefly outlined because of the possibility that, in some of the inflammatory cases, there is some relationship between a noxious substance at work in the lung and bronchiolar epithelial changes similar to, if not identical with, the lesions described by Tregillus.

Some reference must be made to the present state of knowledge of intra-uterine respiratory activity for, presumably this, either as a physiological function or as a result of disordered function from asphyxia, is responsible for much of the abnormal pulmonary conditions present at birth. If only from the recognition of epidermal and vernix material in the alveoli of stillborn and liveborn foetuses, it is quite certain that intra-uterine respiratory movements must take place in some form. Many workers have stated that it is only pathological inspiratory efforts, brought on by asphyxia, which lead to massive depositions in the alveoli, (Reifferscheid (1911), Farber and Sweet (1931), Helwig (1933).). Browne (1924) commented on the initiation of active respiratory movements in utero after making the foetus asphyxiated and made no comment on there being any spontaneous rhythmical movements prior to interference. Ahlfeld, quoted by Reifferscheid (1911), in 1888

had published his findings from clinical observations and tracings,
comparing maternal respiratory movements and pulse with others which
he held were due to contractions of the foetal respiratory musculat-
ure. This observation of periodic foetal respiratory activity with
a rate of 38 to 76 excursions per minute caused much controversy
amongst German workers and for many years gained such little accept-
ance that the experiments were neither considered necessary of con-
firmation by other workers nor were Ahlfeld's views quoted in the
standard texts.

In 1890 he summarised his results in an address
in honour of Ludwig by describing foetal respiratory activities and
their relation to post-natal respiration. He again emphasised that
they were not the commonly known "movements" nor were they caused
by any combination, as suggested later by Olshausen (1894), quoted
by Reifferscheid, of maternal respiratory movements and maternal
aortic pulsation. Runge (1894), another antagonist to Ahlfeld's
views, also observed these periodic rhythmical movements of the
pregnant abdomen in his patients but was at a loss to explain them.
He observed a sheep foetus in utero and noted complete absence of
respiratory movements for three minutes but was able to produce them
by compression of the umbilical cord. Ahlfeld replied to this by
re-emphasising the periodic nature of such movements and suggested
that Runge's observations were made during a period of quiescence
of respiratory activity.

Reifferscheid quoted Ferroni (1899) who consider-
ed that the movements were of a physiological nature and, further,
that they are purposeful during pregnancy and parturition.

Reifferscheid himself in 1911 published his own
findings on the human subject which supported Ahlfeld's findings but

suggested that such movements of the abdominal or thoracic musculature may occur with the glottis closed under normal circumstances.

More recent work by Snyder (1938, 1949) seems to confirm in full the findings of Ahlfeld. In attempting to determine the action of certain drugs on the foetus, Snyder noticed rhythmical sustained movements of rabbit foetuses in the exposed uterus after prolongation of gestation by inducing ovulation with pregnancy urine. The work was elaborated by injecting India ink into the amniotic sac and observing that the foetal lungs rapidly became filled in un-anaesthetised animals but that filling was slower in those given pentothal sodium injections.

Snyder (1949) quotes Reifferscheid and Schiemann (1939) who injected 25 cc. of umbrathor into the amniotic sac and later demonstrated its presence by X-rays in the lungs and intestinal tract of the foetus which had been delivered by hysterotomy.

Clement A. Smith (1946) who views the findings of Ahlfeld, Snyder and others with some reserve quotes the prolonged observations of Barcroft on sheep foetuses over 142 days. Barcroft also observed the foetal respiratory movements but was not satisfied that even minimal stimuli (which must result from operative procedures) were not sufficient causes to set up foetal irritation and reflex movements.

Smith, it seems quite rightly, suggests that the problem is not yet adequately solved but concedes that the human foetus, to some extent is capable of at least some similar intra-uterine respiratory movements to those observed in experimental animals. Certainly, and all workers agree on this, asphyxia does result in active respiratory excursions which do result in the passage of amniotic and even vaginal contents into the foetal lungs

THE OBJECTS OF THE PRESENT INVESTIGATION

The present investigation has been carried out to study a group of cases from a large Australian obstetrical hospital with particular reference to the presence of inflammatory collections in foetal lungs. Since other workers published their findings in large series of cases, the use of the sulphonamide drugs and penicillin has, to some extent, become a routine procedure in some obstetrical complications before and during labour. A survey of cases of congenital pneumonia under these new conditions is considered warranted. Finally, while many workers refer to cases of congenital pneumonia, and some of them have written about this condition exclusively, none give detailed descriptions of the lesions which they consider to constitute the condition. This work makes an attempt to give a more detailed account of the condition and to illustrate most of the cases by photographs. It is pointed out here that the set of illustrations which appear in the work have been chosen to depict all the types of lesions seen and not solely to illustrate each case. In fact, some illustrations, taken alone, would be misleading in certain cases.

THE PRESENT INVESTIGATION

Why human buds, like this, should fall
More brief than fly ephemeral
That has his day;

          -Charles Lamb

For twelve months beginning on March 6th, 1950 post-mortem examinations were performed by the author on all stillborn or newborn infants dying within twenty-eight days of birth at the Womens Hospital, Melbourne. In that period there were 6385 deliveries, 172 stillbirths and 120 neo-natal deaths. A total of 302 post-mortem examinations were made: the additional ones being non-viable aborted foetuses not classified by the obstetric staff of the hospital. Most of the mothers had attended the ante-natal Clinic at the hospital (5901) while others classified as "Emergency admissions" (484) usually were first seen at term or in labour. Some of the statistics of the obstetrical conditions for the twelve month period are set out in Table 1.

With only two or three exceptions (because of objection on the part of the parents), autopsies were performed on the 292 cases dying in the hospital. Almost immediately after birth in the case of stillborn foetuses or after death in the wards of the live-born babies the bodies were delivered to the mortuary in the Pathology Department of the hospital and stored in a refrigerator. Sometimes in the stillborn cases the placenta was sent with the foetus. It was described macroscopically and portions taken for histological examination.

Autopsies were carried out on two days a week usually not more than three or four days apart. The procedure practised was as follows:

The body was weighed and described externally with particular notice taken of its size, colour, the conditions of the anterior fontanelle and umbilical stump and the presence of any externally recog-

TABLE 1.

A LIST OF SOME OF THE STATISTICAL DETAILS FROM

THE OBSTETRICAL STAFF MEETING NOTES FROM MARCH, 1950

TO FEBRUARY, 1951.

	Number	%
Number of deliveries	6385	
Number of patients delivered who had attended the Antenatal Clinic	5901	92.4
Number of Emergency Admissions	484	7.6
Presentations:		
Vertex	5957	93.2
Breech	204	3.2
Forcep deliveries	928	9.6
Caesarean section operations	204	3.2
Artificial rupture of membranes	327	5.1
Accidental haemorrhage	106	1.6
Placenta praevia	27	0.4
Eclampsia	38	0.6
Pre-eclampsia	101	1.5

nisable congenital abnormalities. A mid-line incision was made from above the sternum to the pubis and the skin reflected off the anterior part of the thoracic cage. The serous cavities were inspected for the presence of effusions and the heart and great vessels examined. The external appearances of the lungs were described and portions taken from the lower lobes including the diaphragmatic and anterior surfaces up to the inter-lobar fissure. Occasionally the whole lung was removed. The specimens were then fixed in 5% formalin. In some cases, but not all, the mediastinal and cervical structures were removed and examined. The abdominal part of the examination consisted in an inspection of the bowel, mesentery and lymph glands, examination of the outer and cut surfaces of the liver and spleen, incision into the suprarenal glands and kidneys, examination of the whole urinary tract and the interior of the intestine. The female genitalia were examined, the position of the testes determined and the genital tract examined in the male .

The skull was examined after making a coronal skin incision between the mastoid processes and reflecting the flaps forwards and backwards. The sides of the calvarium were removed leaving the venous and dural structures intact. The occipital lobes were lifted forwards and the tentorium cerebelli inspected on both sides. The left cerebral hemisphere was removed through the corpus callosum and the right removed with the brain stem intact after severing of the tentorial structures. The brain and cerebellum were then examined after coronal sections and the contents of the ventricles and condition of the choroid plexus and basal ganglia noted.

The above was the common procedure followed where no gross abnormalities existed. Where there were congenital abnormalities or other pathological states of macroscopic interest special dissections were performed, specimens were kept if they had any teaching or museum value and colour photographs taken where desirable for the photo-

graphy collection of the department which was mainly used for student's
lectures.

Material taken for histological preparation, after fixat-
ion in formalin, was prepared in the following way. Slices of tissue
approximately 2-3 mm. thick were dehydrated in three alcohols (70%,
90% and absolute) for two hours in each, cleared in cedarwood oil over-
night, washed in xylol for 20-30 minutes and infiltrated in paraffin
(using one change) for four hours. They were then embedded and cut at
approximately 8u and stained with haematoxylin and eosin and by Masson's
Trichrome Method. Certain other sections were stained by Gram's Method
for organisms in tissues.

The lungs were sectioned in 97 stillborn cases and in 40
in which the infant lived less than 6 hours.

These included:

Stillborn	97
Premature	44
Full-term	53
Live-born (less than 6 hours)	40
Premature	32
Full-term	8

Much of the material of the series was lost for histol-
ogical purposes because there was such a high proportion of cases which
showed maceration changes. In some the changes were far advanced, in
others they were just commencing; but mostly the tissues were discarded.
Thus out of the 73 cases showing maceration, in only 18 were pieces of
lung tissue taken for section. Including the few cases sent from out-
side sources, a total of 192 stillborn foetuses were examined by the
post-mortem technique described. Of these, 87 were full-term foetuses
and 105 were premature.

The following cases have been taken, therefore, from an examination of sections of the lungs in 137 cases either stillborn or living less than 6 hours. Each one is described by giving its case number, the age of the mother, the number of previous children, the number of previous pregnancies, the clinical estimate of the period of gestation and a summary of the relevant clinical notes of the mother and of the baby in those cases which lived. The post-mortem findings include the weight of the foetus, any significant macroscopic lesions (with descriptions of the lungs) and a detailed report on the histological sections of the lungs. Finally, a discussion of the findings in the lungs is given in each case.

In the descriptions of the cases which follow, "routine chemotherapy" or "chemotherapy course" are sometimes mentioned. Each indicates that the mother was given either 60,000 units of penicillin 3 hourly or 200,000 units twice daily and a course of one of the sulpha drugs.

DESCRIPTIONS OF SEVENTEEN CASES
OF STILLBIRTH WITH INFLAMMATORY
CELLS IN THE LUNGS.

CASE 10.   Age 22.   Para 1.   Grav 1.   ?   40 weeks gestation

Emergency admission.

Summary of clinical notes:

Pre-eclampsia present "for a few days before admiss -ion" (B.P. 175/110 and albumen ½). Considerable oedema. Membranes artificially ruptured. Routine chemotherapy started 7 hours after admission. Delivery effected by a low forceps application after a 12 hour labour. Foetal heart was not heard just before delivery. Babe did not revive. Membranes had been ruptured for 36 hours.

Post-mortem findings:

Weight: 2445 gms.

Macroscopic: Tear in left tentorium cerebelli. Blood clot cover- ing both cerebral hemispheres posteriorly. This was a thin layer and there was no free blood under the tentorium.

The lungs showed blotchy purple mottling over their surfaces and were more or less solid and of dark purplish colour throu- ghout. Some small portions floated in water.

Microscopic: The lungs have a nearly mature structure and appear expanded except around the edges of the lobe. There is considerable congestion in the large vessels and in the alveolar septa. In one area, many adjacent alveoli contain blood. Surrounding this many alveoli contain numerous leucocytes and small masses of eosinophilic material which in places appears to be fibrin and breaking down red cells. Apart from this area there are leucocytes present in isolated groups of alveoli throughout the block. In other places some alveoli contain particles of cornified material. Some bronchioles contain cornified material and the alveoli surrounding them contain inflammatory cells. There is a sugg- estion that a diffuse inflammatory infiltration is occurring in the interstitial tissues.

Illustrations to CASE 10.

FIG. 1.

Showing aggregated leuco-
cytes and epithelial cells in
a bronchiole and scattered
inflammatory cells beneath its
mucosa. (x 400).

FIG. 2

Leucocytes are present in
the alveolar spaces but the usual
appearance is distorted by vacu-
olation of the lining epithelial
cells. (x 400).

FIG. 3.

A small collection of unlobed
inflammatory cells, mainly in the
interstitial tissues. (x 100).
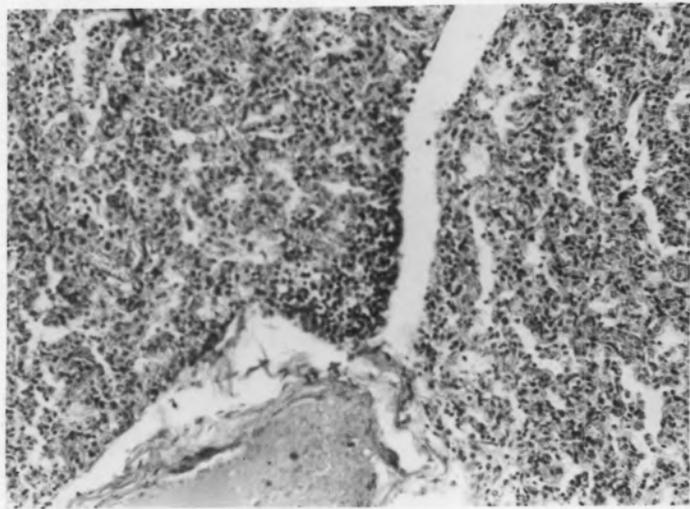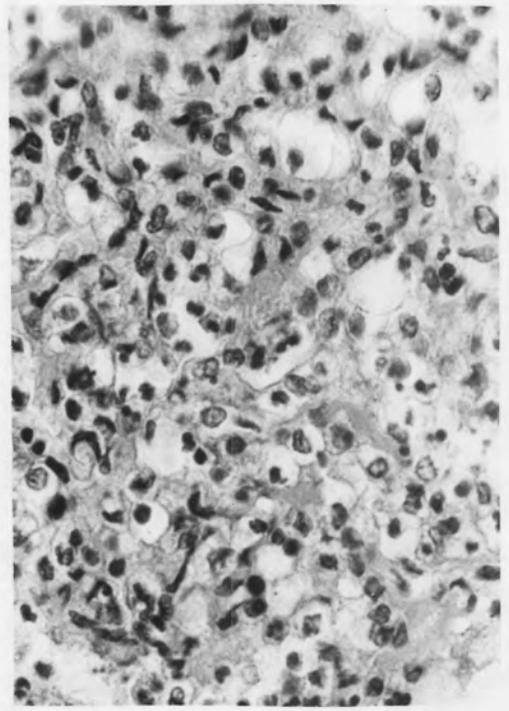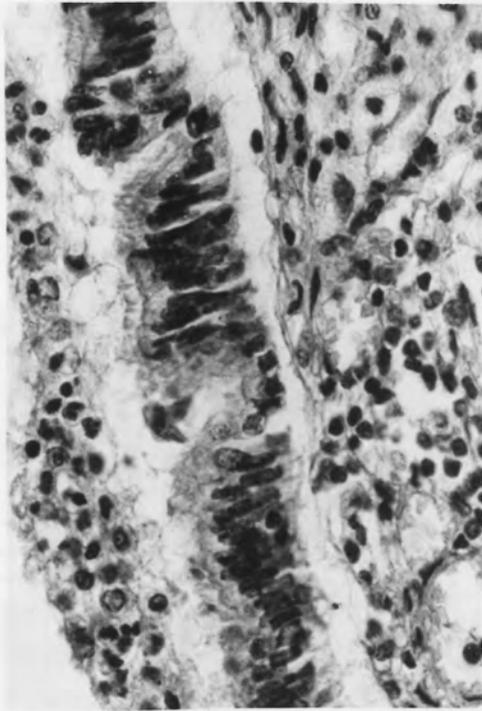
The leucocytes in the alveoli are mostly polymorpho-nuclear in the two and three lobed stages.

Many of the alveoli which show expansion are distended to about twice normal size.

The bronchial epithelium is considerably broken up throughout.

The outstanding features in this lung are the wide-spread congestion, intra-alveolar haemorrhages, the aspiration mainly into bronchioles of masses of epidermal material and more or less circumscribed areas of lobed leucocytes in alveoli. These latter areas are best seen close to three bronchioles which are filled with epid-ermal scales. There appear to be two explanations for such an appear-ance. Either a lobular distribution of aspirated epithelial and puru-lent material has occurred or an inflammatory reaction with a lobular distribution is occurring in the alveoli related to a bronchiole which contains masses of aspirated material. In one of these bronchioles the columnar epithelium is mostly absent and a thin rim of submucosal tissue remains. Partly in this, and between it and the epidermal scales, there are scattered lobed leucocytes and at a very short distance the alveoli are filled by similar cells. In another bronchiole the columnar epithelium is entirely absent but inflammatory cells are not present in its lumen or in its submucosal tissues. The surrounding alveoli con-tain inflammatory cells but they are not as dense. If an interstitial inflammation is occurring, or if the interstitial tissues are affected by a local inflammatory process, slight thickening of the inter-alveolar tissues in this area is the only evidence of such a change. And much of the thickening is due to capillary congestion, which is generalised.

In the central portion there is no evidence of any inflammatory exudate in the artificially over-distended alveoli.

Two things are fairly certain from these appearances. The widespread haemorrhages into the alveoli and the macroscopic appearances of the lungs are almost certainly due to asphyxia. The plugs of epidermal scales in bronchioles (and it is not unreasonable to assume that this occurred extensively throughout both lungs) indicate firstly, that pathological intra-uterine respiratory efforts were made and secondly, that these resulted in widespread bronchiolar blockage. What effect the artificial respiratory attempt (which caused many alveoli to become over-distended) had on the disposition of this material in the bronchioles is difficult to determine; but it almost certainly must have had some.

Practically all throughout the lung the leucocytes are well lobed forms and there are none of the more obviously foetal collections in relation to either the cornified particles or to the alveoli containing leucocytes.

Against the impression that they are all aspirated leucocytes are the facts that they are not present in the numerous bronchiolar structures nor are they anywhere mixed very much with the obviously aspirated epidermal scales. That separate aspirations of material from different parts of the birth canal could occur is undoubted but the similar distribution of these two materials together with the fact that epidermal material appears to be the more recently aspirated makes the supposition rather unlikely when a more simple explanation, namely that a bronchopneumonic type of inflammation is occurring as a result of aspiration of a noxious substance, is more easily tenable.

CASE 36.   Age 37.   Para 3.   Grav. 3.   41 weeks

Emergency admission.

<u>Summary of clinical notes:</u>

Membranes ruptured 2 days before admission. On admission maternal pulse rate over 100; temperature up to 99.6°F. Chemotherapy course given for next 24 hours when normal delivery under chloroform anaesthesia occurred. Labour lasted 6 hours. At delivery the foetal heart was weak and cord pulsations could not be felt. Much liquor amnii aspirated from pharynx.

<u>Post-mortem findings:</u>

<u>Weight:</u> 3010 gms.

<u>Macroscopic:</u>   Lungs solid and of dark reddish purple colour throughout.

<u>Microscopic:</u>   The lungs have a mature structure and are unexpanded. Immediately next to the pleura on two sides of a block a strip of alveoli are empty and in the foetal position. The rest of the lobe (the greater part of it) has a solid appearance. This is due partly to congestion in the alveolar septa and partly to the fact that all the alveoli are filled by a mixture mostly of leucocytes and occasional mononuclear cells. The large vessels and inter-alveolar capillaries show marked congestion. Many of the alveolar epithelial cells show very marked vacuolation and sometimes many swollen together in the same area give the impression of epithelial sheets. In the alveoli there are plugs of leucocytes, mostly lobed forms and many showing dis -integration. Often, where disintegration is occurring in many of the cells, the whole mass appears to be fused. There are interstitial in- flammatory collections. These mostly take the form of clusters of round cells and can be seen in the vicinity of large vessels in fibrous tissue and adjacent lung. The columnar epithelium is mostly

intact and the bronchioles empty. In one, which contains inflammatory cells and partly necrotic epithelial cells, there are scattered unlobed inflammatory cells in its submucosa. Epidermal material is not seen in the lung.

In this case there is definite evidence that there are scattered areas in the lung in which a foetal inflammatory reaction is occurring. Such reaction is occurring mainly in the interstitial tissues. The significance of the intra-alveolar cells is somewhat difficult to determine. The leucocyte masses are more basophilic than the surrounding tissues, nuclear fragmentation is a prominent feature and most of the intact cells are polymorphonuclears. The impression here is that these more or less fused masses of cells are mostly degenerating and that possibly, therefore, they are older than the unlobed cells in the collections in the interstitial tissues.

CASE 38.   Age 28.   Para 1.   Grav. 1.   40 weeks.   Antenatal patient.
Summary of clinical notes:

Slow inert labour lasted 92 hours. Membranes ruptured 29 hours before delivery and chemotherapy course given for the last 24 hours of this. Foetal head manually rotated and a low forceps extraction performed under ether and chloroform anaesthesia. The foetal heart was heard before delivery.

Post-mortem findings:

Weight: 4590 gms.

Macroscopic: Tear in the tentorium cerebelli on the left side. Some

Illustrations to CASE 38.

FIG. 4.

Showing a small haemorrhage
into the loose connective tissue
around a small artery. (x 100).

FIG. 5.

Normal foetal position of
the alveoli. (x 25).

FIG. 6.

An alveolar duct containing
inflammatory cells, cornified
particles and a mixture of disin-
tegrating epithelial cells.
(x 400).
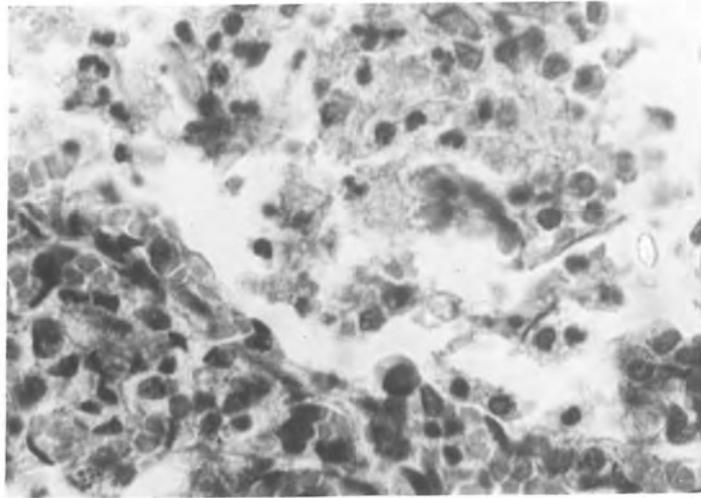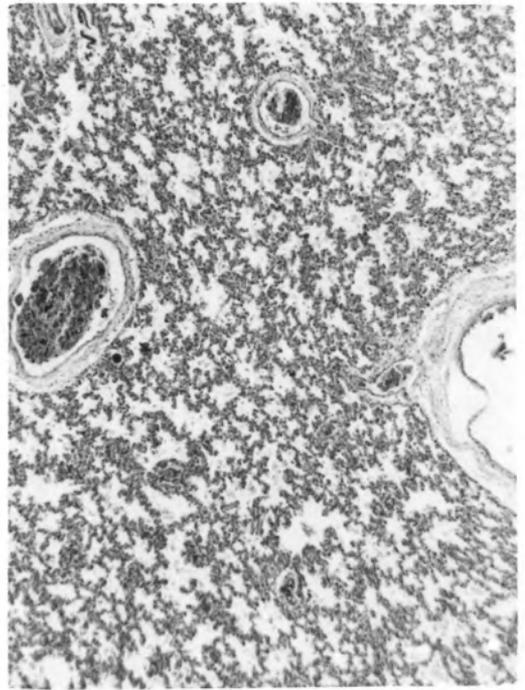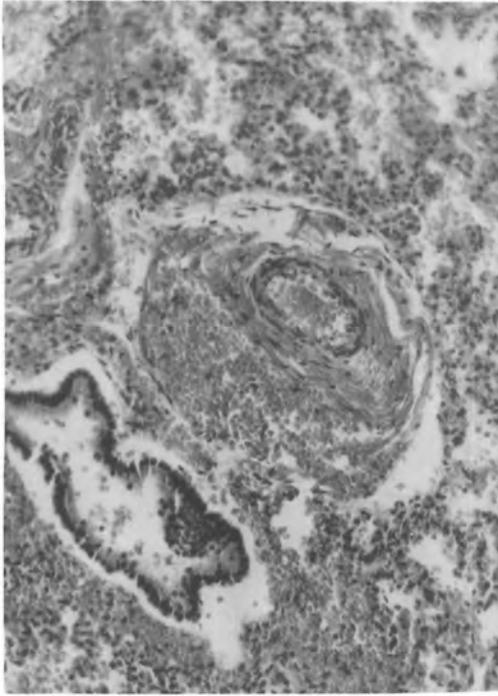
free blood over the right cerebral hemisphere and a large haematoma of the scalp.

The lungs were completely atalectatic. Extensive sub-pleural haemorrhages were present particularly over the lower lobes. <u>Microscopic:</u>   The lungs have a mature structure and all the alveoli are in the foetal position. Haemorrhages have occurred in the connective tissues around the large vessels and in a few places under the pleura. In a small area the alveoli contain red cells. The capillaries around bronchi and between alveoli are considerable congested. Aspirated homogeneous material is present in the bronchi and bronchioles but in these situations there are no inflammatory cells. A group of alveoli towards the periphery of the lobe contain abundant aspirated cornified material in the midst of which are scattered inflammatory cells. No obvious inflammatory reaction has occurred in the surrounding inter-stitial tissues; nor do adjacent alveoli, free of cornified material, show any inflammatory cell infiltration.

The bronchial epithelium is somewhat broken up in a few places; in others it is intact.

The two certain features in this case are the appear-ances in the lung of an asphyxial type of death and evidence of asp-iration of epidermal cornified particles. It is in this single area where this has occurred that polymorphonuclear cells are present to-gether with small clumps of desquamated alveolar epithelial cells. The latter seems to occur as a result of injury but there is no evid-ence of any reactive phenomena occurring in the surrounding lung. The possibility that some noxious factor associated with the epidermal elements has caused a local outpouring of leucocytes into these alveoli has, of course, to be considered.

CASE 62.   Age 35.   Para 7.   Grav. 8. 40 weeks.   Antenatal patient.

Summary of clinical notes:

Mild revealed and concealed accidental haemorrhages. Labour lasted 32 hours, had been given a full course of chemotherapy for 48 hours before delivery. Delivery was normal.

Mother had a clinically enlarged liver and spleen. The cause, after investigation, was not established.

Post-mortem findings:

Weight: 3240 gms.

Macroscopic: Nothing significant.

Microscopic: The lung is mature and unexpanded. The vessels show marked congestion and there are scattered haemorrhages throughout in the tissues around large vessels and into groups of alveoli. Widespread epithelial desquamation is occurring in the bronchi and in the alveoli. In the former there are angular masses of epithelial debris filling the bronchial lumens and in the latter, large vacuolated cells occasionally lie free in the alveoli. In a patchy fashion throughout the block some alveoli contain lobed leucocytes sometimes singly and sometimes in clumps in which the whole ap ears rather basophilic and disintegration is occurring.

Particles of columnar epithelium have become scatter -ed throughout the lung.

In this case which is one showing quite definite maceration changes the assessment of the cellular contents of the alveoli is difficult. Certainly there are leucocytes present and many are three-lobed polymorphonuclears while others appear to be disintegrating. It is not easy in this case to estimate when foetal death occurred in utero but the inflammatory cells must have been present

there in the early stages of labour before maceration of lung tissue commenced. As the maceration changes in the interstitial tissues are not marked the presence of an interstitial inflammatory reaction, if it had occurred, should be obvious. There is, however, no such evidence of a foetal inflammation. Whether the polymorphonuclears are of foetal origin or had been aspirated before foetal death is difficult to determine, but there is evidence that aspiration of amniotic contents did occur before foetal death as some alveoli contain cornified particles. One other fact of importance is that there are leucocytes intimately mixed with the fragments of columnar epithelium which indicates either that maceration changes commenced at a time when aspirated leucocytes were present in the bronchioles or bronchi or that an actual suppurative process was present there before death. This latter explanation appears unlikely in the absence of signs of an inflammatory reaction in the immediate vicinity.

CASE 78.   Age 36.   Para. 4.   Grav. 4.   ? 40 weeks.
             Antenatal patient.

Summary of clinical notes:

Transverse lie turned to a vertex at 32 weeks. Membranes ruptured for 4 days. Slow difficult labour followed. Chemotherapy course started 48 hours after rupture of membranes. Smears from the cervical region 24 hours before delivery showed the presence of B. coli and a few B. Welchii. Birth occurred as a breech with extended legs.

Post-mortem findings:

Weight: 3690 gms.

Macroscopic: Lungs completely atalectatic and of purplish colour throughout.

Microscopic: The lung appears mature and unexpanded. It is also compressed quite considerably throughout one of the blocks. There is moderate congestion throughout, particularly of the alveolar capillaries. The alveolar spaces mostly contain plugs of cellular material. These consist partly of 2 and 3 lobed leucocytes and partly of small masses of what appear to be desquamated terminal respiratory epithelium. In the portions of the lung examined loss of this epithelium from its normal situations is not obvious. Interstitial inflammatory infiltrations have occurred around a vessel near to a main bronchus. The cells in this are small, round and have a darkly staining nucleus. In occasional alveoli there are particles of cornified material. The epithelium in the bronchi and bronchioles is intact. Very occasional bronchioles contain finely granular amorphous material and a few leuco-cytes. A small group of alveoli in one area are greatly over-distended by oedema fluid. Some of the intra-alveolar polymorphonuclears are degenerating.

There is certain evidence that a foetal inflammatory reaction is commencing in this lung and that aspiration of amniotic fluid has occurred. To what extent the intra-alveolar exudate is an outpouring of foetal cells is doubtful. The leucocytes are lobed, in places they are in cluster formations and they are commencing to degenerate. For such an exudate in most of the alveoli interstitial changes are minimal, but alveolar epithelial cells are present in the inflammatory collections which seems to indicate the action of some noxious agent in this situation.

CASE 89.   Age 22.   Para 1.   Grav. 1.   ? 38 weeks.

Antenatal patient.

Summary of clinical notes.

Mild toxaemia. Admitted "head on perineum" and the foetal heart was not heard. Cord found to be presenting alongside the head. Low forceps application and extraction under chloroform anaesthesia. Membranes had been ruptured for one hour.

Post-mortem findings:

Weight: 1800 gms.

Macroscopic: The lungs were completely atalectatic and of purplish colour throughout.

Microscopic: The lungs have a slightly immature structure and are unexpanded and rather compressed throughout. There is moderate congestion of the large vessels. In the central part of a block the alveoli are filled by cellular material and cornified debris giving this area a solid appearance. Some of the cells present appear to be pulmonary epithelial cells and there are many polymorphonuclear cells some of which are degenerating. The interstitial tissues in this area are somewhat widened and occasionally there is a definite increase in inflammatory cells in them. Sometimes these are of the round nucleus type, sometimes they are band forms and polymorphonuclears. Around the edge of the solid area leucocytes are present in the alveoli without other admixture or any supporting framework. The bronchial epithelium is intact and some bronchioles contain leucocytes. In one such, they are plentiful.

The alveoli show intimate mixing of clumps of leucocytes and cornified epithelial cells in their lumens. Aspiration of

large amounts of epidermal material has occurred and it is therefore fairly certain that pathological intra-uterine respiratory movements took place. The interstitial inflammatory reaction is not a well developed one but there is quite certain evidence that it is occurring and takes the form either of single cells scattered widely in the inter-alveolar tissues or of tiny collections of the small round type of cell. In this case there is a more or less imperceptible blending of pulmonary structures and inflammatory material in the alveoli which makes sharp distinction of the lesions rather difficult but the clumpy leucocyte formations, a tendency to disintegration and an intimate association with certainly aspirated elements makes a foetal origin of these cells rather doubtful. But there is, apart from the alveolar lesions, definite evidence of a commencing foetal inflammatory reaction in the interstitial tissues and desquamation of some of the lining cells of the terminal air sacs.

CASE 135.   Age 28.   Para 1.   Grav. 1.   ? 40 weeks.
Emergency admission.

Summary of clinical notes:

Labour commenced 36 hours before attending hospital and foetus was passing meconium. On admission foetus was dead clinically, there was deep transverse arrest of the head and two loops of cord were present around the neck. There was an associated mild toxaemia of pregnancy. Membranes had been ruptured for 48 hours prior to delivery.

Post-mortem findings:

Weight: 3500 gms.

<u>Macroscopic:</u>   The lungs showed patchy congestion and some portions floated in water.

<u>Microscopic:</u>   The lung is considerably macerated but has a mature structure. In the bronchi there is much breaking up of the epithelium and throughout the lung there is a tendency to fusion of all structures. Near the periphery of the lobe the structure of the lung can be made out more easily. There appears to be considerable congestion of the alveolar capillaries and clumps of degenerating leucocytes fill spaces which are obviously alveolar. These leucocytes are polymorphonuclears mostly in 2 and 3 lobed stages. Haemorrhage has occurred into some of the alveoli while others near the periphery contain masses of deeply basophilic material which is granular. Occasional sub-pleural lymph-atics contain nucleated cells and throughout the blocks there are many artificial cystic spaces.

          The evaluation of all the findings in a macerated lung requires that any conclusions made be more than usually guarded. The features in this case which can be taken at their face value are the widespread congestion, the blood in the alveoli and the cells in sub-pleural lymphatics. Death was almost certainly of the asphyxial type and some vital reactive process is occurring in the lung as these lymphatic lesions are seen only in cases where inflammatory cells are present in the alveoli or interstitial tissues. Too much cellular damage has occurred throughout the lung to make an accurate assessment possible but there are polymorphonuclears in the alveolar spaces and it does appear that some type of a foetal reaction occurred either as a result of the aspiration of these or that they are actually foetal products. Meconium particles are scattered widely and there are

occasional cornified cells present so that aspiration of amniotic contents occurred before death.

The maceration changes which cause most of the distortion here are the basophilic masses consisting of compressed epithelial cells, widespread swelling of the alveolar epithelial lining and the formation probably after delivery of moderately large cystic spaces in the lungs.

———————

CASE 143.   Age 27   Para 2.   Grav. 2.   ? 40 weeks.
            Emergency admission.

Summary of clinical notes:

Artificial rupture of the membranes performed in a private hospital 7 days before admission, the indication being post-maturity. An impacted shoulder and prolapsed arm resulted and a contraction ring formed after several attempts to effect internal version. Shortly after admission thoracotomy and embryotomy were performed and the foetus extracted.

Post-mortem findings:

Weight: 2610 gms.

Macroscopic: The lungs showed a purplish colour throughout. A swab was taken in the Labour Ward. No organisms were detected in the direct smear examination nor did culture yield a growth of any organism.

Microscopic: The lung is mature, unexpanded and somewhat compressed. The alveoli contain particles of cornified material, some desquamated pulmonary epithelium and a very occasional leucocyte. The interstitial tissues seem to be hypercellular in places but this appearance is almost

Illustration to CASE 143.

FIG. 7

A small vessel containing an excess of nucleated cells which in the alveolar capillaries give the impression of cellular infiltrations.   (x 220).
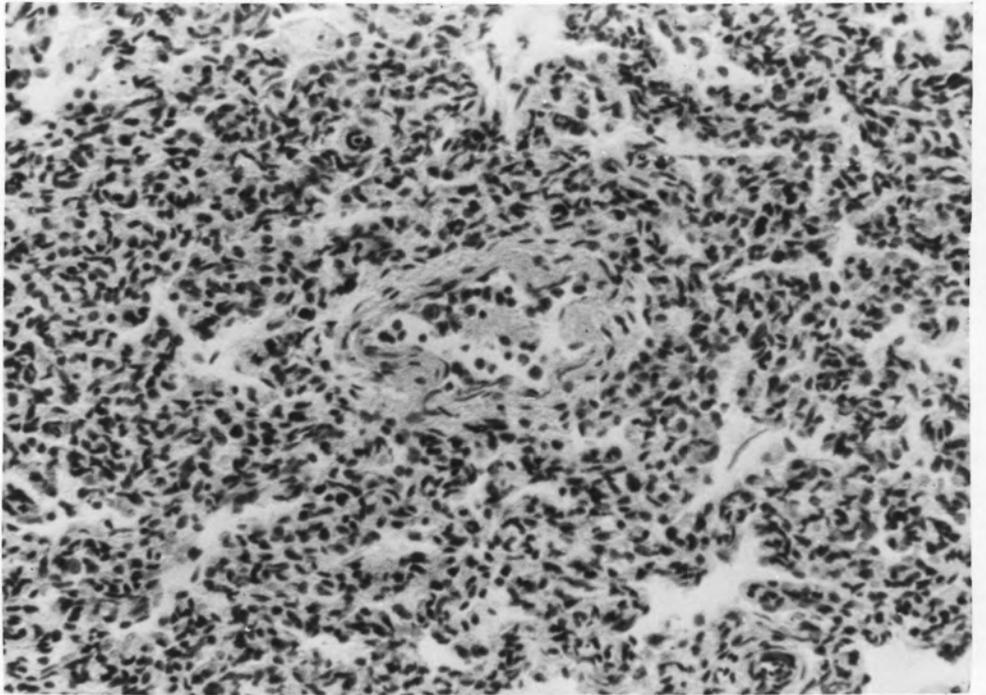
certainly due to the fact that there appear to be excessive numbers of nucleated cells in the blood vessels. The bronchial epithelium is somewhat broken up throughout.

There is insufficient evidence in this case that a foetal inflammatory reaction has occurred. Some aspiration of epidermal scales and a very occasional leucocyte must have occurred before death but the increased nuclear content of the inter-alveolar tissues is almost certainly due to increase of nucleated cells in the blood vessels. It would otherwise have been described as an interstitial type of pneumonia.

—————————

CASE 151.   Age 33.   Para. 1.   Grav. 1.   28 weeks.
            Emergency admission.

Summary of Clinical notes:

Mother admitted to hospital with intestinal obstruction. After 3 days conservative treatment, uterus, tubes and ovaries (containing tumour formations) were removed and a caecostomy performed. Patient came into spontaneous labour on the next day. It was short and uneventful. Laparotomy later revealed carcinomata in the left ovary and sigmoid colon of slightly different structure. A course of chemotherapy was commenced at the conclusion of the first operation.

Post-mortem findings:

Weight: 1100 gms.

Macroscopic: The lungs were completely atalectatic and covered by almost confluent sub-pleural haemorrhages.

Microscopic: The lungs are markedly immature and are unexpanded. The vessels show congestion. In most places the alveolar septa appear wider than usual and near the edge of the block this appearance becomes quite definitely marked. Scattered in the inter-alveolar tissues are occasional inflammatory cells of the small round cell type. Some alveoli contain cornified particles and occasional squamous cells. The bronchial epithelium is considerably broken up throughout.

The presence of even a few inflammatory cells in the interstitial tissues indicates that some inflammatory reaction is occurring in these tissues and that in this case it must be regarded at this stage as being an interstitial pneumonia. In such a primitive lung where foetal mesenchyme cells separate the alveoli widely it is difficult, if not impossible under these minimal inflammatory conditions, to determine whether the inter-alveolar tissues are widened. The inflammatory changes are uniform throughout the lung tissue and are not particularly related to the alveoli containing aspirated material.

CASE 198.   Age 40.   Para. 3.   Grav. 3.   42 weeks.
            Antenatal patient.

Summary of clinical notes:

Admitted "head on perineum". Urine showed albumen ½ and movements had not been felt for 24 hours.

Delivery was normal under chloroform anaesthesia.

Post-mortem findings:

Weight: 3150 gms.

Macroscopic: Nothing significant.

Illustration to CASE 198.

Fig. 8

Showing a cylinder of cornified particles and
amorphous material in a large bronchiole.
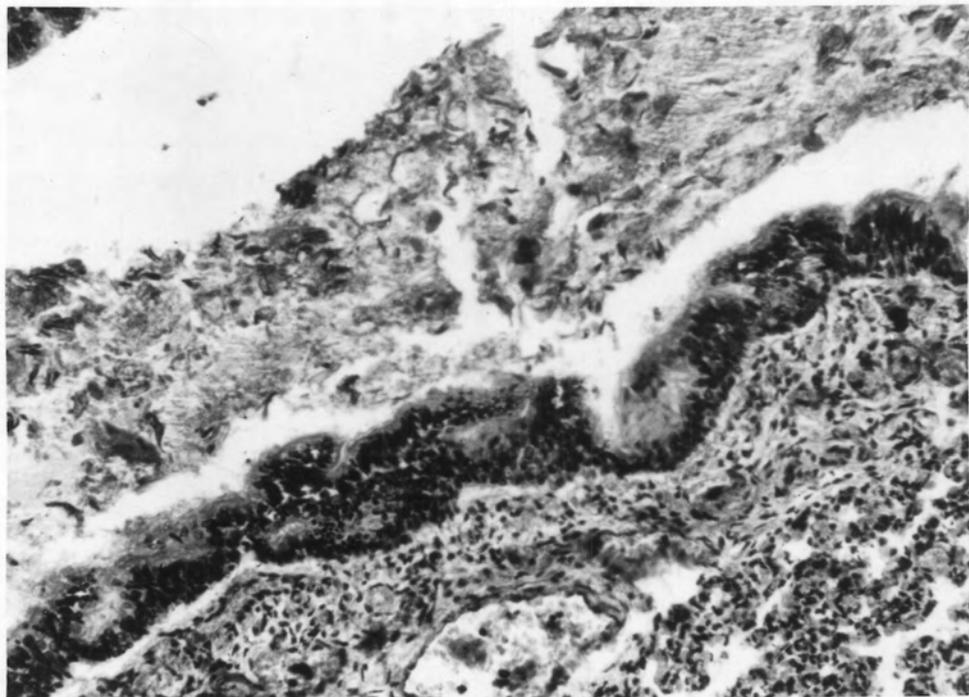
<u>Microscopic:</u>　　　　The lung appears mature and is unexpanded. Most
of the vessels show slight congestion. Many alveoli contain particles
and plugs of cornified material, some in greater concentration than
others. This material is also present in a small bronchus. In some
places where there has been massive aspiration there is an excess of
inflammatory cells in the interstitial tissues. These are sometimes
occurring singly and sometimes as small clusters. In one tiny area
which over-all has a more basophilic appearance the lung structure is
not so well marked and instead of cornified material the alveoli are
filled by partly degenerating leucocytes, some of which are in the
band and 2-lobed stages. Where the cornified particles are prominent
there are no leucocytes in the alveoli. The bronchial epithelium is
often broken up and in one bronchiole is mixed intimately with cornified
particles.

　　　　This lung shows evidence of massive aspiration of
cornified epidermal material in bronchi and in most of the alveoli
throughout the block and there is no good evidence of aspiration of
leucocytes at the same time. However an interstitial inflammatory
reaction has occurred in relation to the aspirated material and a
widespread pneumonia has resulted. In the small area described the
lung substance appears to be commencing to undergo necrosis and an
intra-alveolar suppuration is occurring. Some of the cells in this
area are young polymorphonuclears but most are unlobed forms and many
are in various stages of degeneration. It seems unlikely that this
is an aspiration phenomenon in view of the fact that the rest of the
alveoli are free of leucocytes and it seems most likely that the rea-
ction to some aspirated noxious substance is more advanced in this
small area than elsewhere. A few alveoli immediately adjacent on one
side contain cornified particles.

CASE 202.   Age 24.   Para. 1.   Grav. 1.   26 weeks.

Emergency admission.

Summary of clinical notes:

Spontaneous premature labour. Foetus expelled as a breech. Placenta expelled intact. Not known how long the membranes had been ruptured but thought to be of short duration. Examination of the swabs taken from the cervix showed "many anaerobic streptococci and gram negative bacilli". Some doubt existed as to whether or not the foetus made a few gasping respirations.

Post-mortem findings:

Weight: 820 gms.

Macroscopic: There was a thin layer of blood over the right cerebral hemisphere.

The lungs appeared completely atalectatic and had a purplish colour throughout when cut.

Microscopic: The lungs have a markedly immature structure and appear to be more or less solid. A few alveoli have a rounded contour but the impression gained is that actual sustained respirations did not occur. There are a few tiny interstitial haemorrhages. Many of the alveoli contain leucocytes, nearly all with two or three lobed nuclei. Others contain particles of cornified material and sometimes these are mixed with leucocytes. Some of the solid appearance of the lung is due to this dense intra-alveolar cellular deposition; much is due to immaturity. In patches throughout the lung there are collections of foetal inflammatory cells in the interstitial tissues. In some places they are infiltrating the tissues just outside bronchioles forming collars around these structures. In one block the sub-pleural lymphatics are stuffed with cells. These are mostly small to medium sized mononuclear cells with the characteristics of lymphocytes but

Illustrations to CASE 202.

FIG. 9.

Inflammatory infiltration has
occurred around a small bronchiole
which contains particles of epider-
mal material. (x 400).

FIG. 10.

Lobed leucocytes fill an
alveolar duct and an inflammat-
ory reaction comprising un-lobed
cells is occurring in the surr-
ounding tissues. (x 400).

FIG. 11.

The sub-pleural lymphatics are dilated
and filled by lymphocytes. The immature
structure of the lung is well shown.
(x 100).
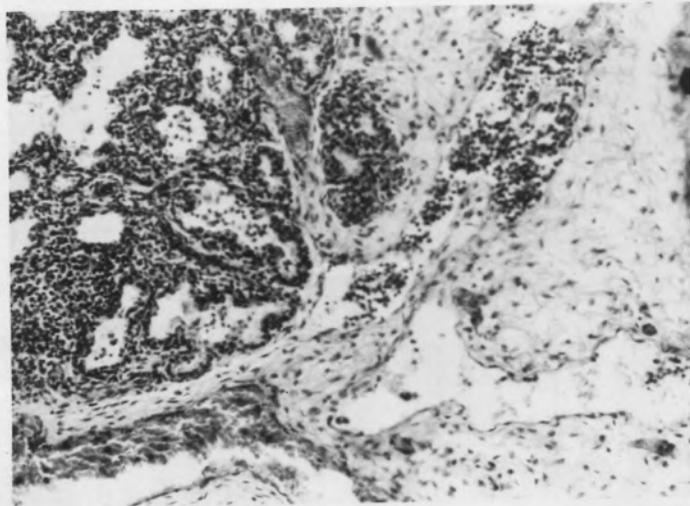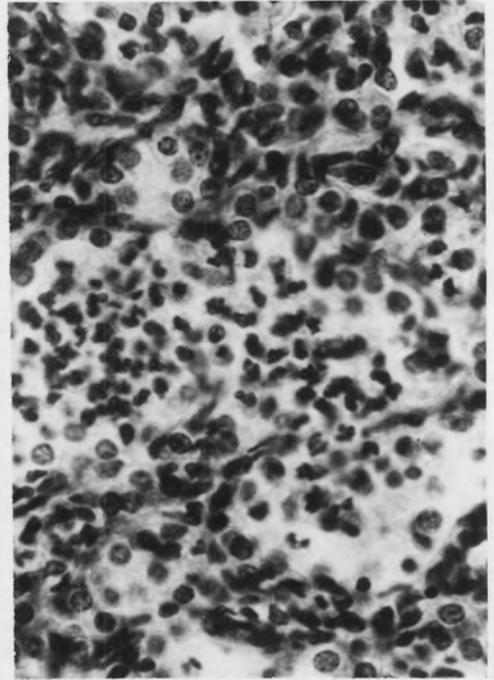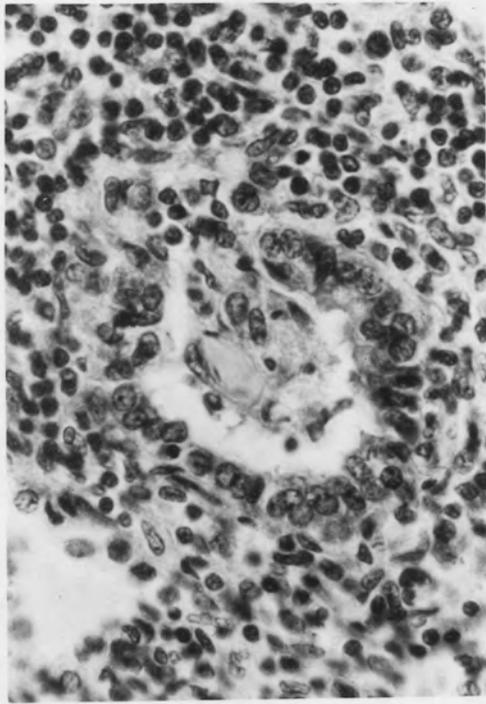
there are occasionally apparently early lobed forms and a few others
with irregular nuclear structure and more abundant cytoplasm.

This case illustrates very clearly the possibility
that most, if not all, of the alveolar leucocytes may be aspirated
and that quite certainly a widespread foetal inflammation is occurring.
The lesions are predominantly peri-bronchiolar in which small darkly
staining cells are present in the immediate neighbourhood of these
structures. The presence in various situations of epidermal deriva-
tives makes quite certain that pathological inspiratory efforts were
made either in the uterus or lower in the birth canal and it does not
seem improbable that similar aspiration of frank pus from the cervical
region or vagina should not also occur. From the histological appear-
ances it would seem peculiar for two separate types of inflammatory
reaction to be occurring together over what must have been a fairly
short period and it does not seem probable that the cells of the inter-
stitial collections could give rise to those in the alveoli, for the
latter are almost entirely polymorphonuclear. One other feature in this
case are the dilated lymphatics; a condition which appears to occur
only in association with other definite evidences of foetal pulmonary
inflammation.

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CASE 241.   Age 26.   Para 1.   Grav. 3.   43 weeks.
             Antenatal patient.
Summary of clinical notes:

Two previous miscarriages and no living children. Was

Illustration to CASE 241.

FIG. 12.

Lobed leucocytes and finely granular material filling a bronchiole. (x 400).

FIG. 13.

A similar condition to that in Fig. 12. The bronchiolar mucosa is intact in both and the submucosal tissues are free of inflammatory infiltration. (x 400).

FIG. 14

A focal inflammatory lesion is occurring in an area of lung tissue in which the alveoli contain much cornified material. (x 100).
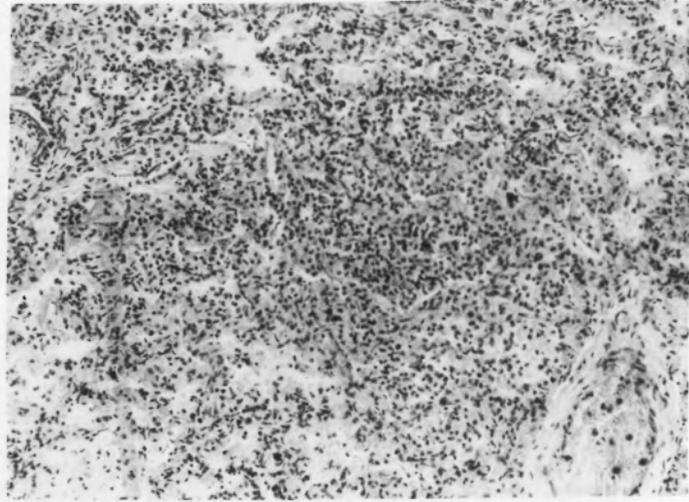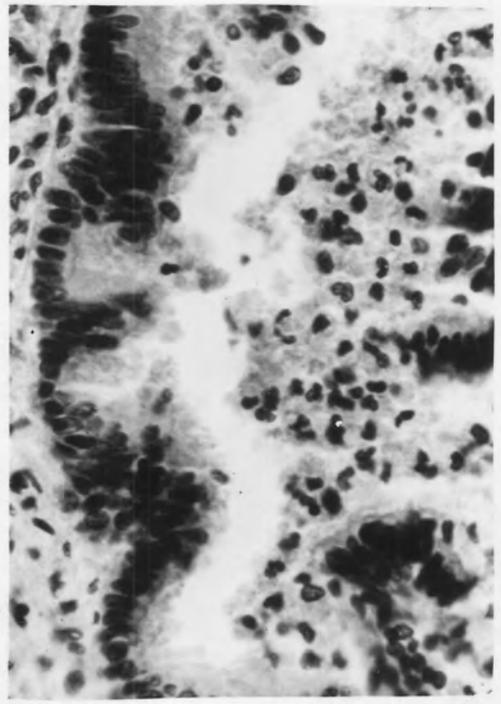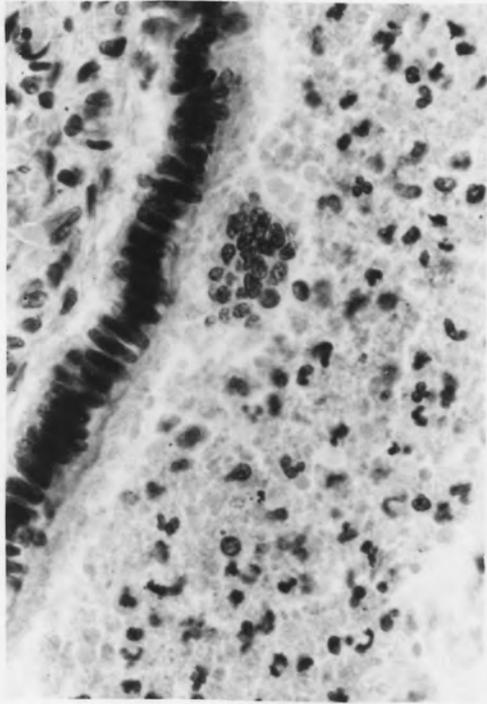
apparently two weeks overdue and had lost 3 lb. in weight in a week. Was admitted because of post-maturity and came into spontaneous labour. The labour was easy and a vertex delivery followed. The membranes had been ruptured for 1¼ hours. The cord was pulsating at birth but breathing did not occur.

Post-mortem findings:

Weight: 3180 gms.

Macroscopic: The lungs were completely atalectatic and had a purple colour throughout.

Microscopic: The lungs have a mature structure and the alveoli are in the foetal position except a few at the centre which are over-distended. Around the edge they are somewhat compressed. Haemorrhage has occurred into many alveoli and in occasional others there is a lightly staining oedema fluid. Many, however, contain particles of cornified material. To quite some extent there is vacuolation and desquamation of the alveolar epithelial cells and in places the interstitial tissues are considerably thickened and contain scattered inflammatory cells. Many bronchioles and alveoli contain lobed leucocytes. In places these are quite dense and are intimately mixed with cornified particles or desquamated epithelial cells. In a small area where there is some pulmonary collapse there is an extensive inflammatory reaction in which the cells are of the unlobed type.

The outstanding findings here are the presence of lobed leucocytes in bronchioles, alveolar ducts and alveoli and scattered interstitial inflammatory reactions throughout lungs in which widespread epithelial degenerative changes are occurring. There has also been a massive aspiration of epidermal scales so that practically all the alveoli seen appear to be filled by masses of one or another

type of cell. In places it is rather difficult to be certain of the type of cell present in the interstitial collections but while band forms and occasionally polymorphonuclears appear to be present it is quite certain that most of the cells are of the unlobed type.

CASE 247.   Age 37.   Para 4.   Grav. 5.   40 weeks.
          Antenatal patient.

Summary of clinical notes:

          Mother had had two normal children, then a miscarr
-iage and then a stillborn anencephalic monster. Was in labour for
7 days, the membranes had been ruptured for 22 hours when a breech
delivery followed under chloroform and ether anaesthesia.

Post-mortem findings:

Weight: 3870 gms.

Macroscopic: Hydrocephalus with enormous enlargement of the
ventricles, spina bifida, Leukenschadel of skull.

          The lungs were completely atalectatic and of purplish
colour throughout.

Microscopic: The lungs have a mature structure and are unexpanded.
There is very marked congestion throughout, but particularly in the
alveolar capillaries, and in places small petechial haemorrhages have
occurred. The inter-alveolar tissues are markedly thickened and more
or less throughout both lung blocks show infiltrations by scattered
inflammatory cells of the small round nucleus type. Many alveoli
contain particles of cornified epidermal material. In the large bron-
chioles and in a bronchus there are casts of inflammatory exudate.
In some, lobed leucocytes predominate while in others there are

Illustrations to CASE 247.

FIG. 15.

A small bronchus containing densely aggregated leucocytes and a large mass of fibrin. (x 100).

FIG. 16.

Showing leucocytes and degenerating cellular material in a bronchiole. (x 400).

FIG. 17.

The same as shown in Fig. 16 under lower magnification to show the absence of an inflammatory reaction in the submucosa. Its small vessels are congested. (x 100).
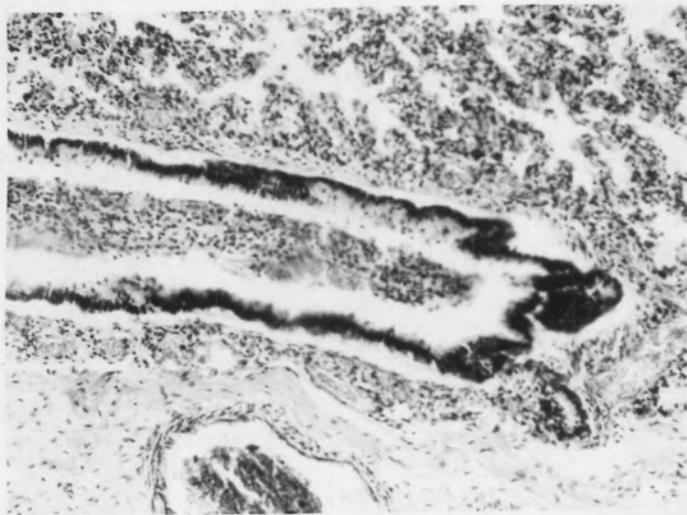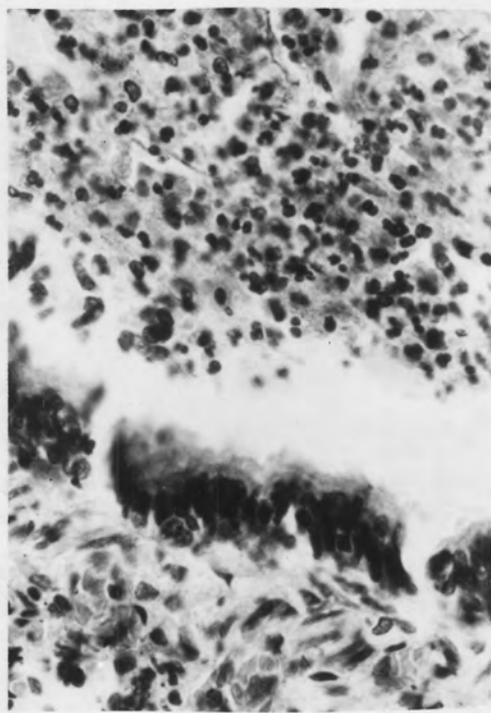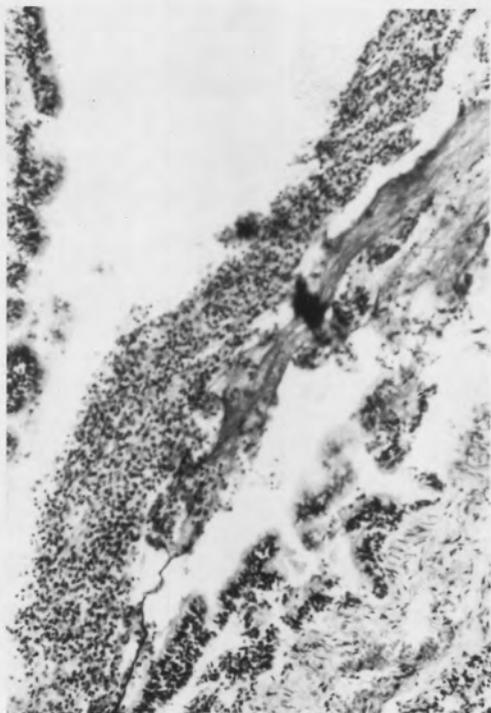
leucocytes, red cells, cornified particles and masses of fibrin; and in some places all these constituents are more or less fused. Disintegrating particles of bronchial epithelium are sometimes intimately mixed in these structures.

The main features are the widespread interstitial pneumonia commencing in these lungs and the presence of casts of inflammatory material in the larger air passages. It is to be noted that in the peripheral portions of the lung the only aspirated structures are singly scattered epidermal scales in occasional alveoli. The presence of such densely cellular exudates in the bronchi is unusual and that these are made up of predominantly lobed leucocytes and masses of fibrin without any peripheral counterpart or evidence of bronchial inflammation seems to make a foetal origin most unlikely.

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CASE 274.   Age 30.   Para. 1.   Grav. 1.   40 weeks.
            Antenatal patient.

Summary of clinical notes:

First antenatal visit made at 34 weeks gestation. The B.P. was 170/100 and weight 276 lb. One month later the B.P. had risen to 230/100 but after admission and bed rest it fell to 155/100. Medical induction of labour was attempted twice but failed. Membranes ruptured spontaneously 8 days before delivery. A full course of chemotherapy was given until delivery which was effected by a difficult high forceps application and extraction. The foetal heart was heard before delivery. The mother ceased breathing under anaesthesia and her condition was poor for some hours afterwards.

Illustrations to CASE 274.

FIG. 18.

A cluster of inflammatory
cells adjacent to a terminal
bronchiole. (x 100)

FIG. 19.

Lobed leucocytes and granular
material in a bronchiole.
(x 100).

FIG. 20.

The alveoli contain fine particles of
golden staining material and occasional leuco-
cytes. (x 100).
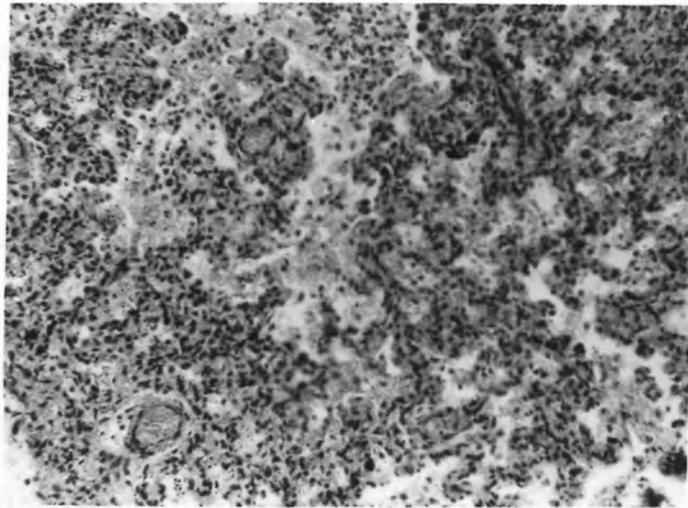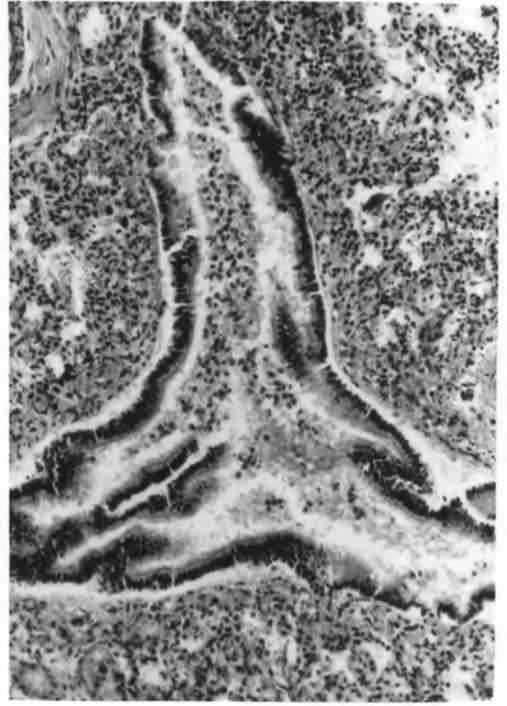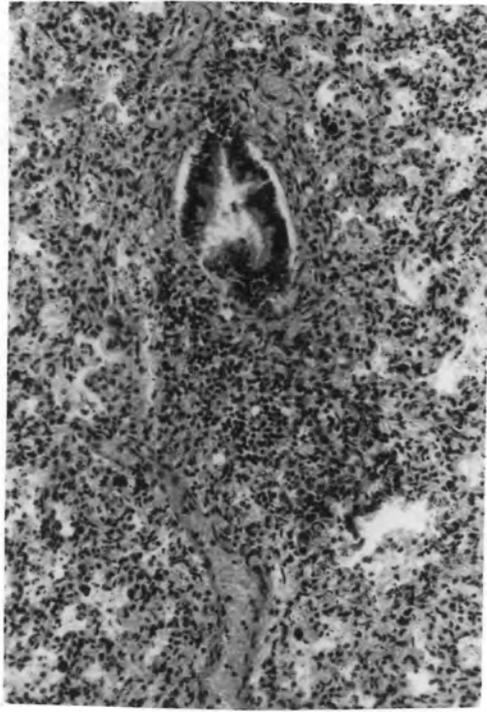
Post-mortem findings:

Weight: 4750 gms.

Macroscopic: Bilateral sub-dural haematomata. Fracture of the
spine between L5 and S1.

Microscopic: The lungs have a mature structure and are unexpanded.
There is no obvious congestion but occasionally there are small haem-
orrhages into the interstitial tissues around blood vessels. Most of
the alveoli contain mixtures of epithelial debris and lobed leucocytes.
The debris is derived mostly from desquamated alveolar epithelium and
in many places the cells are still in intact groups. The cytoplasm
from other cells forms small masses of structureless finely granular
material in which epithelial cells and leucocytes are sometimes mixed.
There are occasional particles of cornified material in the alveoli,
Some bronchioles contain lobed leucocytes and their epithelial lining
is mostly broken up. In a few places there are small focal inflamm-
atory infiltrations of round cells in the interstitial tissues near
to small bronchioles.

            There is quite definite evidence of a commencing
inflammatory process in these lungs, taking the form of para-bronchial
focal infiltrations. In addition, there are scattered lobed leucocytes
throughout the alveoli and in the lumens of small bronchioles. Quite
widespread alveolar desquamative and degenerative changes are occurring.
It is rather difficult to assess the significance of the intra-alveolar
leucocytes in this case as to their origin but it is certain that a
noxious substance is at work throughout the lungs and that limited
inflammatory reactions are occurring.

CASE 282.   Age 34.   Para 1.   Grav. 1.   40 weeks
         Emergency admission.

Summary of clinical notes:

          Single woman.   "Long labour outside".   Membranes
ruptured 60 hours before admission for the last 48 hours of which
she had a course of chemotherapy.   On admission her temperature was
100°F and pulse rate 112.   The cervical os was dilated $\frac{3}{4}$ and a left
occipito-posterior position of the foetus found.   Given intra-venous
therapy, penicillin and Solutox, 10 hours after admission the foetal
heart became irregular and ceased suddenly.   Delivery followed after
another 4 hours.   In labour for a total period of 108 hours.   Liquor
said to be dirty and offensive.

Post-mortem findings:

Weight: 3600 gms.

Macroscopic: The lungs were completely atelectatic and there were
large petechial haemorrhages under the pleura, mainly of the lower
lobes.

Microscopic: The lungs are mature and unexpanded.   There is mar-
ked congestion of the large vessels and to a lesser extent of the
alveolar capillaries.   Scattered groups of alveoli are filled with red
cells.   In many places the alveoli contain numerous particles of corn-
ified material and occasionally plugs of polymorphonuclear leucocytes.
The bronchi and many of the bronchioles contain cylinders of compressed
cellular material.   This consists of lobed leucocytes, numerous part-
icles of epidermal debris and a finely granular basophilic material.
In quite a few places there are tiny focal collections of inflammat-
ory cells in the submucosal tissues of the large bronchi.

Illustrations to CASE 282.

FIG. 21.

Showing a bronchus filled by a solid cellular mass containing a mixture of leucocytes; small epithelial cells; large, probably squamous cells and a, more or less, homogeneous basophilic material. (x 55).

FIG. 22.

Showing a mass of markedly swollen alveolar epithelial cells and a few inflammatory cells at the periphery of an alveolus. (x 840).
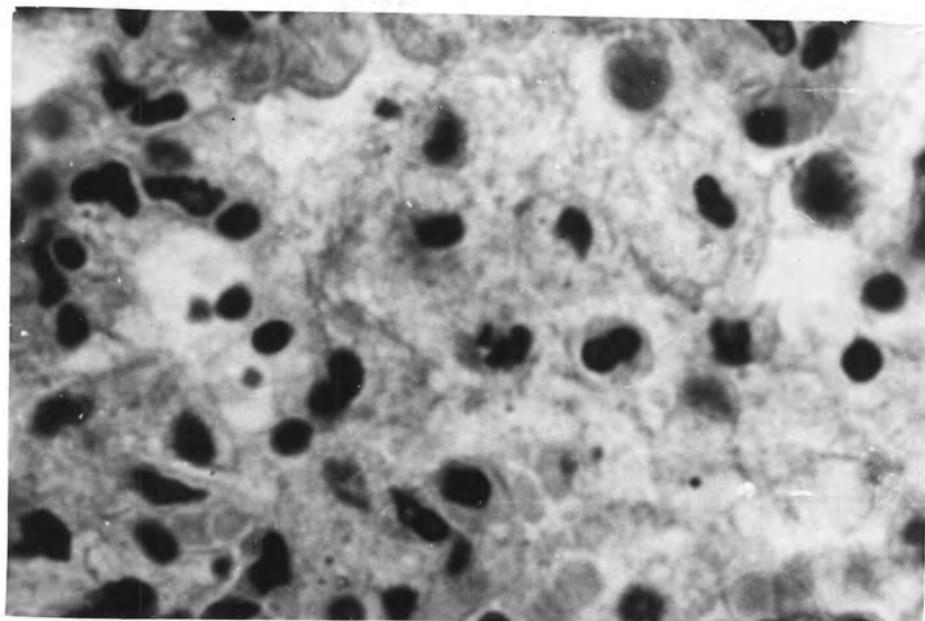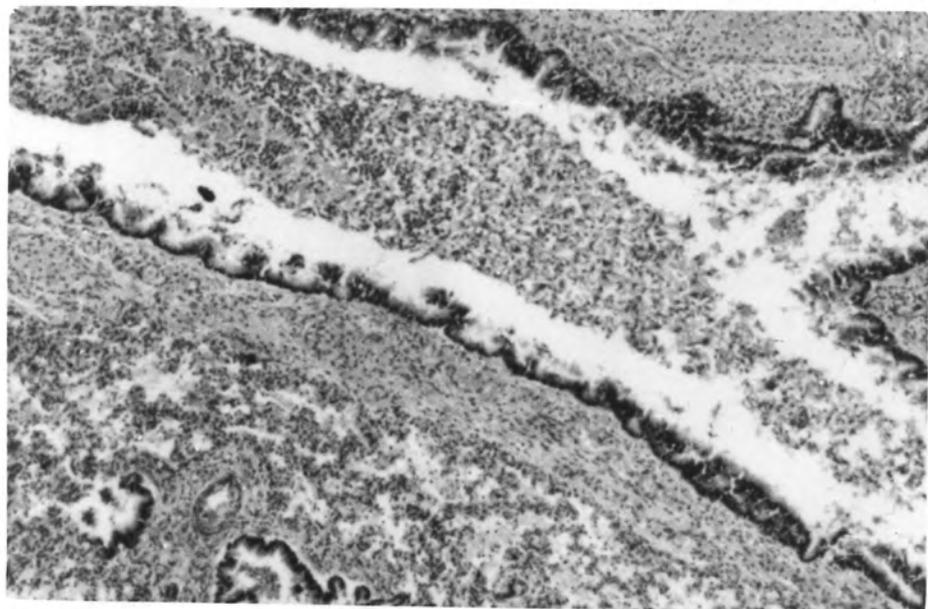
Illustrations to CASE 282.

FIG. 23.

Structures near the hilum of the lung. The two small
bronchi contain plugs of densely cellular material and the
surrounding alveoli are in the foetal position.
(x 25).

FIG. 24.

A few leucocytes and red cells mixed intimately in a
mass of desquamated alveolar epithelial cells.

(x 400).
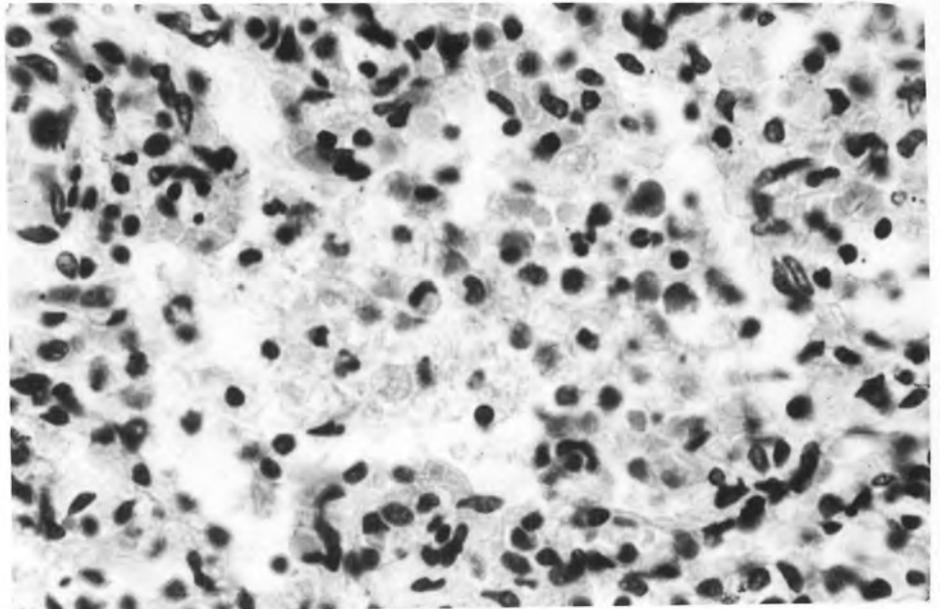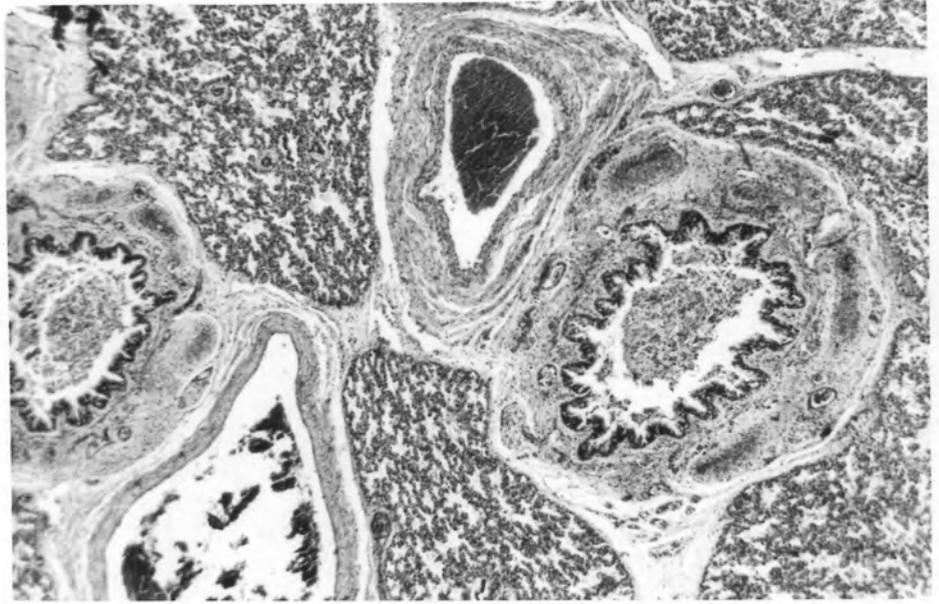
The remarkable findings here are the densely cellular cylinders filling the bronchi and the fact that in a few places there is evidence that an inflammatory process is commencing in the walls of these structures. The reactionary changes to foreign material are usually more peripherally situated but it seems quite reasonable to suppose that, where such large masses are aspirated, there may be sufficient time for a local reaction to occur in view of the possibility that such particles may not be able to pass further into the lung. A true congenital bronchitis may therefore be said to be commencing in this lung. In the more peripheral parts, alveoli or their ducts are occasionally filled by plugs of lobed leucocytes and there are fairly widespread degenerative changes in the epithelial lining, many swollen cells with finely granular cytoplasm lying free. There are also scattered inflammatory cells in the interstitial tissues.

—————————

CASE 300.   Age 21.   Para. 1.   Grav. 2.   41 weeks.
            Antenatal patient.

Summary of clinical notes:

Patient had attended the Sterility Clinic at the Womens Hospital. Two external versions performed in the antenatal clinic. Patient became distressed after 50 hours labour, given heroin gr. 1/6. Foetal heart became irregular 13 hours before delivery and ceased 2 hours before forceps extraction. Membranes ruptured 2 hours. There was a large retro-placental clot.

Post-mortem findings:

Weight: 3300 gms.

Macroscopic: The lungs were completely atalectatic. There were

plugs of muco-purulent material in the trachea and main bronchi.

Microscopic: The lungs appear mature and are unexpanded. They have a more or less solid appearance particularly towards the centres of the lobes. The vessels throughout are moderately congested. Many alveoli contain single particles of cornified material while most are filled with mixtures of desquamated epithelial cells and clumps of leucocytes. In many others the lumens are partly occluded by swelling of intact epithelial cells. In the interstitial tissues there are scattered collections of unlobed leucocytes which in one or two places appear as quite dense clusters. Around the occasional bronchi and large bronchioles there are scattered inflammatory cells in the sub-mucosal fibrous tissue. The bronchial epithelium is very consider-ably broken up throughout.

The curious solid appearance of the lung in this case is largely due to the enormous epithelial content of the alveoli and to the clumps of leucocytes which sometimes fill the alveoli with-out other admixture. Amongst the leucocyte collections there is not much suggestion that disintegration is occurring. In some places the unlobed leucocyte is present in the intra-alveolar collections mixed with polymorphonuclears, as well as in the interstitial tissues. There is no doubt that a pneumonia is well established in this lung and there must be some other factor which caused one lung such as this to show such extensive epithelial damage. It seems probable that a nox-ious factor which can apparently cause these epithelial changes during intra-uterine life may perhaps act and continue the changes not only after death in the uterus but also after extraction. And as the changes are not seen (apart from maceration) in lungs not showing inflammatory

cells it seems reasonable to assume that a single factor may be responsible for both. Possibly these are but maceration changes hastened by a set of factors superimposed on a lung which is already undergoing inflammatory change.

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CASE 302.   Emergency admission.

Clinical notes not available.

Complete miscarriage. Membranes had probably not been long ruptured. Patient had no chemotherapy.

Post-mortem findings:

Weight: 750 gms.

Macroscopic: The lungs were completely atalectatic and of purplish colour throughout.

Microscopic: The lungs have a markedly immature structure and are unexpanded. The rather circular "gland-like" alveoli are fairly widely separated by foetal mesenchyme. The vessels throughout show slight congestion. Nearly all the alveoli contain particles of eosinophilic epidermal material, some of which still contain nuclei or nuclear remnants. Mixed with this and sometimes separately are small clumps of lobed leucocytes. There are very numerous focal collections of inflammatory cells in the interstitial tissues often in relation to the smaller bronchioles. The bronchial epithelium is just commencing to lift and become broken up but mostly it is intact.

This case illustrates the possibility of asphyxial death post-partum from the enormous deposition of epidermal material in

Illustration to CASE 302.

FIG. 25.

The alveoli are filled by particles of epidermal
material which is brightly eosinophilic. Occasional
lobed leucocytes are present in this material and the
interstitial tissues show inflammatory infiltration.
(x 100).
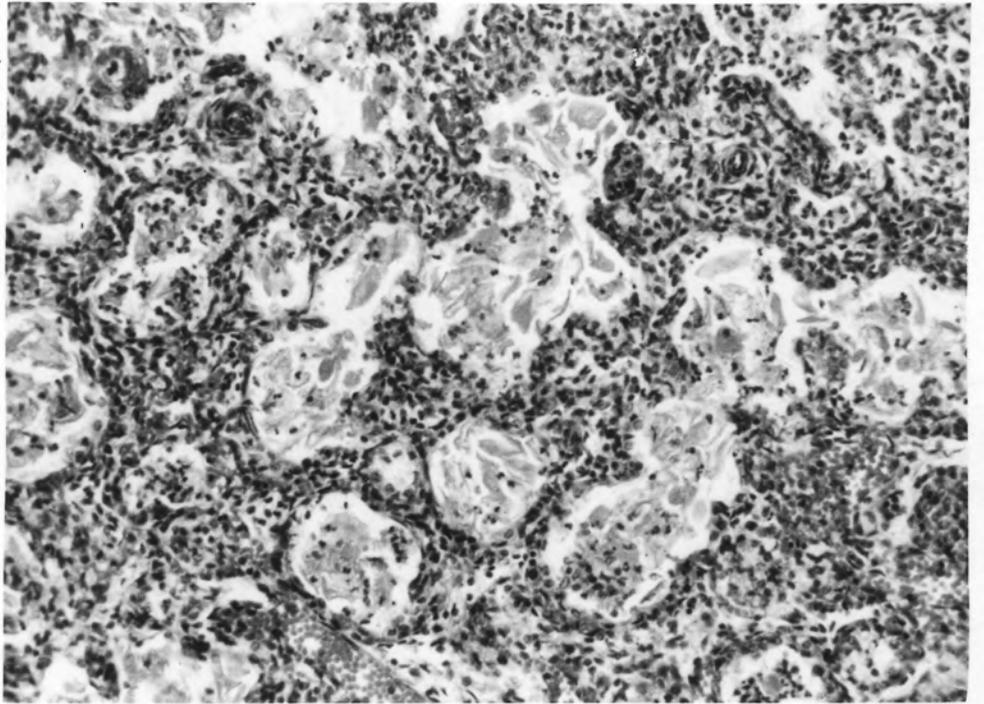
all the alveoli. In addition, widespread focal inflammatory infil-

trations have apparently occurred as a result of this aspiration.

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DESCRIPTIONS OF CERTAIN LIVEBORN
CASES WITH INFLAMMATORY CELLS
IN THE LUNGS.

CASE 5.   Age 30.   Para 1.   Grav. 1.   36 weeks.

Antenatal patient.

Summary of clinical notes:

Mother had a sub-total thyroidectomy 3 years previously. The B.P. at her first antenatal visit was 170/110. In labour 10 hours. Face presentation. Normal delivery.

Babe was an anencephalic monster, lived 3 hours.

Post-mortem findings:

Weight: 2040 gms.

Macroscopic: Typical anencephalic monster without other congenital abnormalities.

Microscopic: The lungs have a nearly mature structure and are well expanded. There is patchy congestion in the alveolar septa and cornified epidermal particles in occasional alveoli but otherwise the lungs appear fairly normal. There are scattered inflammatory cells throughout the interstitial tissues and in one or two places they are aggregated into focal infiltrations. One of these is in intimate relationship to a small vessel.

The inflammatory changes here are of minimal type but there are quite definite evidences of an established interstitial inflammation. The peculiar feature is that, except for a few epidermal particles, the alveoli are free of cellular material. The possibility then that this pneumonia is of septicaemic origin merits consideration and the proximity of inflammatory cells to vessels and their strict localisation in interstitial tissues lends support to this idea.

CASE 53.   Age 33.   Para. 4.   Grav. 4.   39 weeks.

Antenatal patient.

Summary of clinical notes:

Normal pregnancy and labour. Delivered under chloro-
form anaesthesia. Babe difficult to revive. Was cyanosed until death
which was between 4 and 8 hours after birth.

Post-mortem findings:

Weight: 3060 gms.

Macroscopic: Nothing significant.

Microscopic: The lung has a mature structure. Some of the more
central alveoli are over-expanded while some at the periphery are
still in the foetal position. Patchy haemorrhages have occurred
into the interstitial tissues, under the pleura and, in places, into
the alveoli. The alveolar capillaries are markedly congested. Many
alveoli contain finely granular material, which is otherwise structu-
reless, and occasional particles of cornified material. Also occurr-
ing with this, sometimes intimately, each alveolus contains a few
leucocytes. Some are of the band type while others show 2-3 lobes.
There are quite widely scattered leucocytes in the interstitial tiss-
ues and they are mostly early lobed forms.

The outstanding features are the enormous congestion
and widespread haemorrhages throughout the lung which probably resulted
from intra-uterine asphyxia from which the baby never recovered. Massive
aspiration of epidermal material has occurred and the finely granular
material throughout the alveoli seems to be the residue of fluid which
they apparently contained either by aspiration or as an oedema fluid.
The scattered leucocytes indicate a diffuse inflammatory reaction both
in and around alveoli. In this case the distribution of the pneumonia

Illustration to CASE 53.

FIG. 26.

Particles of cornified material in a bronchiole.
The surrounding lung shows congestion. Red cells,
granular material and cellular debris are present in the
alveoli.   (x 100).
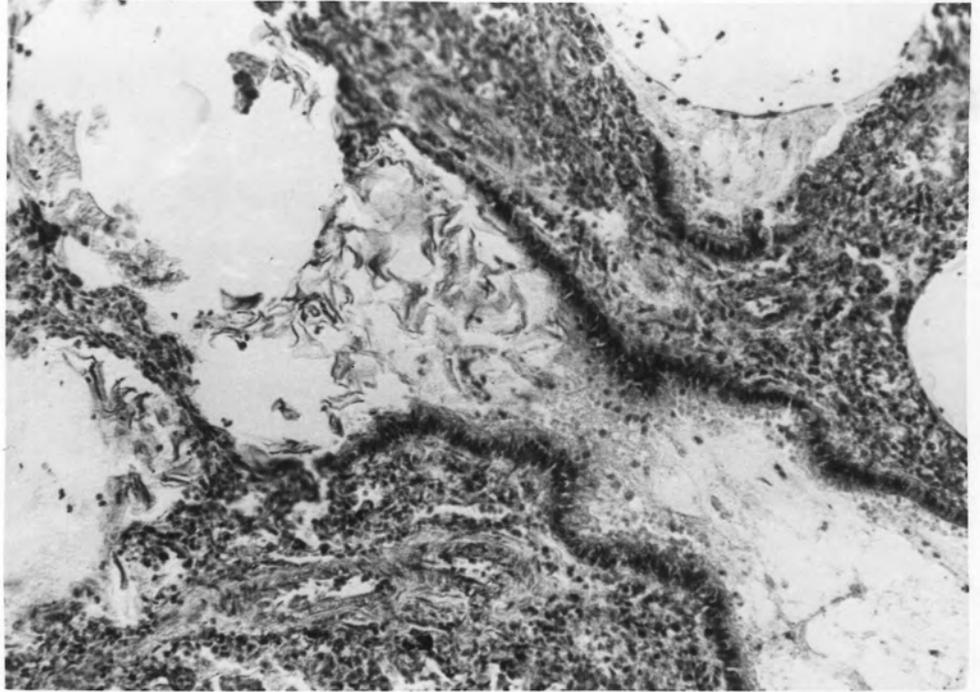
is not easy to determine because the whole lung structure is so distorted by the asphyxial lesions. It is certainly not bronchiolar.

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CASE 81. Emergency admission.

Clinical details incomplete.

Summary of clinical notes:

24 weeks gestation. Maternal temperature on first day of admission was 101.8°F. Given 60,000 units of penicillin 3 hourly after which the temperature subsided almost immediately. At that time a swab was taken from the cervix which showed the presence of anaerobic streptococci and anaerobic Gram negative bacilli.

Foetus aborted after 24 hours. It lived 3 hours.

Post-mortem findings:

Weight: 900 gms.

Macroscopic: Bilateral intra-ventricular blood clot in the brain. The lungs were dark in colour and almost solid throughout.

Microscopic: The lungs have a markedly immature structure and all stages in what appear to be the generation of alveoli can be made out in the abundant foetal mesenchyme. Only scattered alveoli are expanded and these are nearer the periphery. All the alveoli and bronchioles contain masses of inflammatory cells occasionally mixed with cornified particles or actual epidermal cells. Sometimes these are supported by a homogeneous finely granular material. In addition to dense intra-alveolar collections there are more or less round collections in the interstitial tissues often around a bronchiole. Many lymphatics in the wider inter-lobar fibrous tissue are dilated and densely packed

Illustrations to CASE 81.

FIG. 27.

Darkly staining round cells are present in the interstitial tissues. The neighbouring alveoli contain lobed and unlobed leucocytes. (x 400).

FIG. 28.

An immature alveolar duct filled by lobed leucocytes. There are scattered inflammatory cells in the interstitial tissues. (x 400).

FIG. 29.

A collar of inflammatory cells around a terminal bronchiole which contains one or two nucleated squamous cells and desquamated columnar cells undergoing degeneration. (x 400).
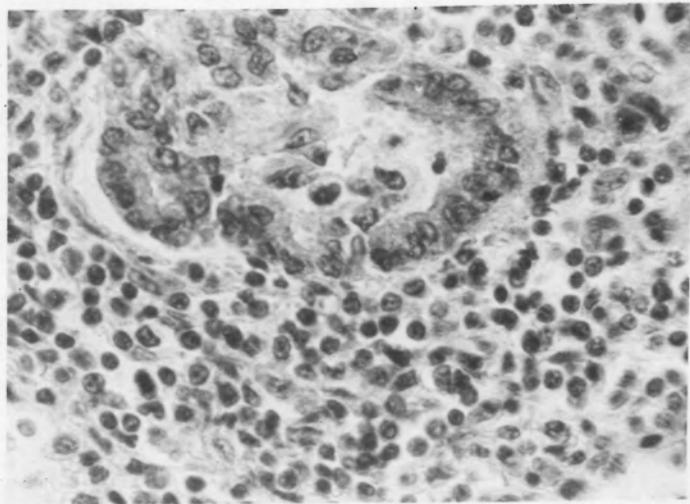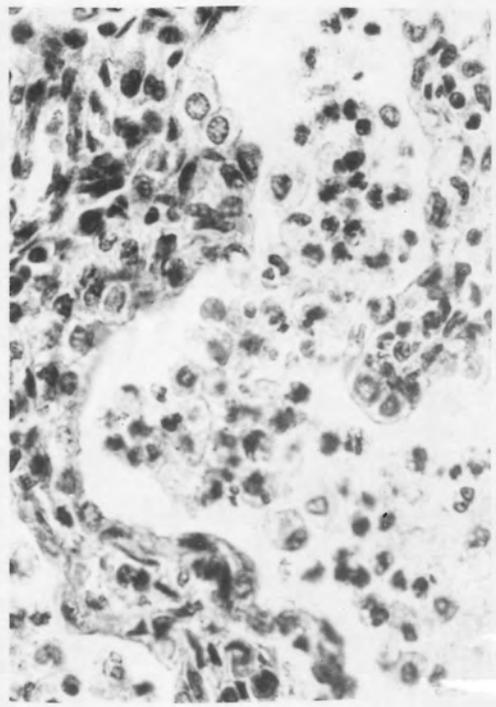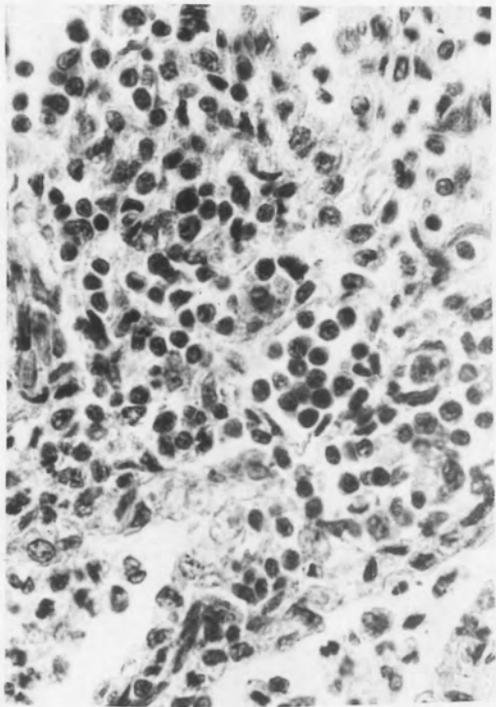
Illustrations to CASE 81.

FIG. 30.

Dilated sub-pleural lymph-
atics packed with lymphocytes.
Plugs of leucocytes can be seen
in the immature alveoli.
(x 100).

Fig. 31.

Showing detail of inflammat-
ory cells in an alveolar duct. They
appear to be partly fused and their
cytoplasm is coarsely granular.

FIG. 32.

A few squamous cells and leucocytes in an
alveolar duct. Nuclear detail can still be seen
in the large cell. The surrounding tissues show
inflammatory infiltration. (x 400).
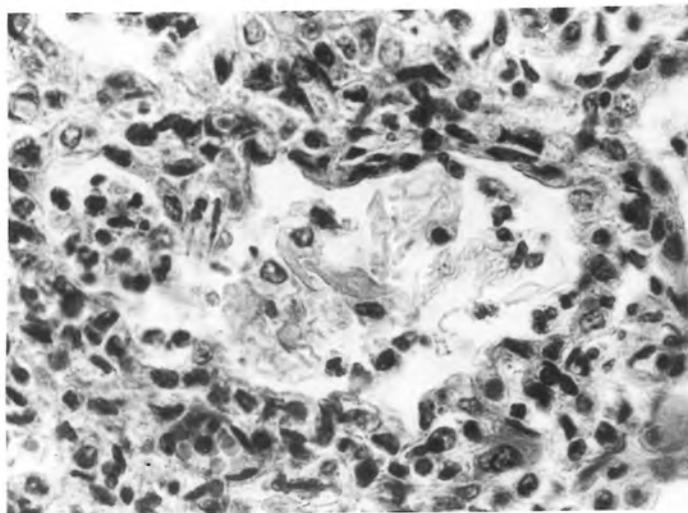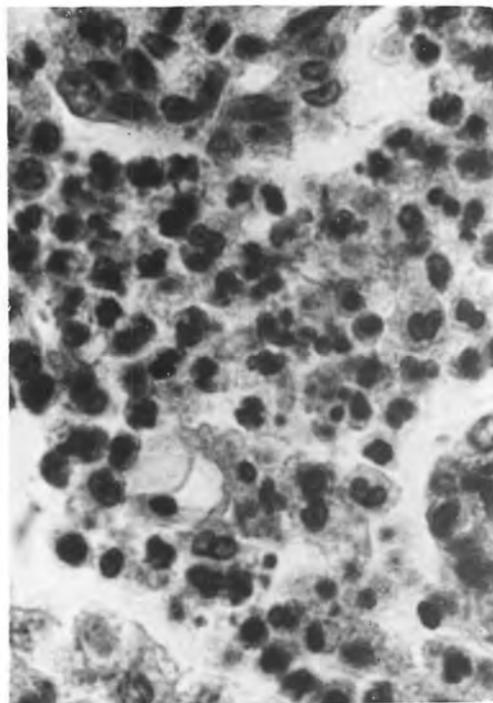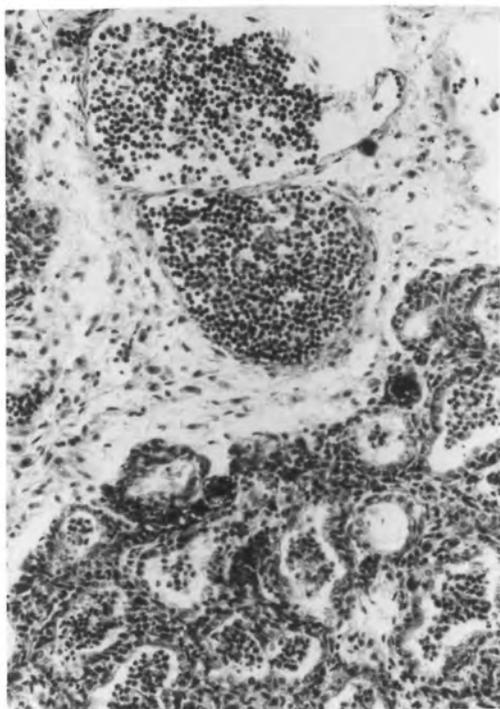
Illustrations to CASE 81.

FIG. 33.

Showing immature lung structure with plugs of
leucocytes in the alveoli. (x 55).

FIG. 34.

Detail of inflammatory cells in a sub-pleural
lymphatic and a peripheral alveolus. (x 400).
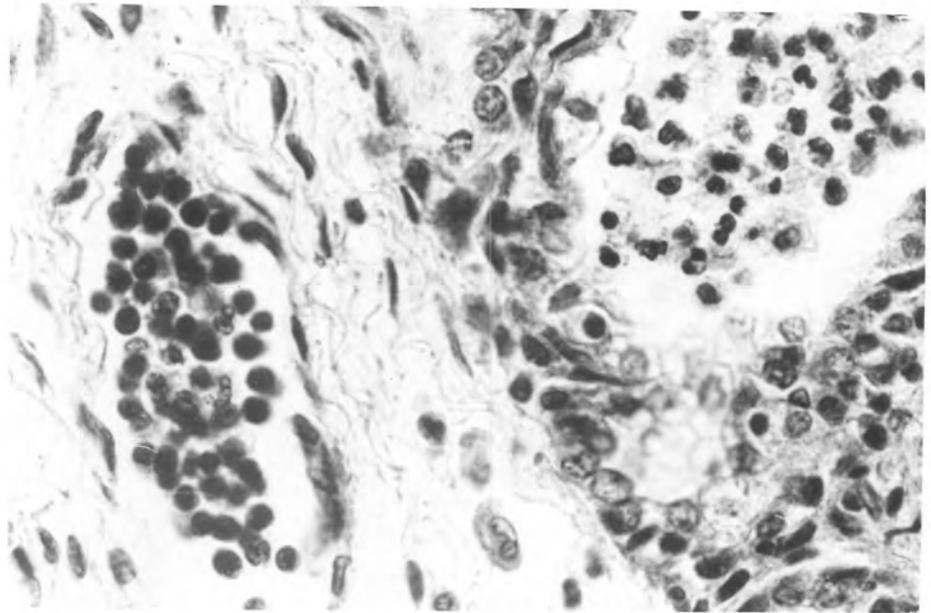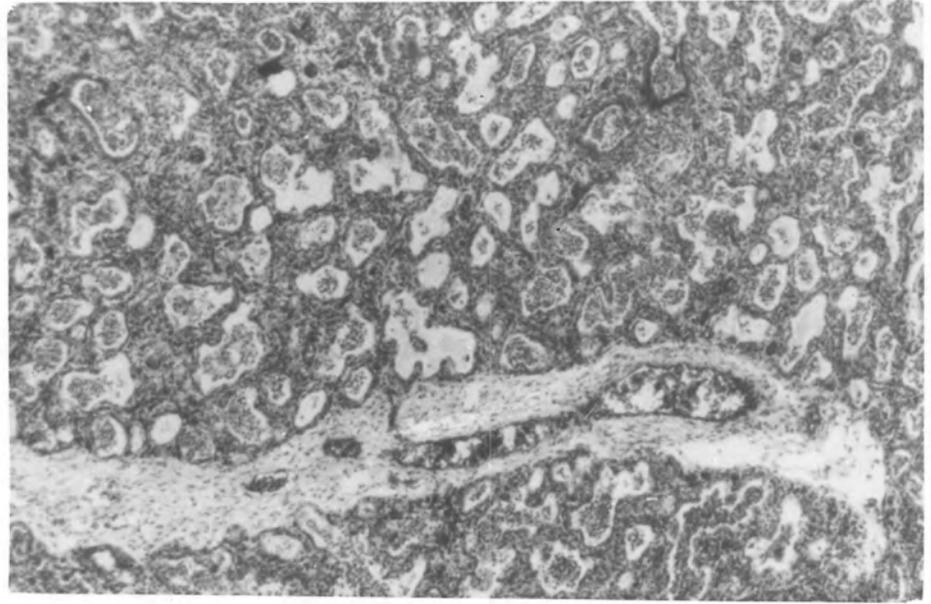
by cells.

This is a most remarkable picture in such an immature
lung. There is evidence that widespread aspiration of epidermal
material has occurred and it seems possible that some, if not all, the
pus in the alveoli has been aspirated. The leucocytes are predomin-
antly lobed forms, some are degenerating and often they are intimately
mixed with cornfied particles. There is also, however, quite a
mixture of the small round type of cell which is seen in the para
-bronchial infiltrations and in the interstitial tissues. The general
impression however is that, whatever has been aspirated, there is a
pneumonia of approximate lobar distribution.

CASE 92.

Summary of clinical notes:

Babe sent to hospital. Obstectric details unknown.
Condition poor in ambulance, moribund on admission. Lived for a
total of 5½ hours.

Post-mortem findings:

Weight: 1500 gms.

Macroscopic: The lungs were almost solid and of dark colour.

Microscopic: The lungs are moderately immature and are not obvious-
ly expanded. In some areas there appears to be an acquired collapse.
The vessels throughout are congested and small interstitial and intra-
alveolar haemorrhages have occurred. Most of the alveoli contain
clumps of leucocytes, which are not densely cellular, and these are
mostly polymorphonuclears. They are occasionally associated with
cornified particles but cell by cell are more or less discrete in the

Illustrations to CASE 92.

FIG. 35.

An extension of inflammatory cells is occurring into the loose sub-pleural fibrous tissue. (x 100).

FIG. 36.

Showing leucocytes and epithelial cells in an alveolar duct and inflammatory cells in the surrounding interstitial tissues. (x 400).
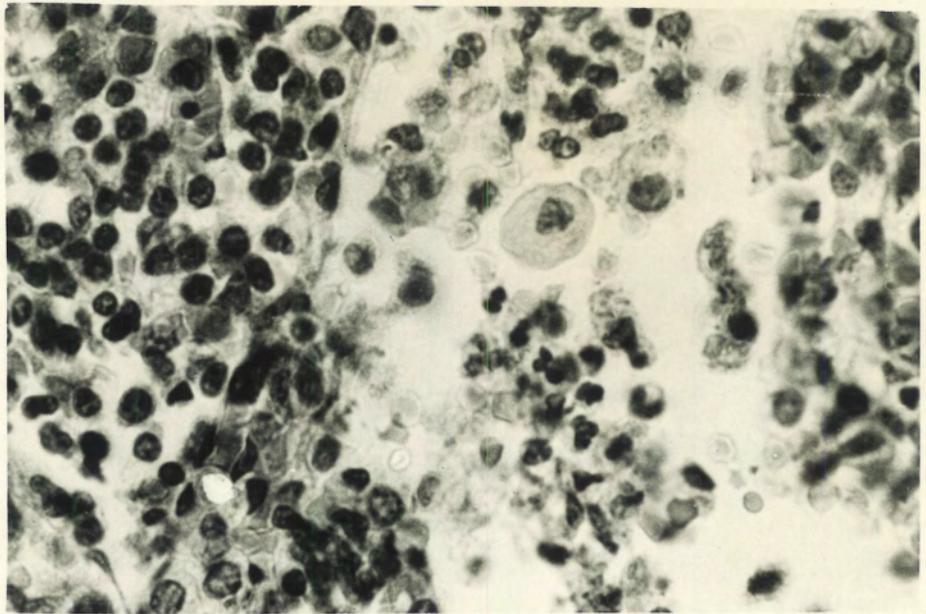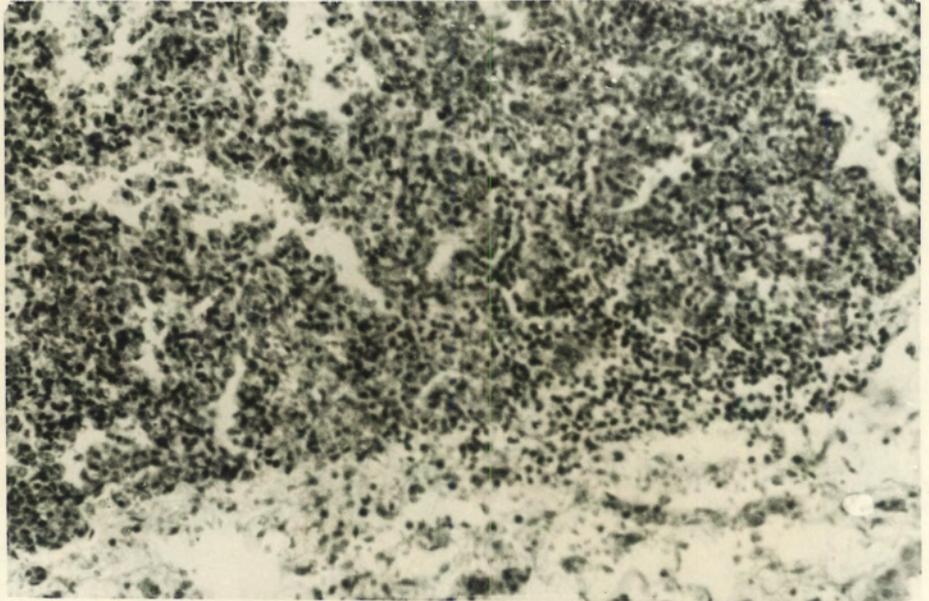
alveoli. In occasional areas there are clusters of inflammatory cells in the interstitial tissues and in one or two places they are infiltrating the loose fibrous tissues under the pleura.

Most of the interstitial reaction in this case is towards the periphery of the lung and an interesting finding is the infiltration into the sub-pleural tissues. There are several rather dilated blood vessels in the lung in one of which are numerous leucocytes. Throughout these blood vessels all the leucocytes are mononuclear and only one is a band form of polymorphonuclear but the leucocytes in the alveoli are often 3 lobed forms and some are disintegrating. It seems reasonable to postulate that many of these leucocytes are aspirated but in any case a widespread pneumonia is developing in the lung mainly in the interstitial tissues.

CASE 146.   Age 24. Para 1. Grav. 1. 38 weeks.

Antenatal patient.

Summary of clinical notes:

Patient developed hydramnios (increased by 24 lb. in weight in 15 weeks). Membranes ruptured artificially at 38 weeks. In labour for 17 hours, delivered under chloroform anaesthesia.

Babe lived for $\frac{3}{4}$ hour.

Post-mortem findings:

Weight: 2650 gms.

Macroscopic: Moderate amount of free fluid in both pleural cavities.

Microscopic: The lungs appear mature but do not show any considerable

Illustrations to CASE 146.

FIG. 37.

A group of alveoli filled by particles of eosinoph-
ilic cornified material. Such lesions were scattered
widely throughout these lungs. (x 100).

FIG. 38.

The same under higher magnification showing swell-
ing and vacuolation of the epithelial cells lining
neighbouring alveoli and occasional inflammatory
cells in the interstitial tissues. (x 400).
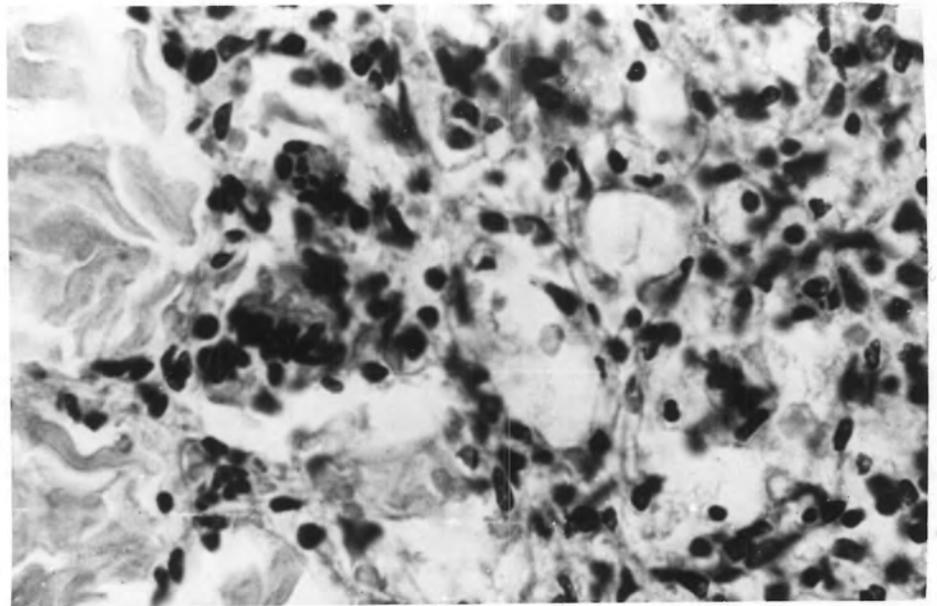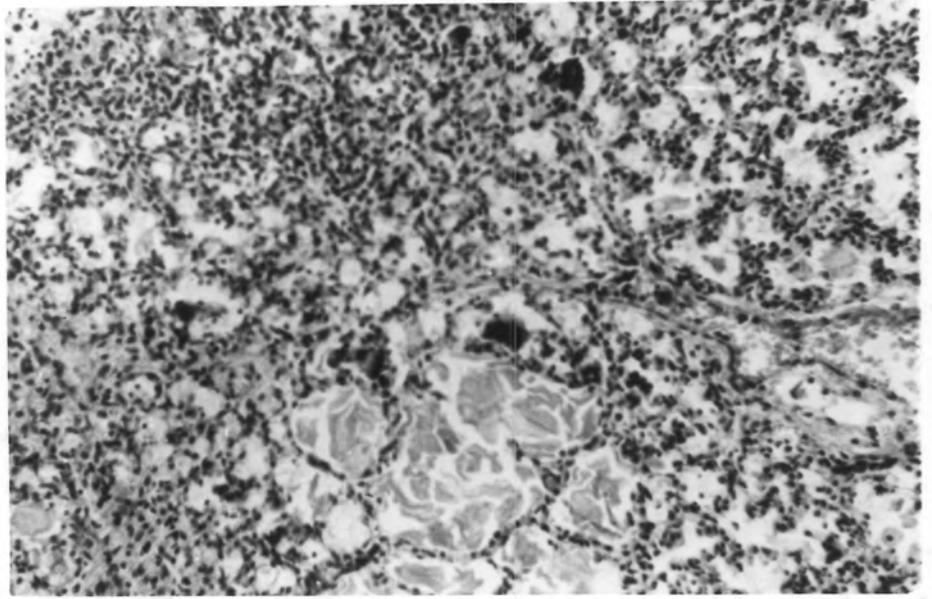
expansion, most of the alveoli still being in the foetal position. Scattered alveoli which are expanded are actually distended by masses of epidermal material and such patches are seen throughout the block. In these areas the interstitial tissues are infiltrated by singly scattered inflammatory cells. In one place, in the inter-lobular fibrous tissue quite a dense inflammatory infiltration has occurred in a follicular fashion. Many small sub-pleural lymphatics are distended and contain many cells.

This is another example of massive aspiration of epidermal material apparently resulting in a widespread interstitial pneumonia. In this case there is no suggestion of aspiration of leucocytes for the alveoli are free of them.

CASE 150.   Age 41.   Para 6.   Grav. 6.   26 weeks.
   Emergency admission.

Summary of clinical notes:

   Admitted in premature labour (B.P. 110/80, urine clear by chemical tests) and with an haemoglobin concentration of 8.0 gms; %. Blood transfusion given. Revealed and concealed accidental haemorrhage. Twin delivery. First babe lived and showed marked hydrocephalus. This one, extracted as a breech, revived well at first after delivery but respirations soon became irregular and gasping. (13 days before delivery a cervical swab on bacteriological examination showed the presence of a few anaerobic streptococci and Cl. Welchii). Further examination eight days before delivery after a course of penicillin and sulpha drugs failed to reveal any pathogenic organisms.

Illustrations to CASE 150.

FIG. 39.   FIG. 40.

Showing alveoli stuffed   Solid particles of basophilic
with red cells. (x 100).   material containing a few leuco-
   cytes in alveolar ducts.
                                                        (x 100).

FIG. 41.

The same degenerating cellular material lying
in a bronchiole from which much columnar epithel-
ium is lost. (x 400).
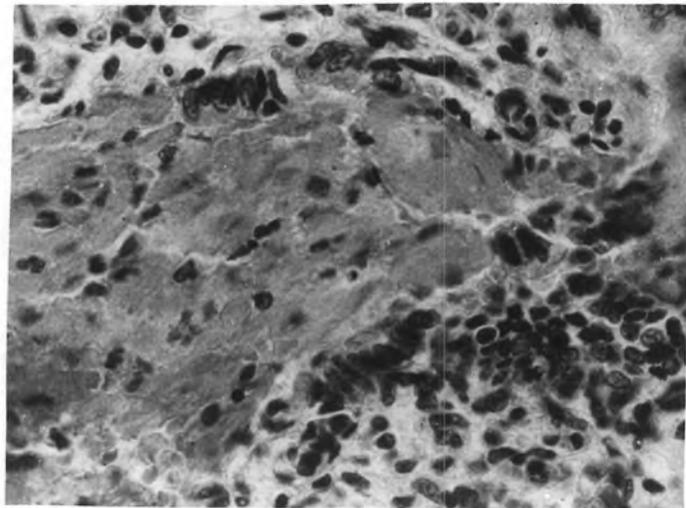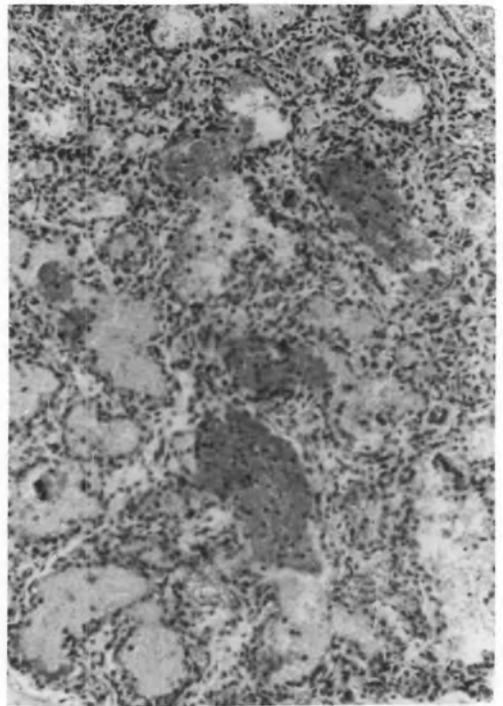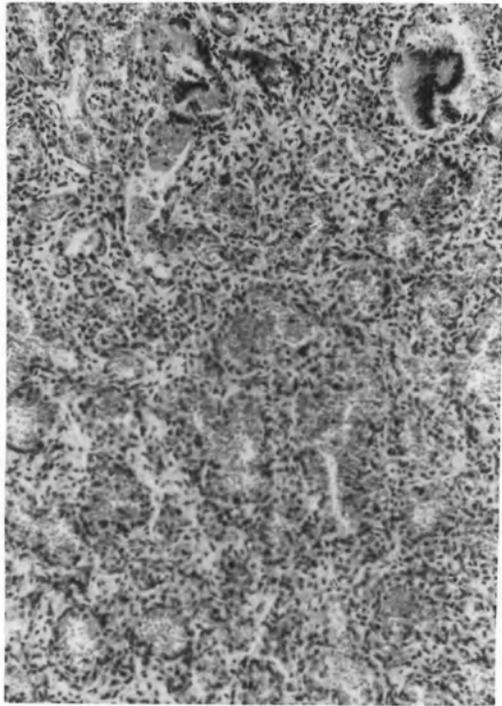
Babe lived 1½ hours.

Post-mortem findings:

Weight: 1080 gms.

Macroscopic: The lungs were practically solid throughout and
of purple colour.

Microscopic: The lungs have a markedly immature structure and in
a few places only appear expanded. Large groups of alveoli are filled
by red cells and occasionally these are also present in bronchioles.
The bronchiolar epithelium is mostly lifted and often broken up and
in several places the basophilic cytoplasm of the apparently disin-
tegrating cells is in continuity with masses of deeply basophilic mat-
erial with which is mixed occasional lobed leucocytes. In other bron-
chioles, in alveolar ducts and alveoli masses of this material taking
the contours of the spaces in which they lie are present without any
definite relationship to degenerating epithelial cells. The masses
themselves are not altogether homogeneous and mostly give the
impression of consisting of a close mixture of particles somewhat
larger than the average of the columnar epithelial cells in the
respiratory tract. In one or two places these are scattered unlobed
leucocytes in the immature interstitial tissues.

     The main features in these lungs are the peculiar
basophilic masses which appear to be cellular disintegration prod-
ucts, the more or less lobular distribution of haemorrhages into
the lung and the presence of a commencing inflammatory reaction in
the interstitial tissues. Most of this basophilic material is pres-
ent in those bronchioles where the epithelium is broken up and the
cell outlines somewhat distorted. In some places it has exactly
similar staining characteristics to the cytoplasm of the columnar

cells and in some it is in continuity with the extruded cytoplasm.
In other places, where the masses lie discretely, they are more
basophilic. Such findings are not common and the origin of the
material seems somewhat doubtful. In many cases small plugs of
otherwise intact strips of columnar cells lie free not only in the
bronchioles from which they have apparently been shed but also in the
more distal parts of the lung. These appear/to be artefacts arising
^{in other cases}
either during cutting of the specimen or possibly lodging distally
in the lung as a result of artificial respiratory movements of a
dead foetus in its passage through the birth canal. In this case
the findings are quite difficult to interpret but from the appear-
ances of the shapes and relationships of these structures it seems
more than likely that they were formed before death. Another pec-
uliar feature is the almost constant association with these structures
of lobed leucocytes in small numbers mixed intimately in the substance
of this material: they are not found elsewhere in the air spaces.
From the purely morphological appearances of these lesions it seems
quite probable that a product of cellular disintegration mainly in
the bronchioles can take the form of large basophilic fragments and
become aspirated to more peripheral situations in the lungs.

CASE 194.   Age 29.   Para 4.   Grav. 5.   42 weeks.

        Antenatal patient.

Summary of clinical notes:

Mother treated in a sanatorium for tuberculosis for
one year, nine months previously. External cephalic version performed
at 36 weeks. Babe showed asphyxia pallida at birth. Respirations

became established but bradycardia persisted and there was no marked response to stimulants. One-fifth of the placenta showed infarction. Lived 4 hours.

Post-mortem findings:

Weight: 3770 gms.

Macroscopic: Nothing significant.

Microscopic: The lungs appear mature and show quite good expansion throughout. Some alveoli are over-distended. In scattered alveoli throughout there are small collections of cornified particles and occasional squamous epithelial cells. In two places in the fibrous tissue surrounding terminal bronchi there are small clusters of inflammatory cells.

These tiny inflammatory collections while not amounting to much in themselves do indicate that either a foetal or an immediately neo-natal bronchitis can occur and in spite of the extensive inflammatory changes found in the lungs in other cases it is not common to find lesions in these situations. There is plentiful evidence that much aspiration of epidermal material occurred before or during birth but no inflammatory changes have occurred as a result of this in the distal parts of the lungs.

CASE 232. Emergency admission.

Summary of clinical notes:

History of repeated miscarriages. In this pregnancy the urinary pregnandiol level was 24 mgm/24 hours - normal at stage

Illustrations to CASE 232.

FIG. 42.

Showing a minimal inflammatory focus in the immature interstitial tissues. (x 400).

FIG. 43.

A similar infiltration in and around the wall of a small blood vessel. (x 400).

FIG. 44.

A tiny particle of intact squamous epithelium filling an alveolar space. There are scattered inflammatory cells in the surrounding tissues. (x 400).
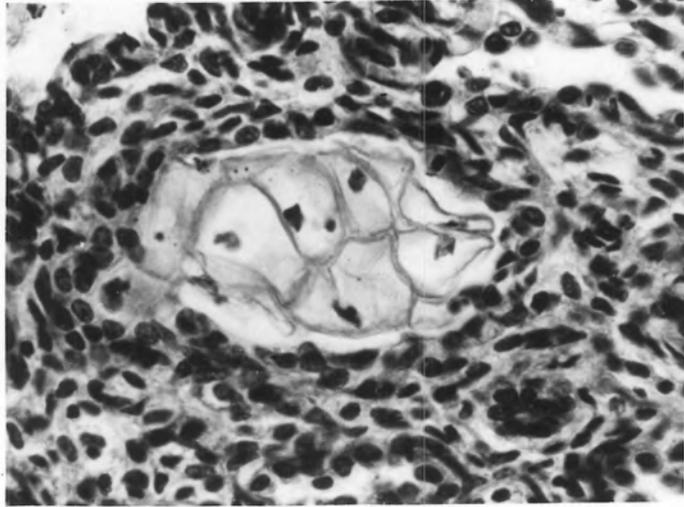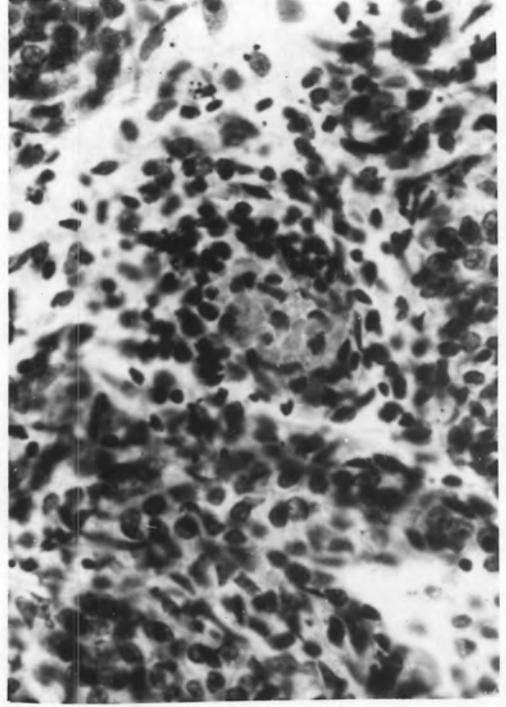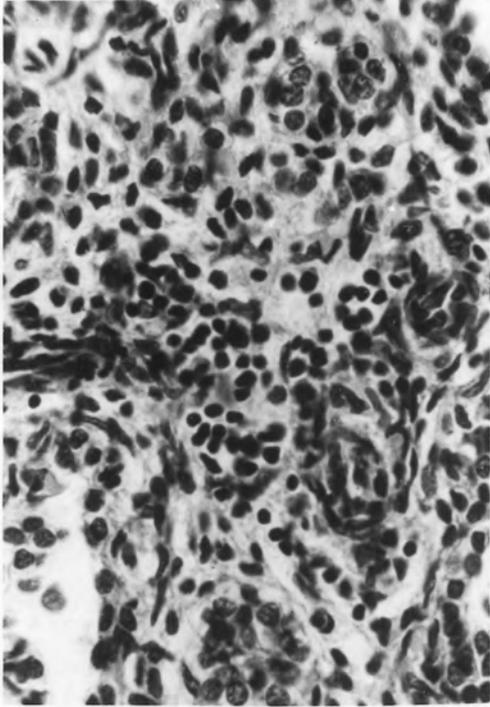
taken 44 - 72 mgm. Membranes were ruptured for 7 days. On the first day was given penicillin which was continued until the fifth day. On the third day a swab from the cervix did not reveal the presence of any pathogenic organisms. Foetus aborted 3 days after penicillin was discontinued. It lived for 2 hours.

Post-mortem findings:

Weight: 550 gms.

Macroscopic: Nothing significant.

Microscopic: The lungs have a grossly immature structure with marked paucity of alveolar structures most of which are lined by a cuboido - columnar type of epithelium. The foetal structure is minimally distorted by pathological changes. A few alveoli show slight expansion and a very occasional one contains a few particles of aspirated material. There are a few tiny focal inflammatory collections in the primitive interstitial tissues and in one situation a collar of inflammatory cells is present partly in the wall of a minute blood vessel.

Here, in an extremely immature lung, there are commencing inflammatory infiltrations in the inter-alveolar tissues with very little evidence of any inflammatory change or of foreign material in the air passages. It seems quite probable on the appearances that infection has reached the lungs by the blood-stream.

CASE 236.   Age 30.   Para 2.   Grav. 6.   28-30 weeks.
          Antenatal patient.

Summary of clinical notes:

Illustrations to CASE 236.

FIG. 45.

Showing the almost homogeneous material lying in an
alveolar duct in which the lining epithelium is incomplete.
(x 400).

FIG. 46.

The same in a terminal bronchiole in which cellular
outlines can still be recognised. (x 400).
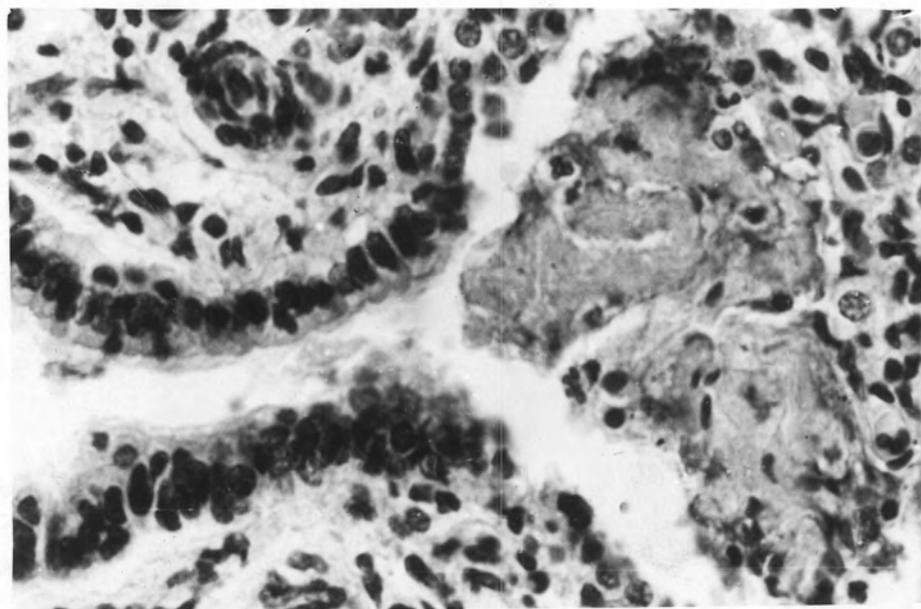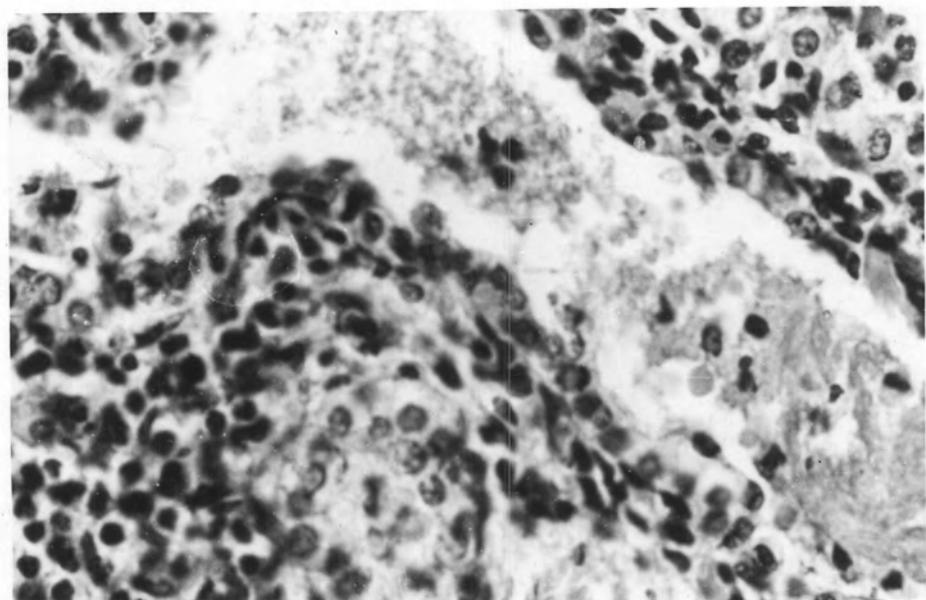
History of an ectopic pregnancy 7 years previously followed by repeated miscarriages at 5 months. 3 years previously a spontaneous premature birth occurred and the baby lived one day. Spontaneous premature labour occurred again.

Babe's condition poor. Lived 6 hours.

Post-mortem findings:

Weight: 1000 gms.

Macroscopic: Nothing significant.

Microscopic: The lungs have a markedly immature structure and there is very little evidence of alveolar expansion. Small haemorrhages have occurred in places under the pleura. Quite a few alveoli are stuffed by rather solid basophilic material which in places is homogeneous and in others appears to be composed of compressed degenerating cells. In both types there is a diffuse mixture of lobed leucocytes. In many alveoli there are quite dense masses of lobed leucocytes and throughout the lungs there is a diffuse inflammatory infiltration of the interstitial tissues. As well as occurring in the inter-alveolar tissues unlobed leucocytes are present in small numbers in the inter-lobular fibrous tissue and under the pleura. The bronchial and bronchiolar epithelium are more or less intact throughout.

There is a widespread pneumonia in these lungs in which quite dense cellular infiltrations are occurring in the primitive mesenchymal tissues and in this case not only between the alveoli but also in the sub-pleural connective tissues. In addition, quite large composite degenerating cellular particles are present in some alveoli. It is rather difficult to be sure whether these are particles of desquamated respiratory epithelium or whether some particles are made up of squamous epithelial cells. The latter appears unlikely for several

reasons. The appearances are not those usually seen of epidermal derivatives, single cornified particles are absent from other situations, there is loss of alveolar lining cells where these masses occur and finally, in some places, not only can continuity be made out between the lung substance proper and the cellular masses but in these latter enough cell detail can be seen to determine that small fragments of bronchiolar and alveolar epithelium are present. Quite frequently such masses in addition to containing a few leucocytes also lie in spaces in which polymorphonuclears are densely accumulated.

CASE 265   Age 31.   Para 2.   Grav. 5.   28 weeks.

Emergency admission.

Summary of clinical notes:

Vertex presentation, delivered under chloroform anaesthesia after a labour lasting one hour.

Lived 1 hour.

Post-mortem findings:

Weight: 690 gms.

Macroscopic: Nothing significant.

Microscopic: The lungs have a very immature structure and do not show the usual evidences of expansion. Very occasional alveoli and alveolar ducts contain a few lobed leucocytes and an occasional squamous epithelial cells. In the wide interstitial tissues there are scattered inflammatory cells throughout and these occasionally form clusters in the vicinity of small bronchioles. Very occasional small arterioles contain one or two inflammatory cells in their walls.

Illustration to CASE 265

FIG. 47.

Inflammatory cells lying in the interstitial tissues
alongside immature alveoli.   (x 400).
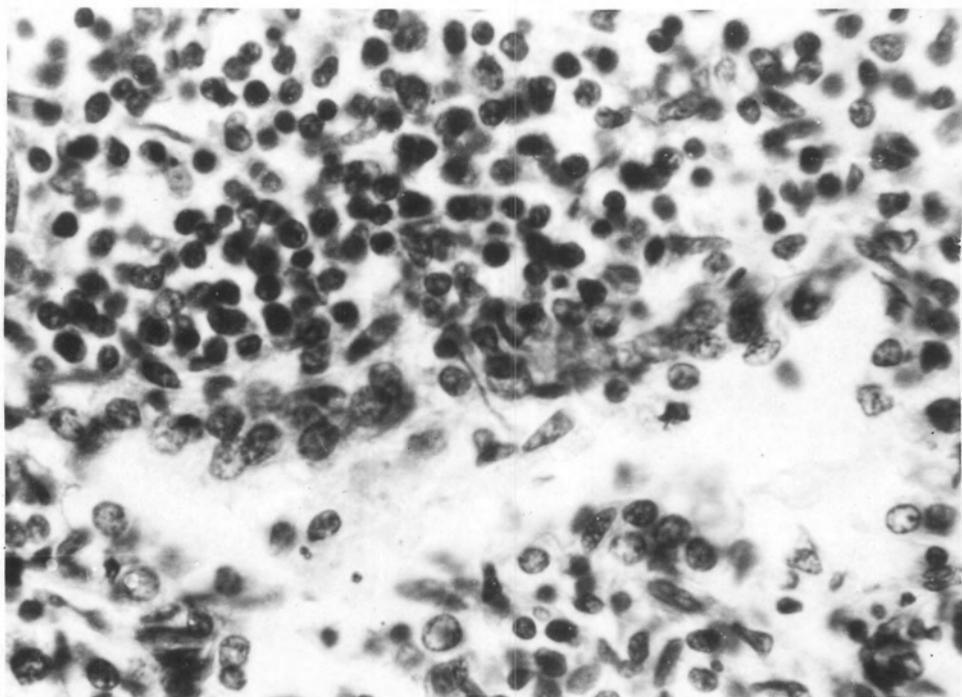
Here, in these very immature lungs there is a well established interstitial inflammation showing some tendency to maximum density of cells around bronchioles. Evidence of aspirated material except for very occasional squamous cells is absent but it does seem probable that the few polymorphonuclears may be aspirated. Another possible source of infection is the blood stream but the slightly bronchiolar distribution of the lesions is considerably against this being likely.

—————————

CASE 269.   Age 34.   Para 1.   Grav. 1.   20 weeks.
Emergency admission.

Summary of clinical notes:

Pre-viable premature birth.   Large retro-placental clot of blood.   No obvious cause.

Lived 2 hours.

Post-mortem findings:

Weight: 840 gms.

Macroscopic: Blood clot filled the right cerebral ventricle and the choroid plexus showed enormous congestion.

The lungs were pink in colour.

Microscopic: The lungs are markedly immature and do not show much evidence of alveolar expansion although some alveoli appear to be expanded.   Most alveoli are lined by cuboido-columnar epithelium and the interstitial tissues seem somewhat looser than others at this stage of development. Occasional alveoli contain particles of aspirated material, mainly epidermal derivatives while others are partly filled by leucocytes in 2 and 3 lobed forms. There are widespread

Illustrations to CASE 269.

FIG. 48.

Inflammatory infiltrations around terminal bronchioles in an immature lung. (x 100).

FIG. 49.

One of the bronchioles under higher magnification showing detail in the inflammatory cells and a suggestion of continuity between those within the lumen of the bronchiole and those without. (x 400).
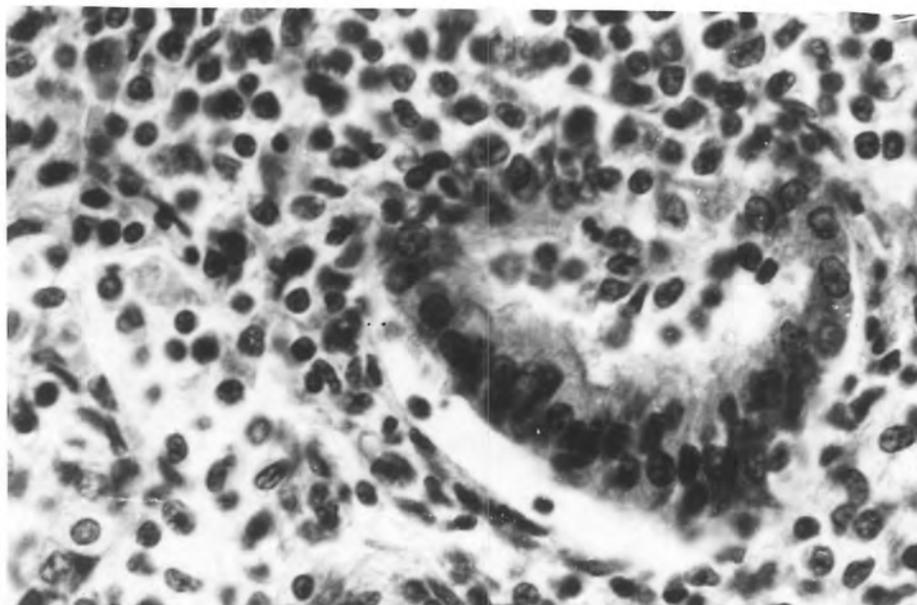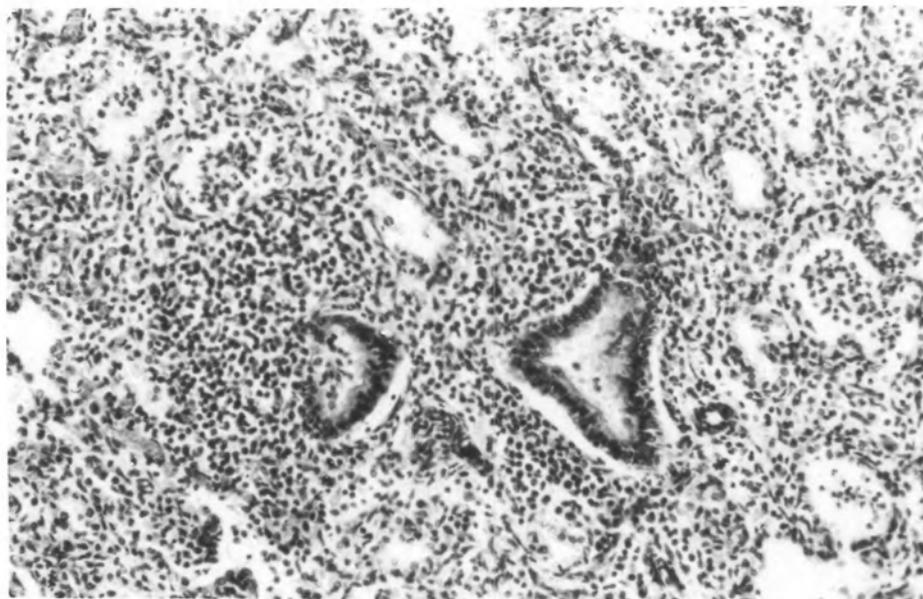
interstitial inflammatory infiltrations sometimes in strands be-
tween alveoli and sometimes as dense clusters of cells. Quite
often these cluster formations surround, or are closely related to,
small bronchioles. In one or two bronchioles there is a definite
suggestion of continuity of the inflammatory cells through the
mucosa.

The main feature in this case is the presence
of an extensive interstitial pneumonia in a markedly immature
lung. There are scattered particles of obviously aspirated mater-
ial and the appearance of the occasional intra-alveolar leucocytes
is suggestive that they also may have been aspirated as they occur
as small clumps in isolated alveoli unrelated to areas of estab-
lished inflammation and they are mainly markedly lobed cells.

CASE 277. 24 weeks. Emergency admission.
Summary of clinical notes:

For 6 weeks, intermittent vaginal bleeding. Abort
-ed foetus when fundus 24 weeks. Mother had thrombo-phlebitis
of right thigh and calf on admission. Given penicillin after the
miscarriage.

Foetal heart sounds said to be audible for 40
minutes, gave three breaths.

Post-mortem findings:

Weight: 750 gms.

Macroscopic: The lungs were fairly light and pale pink in colour.

Illustrations to CASE 277.

FIG. 50.

The alveolar ducts and alveoli are choked with densely
packed markedly lobed leucocytes. (x 100).

FIG. 51.

Showing greater detail in the inflammatory material which
consists of a mixture of inflammatory cells and partly degen-
erated epithelial cells and occasional cornified particles.
(x 400).
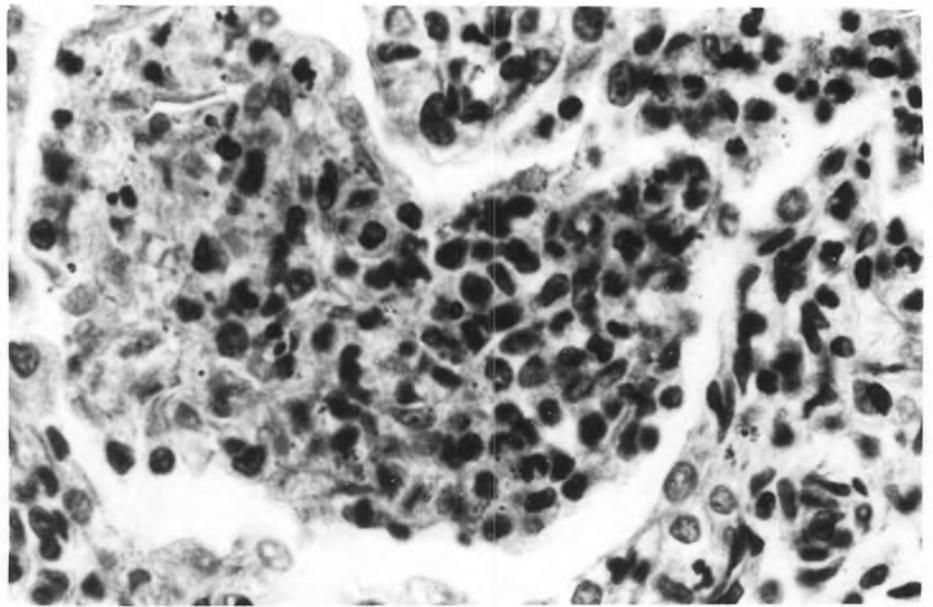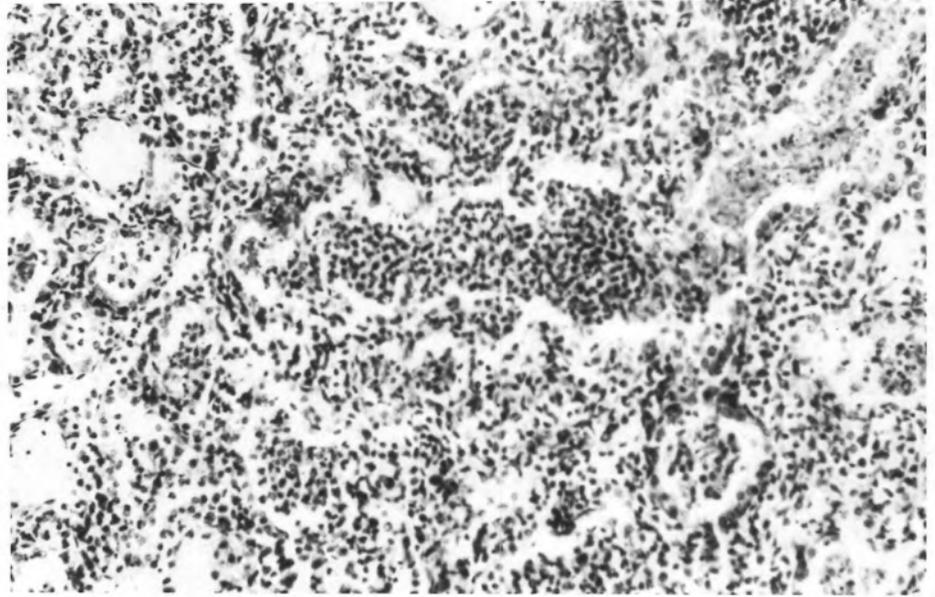
Illustrations to CASE 277.

FIG. 52.

A dense cluster of inflammatory cells around a
bronchiole. (x 100).

FIG. 53.

Higher magnification shows that in some places
the intra-alveolar cells are partly lobed and partly
un-lobed. A few are seen in the surrounding tissues.
(x 840).
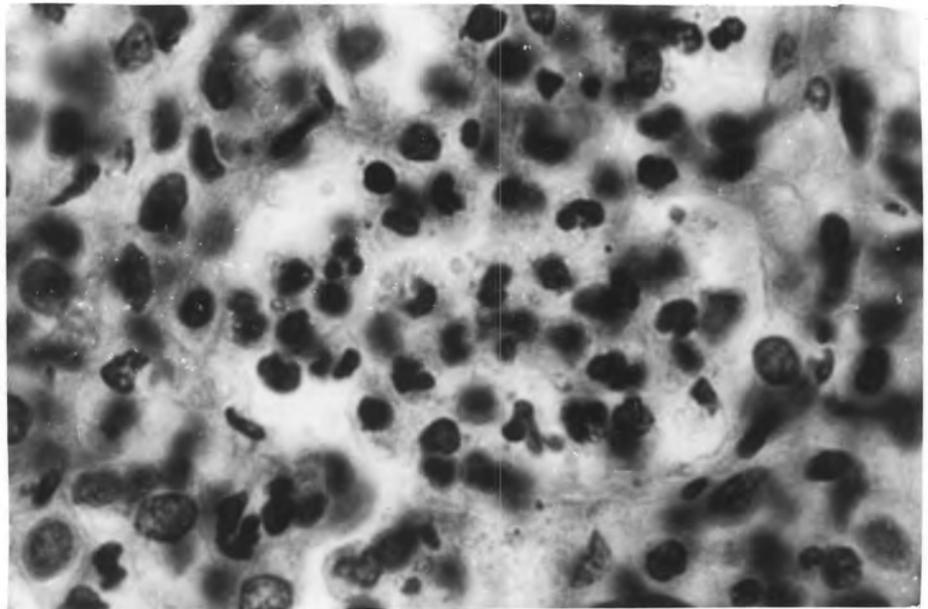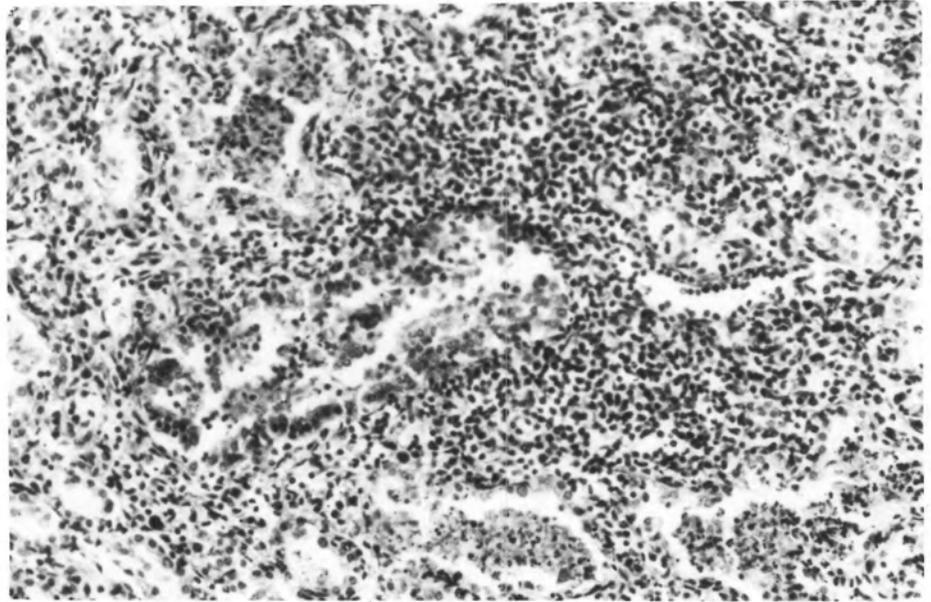
<u>Microscopic:</u>   The lungs have a markedly immature structure and there are practically no alveoli which appear to have contained air. Instead they are mostly filled by lobed leucocytes which are not lying more or less singly but as masses of apparently adherent cells. Such formations block the alveolar ducts as well as fill alveoli. There are occasional particles of epidermal material. In the inter-stitial tissues there are scattered clusters of inflammatory cells of the unlobed type and these are often adjacent to bronchioles. Occasional inflammatory cells are lying free in the bronchi.

The findings in this case are quite remarkable and there are denser inflammatory cell collections in the alveoli through-out the whole lobe than in any case in the present series. Such masses of lobed leucocytes actually fill the spaces in which they lie so that the lung has a, more or less, solid appearance. In addition to this, these are quite well established inflammatory collections in the interstitial tissues which are mostly related to terminal bronchioles.
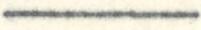
Twenty-nine cases have been described in all of which there were formations of inflammatory cells in the lungs. Of these, seventeen were stillborn and twelve liveborn. These lived less than six hours. The time limit of six hours was decided on arbitrarily as a period during which it was unlikely that a neo-natal inflammation could arise without an existing intra-natal or intra-uterine inflammatory process. A longer interval would have included a few more cases but the probability of adding one or two purely neo-natal inflammations seems considerable. Other writers, notably Johnson and Meyer (1925), allow up to three days; but in cases of minimal lesions, and even the more obviously developed ones in this series, the period seems far too long and, at any rate, for a discussion of the morphological aspects of congenital pneumonia, as opposed to its statistical aspects for example, it is better that a short post-natal interval is taken.

Before proceeding to a discussion of the lesions it is interesting to recall here the incidence of the lesions on the basis of maturity. Of the seventeen stillborn foetuses, twelve were mature while in the liveborn group only three were mature. The numbers in the whole series in these two groups were, stillborn 53 full-term, 44 premature and in the liveborn group 8 full-term and 32 premature. While it is difficult to draw conclusions from this it does not appear probable that prematurity predisposes to intra-uterine inflammation in the lungs, but that in premature foetuses with congenital pneumonia there is less likelihood of other causes acting to result in stillbirth.

Certain lesions, or a combination of lesions, were encountered in this survey which represent true foetal pulmonary inflammatory reactions acquired in utero or intra-natally. The following

is a list of the various types of lesion found:-

(1)   Lobed or un-lobed inflammatory cells in the alveoli bearing some relationship morphologically or in the manner of their distribution to the cells in the surrounding interstitial tissues.

(2)   Focal collections of cells in the interstitial tissues around air sacs containing either leucocytes or masses of epidermal material, or the two together.

(3)   Focal collections of inflammatory cells in the fibrous tissue supporting blood vessels and bronchi.

(4)   Cellular infiltrations into the sub-pleural tissues.

(5)   Increased cellular content (not in focal formations) of the interstitial tissues, particularly where the alveoli contained leucocytes, cornified particles or desquamated swollen and disintegrating alveolar epithelial cells.

(6)   Collars of inflammatory cells around terminal bronchioles.

(7)   Infiltrations into the sub-mucosal tissues of bronchi or bronchioles.

(8)   Lymphocytes distending lymphatic vessels in the sub-pleural or inter-lobular fibrous tissue.

(9)   Focal collections of inflammatory cells, usually in immature lungs, in the interstitial tissues around blood vessels.

In addition to these nine types of lesions there were often intra-alveolar collections of markedly lobed leucocytes in

clumpy formations without any relation to cells in the interstitial tissues but sometimes in association with similar collections in the larger bronchioles and bronchi. As these may not always be of foetal origin they have not been included in the above list of criteria, which covers lesions which are indicative of a true pneumonia acquired in utero or intra-natally.

Before proceeding further it would be well to mention three of the stillborn cases in which the significance of the finding of inflammatory cells seems somewhat doubtful. These are CASES 38, 62 and 143. In CASE 38 the main lesions present are large masses of aspirated epidermal material which are scattered patchily throughout the lungs. In one area the epidermal particles are mixed with lobed leucocytes and occasional desquamated alveolar epithelial cells. These latter, in other cases, seem to degenerate only in the presence of some obvious inflammatory process and the fact that the leucocytes are confined to one portion of the lung makes it seem probable that inflammatory infiltration of the aspirated material is occurring. There is, however, no interstitial tissue involvement so that a diagnosis rests on the inflammatory cells in the alveoli mixed with cornified material. As the two elements could have been aspirated together this case is at least to be regarded as a doubtful one of true pulmonary inflammation. CASE 62 was one of the few macerated lungs sectioned in the series. It shows quite definitely that there are leucocytes in the alveoli but maceration changes have so distorted the picture that their exact morphology cannot be determined. As far as can be seen there are no inflammatory infiltrations in the interstitial tissues. Thus two of the seventeen cases are doubtful. The third, CASE 143, does not show sufficient evidence for a diagnosis of pneumonia. There are very occasional leucocytes in scattered alveoli but the interstitial changes seem to be largely due to the

high percentage of nucleated cells in the alveolar capillaries. For
an inflammatory reaction the changes would be minimal.

Without reference at the moment to their significance,
the two most outstanding lesions were where the alveoli contained
masses of leucocytes or where discrete inflammatory collections were
present around terminal bronchioles. The former of these lesions is
depicted in Figures 31,33,34,50 and 51 and the latter in Figures 18,
29,48,49 and 52. Intra-alveolar leucocytes were found in twenty-three
cases and, with five exceptions, were associated with epidermal partic-
les. The lesions around terminal bronchioles were always associated
with the presence of lobed leucocytes in the alveoli and occurred in
seven cases. It is somewhat peculiar that these bronchiolar lesions
were almost confined to the premature cases (six out of the seven
being premature); three were stillborn and four died within six hours
of birth.

Interstitial inflammatory collections were present
in varying degrees in twenty-four cases. The five in which they were
absent were stillborn. In some cases the collections were quite dense.
In others, individual cells were scattered singly in the interstitial
tissues. Mostly such lesions were present in association with inflam-
matory material in the alveoli. This often consisted of lobed leuco-
cytes, epidermal particles and desquamated alveolar or bronchiolar
epithelium. Uncommonly, small collections of cells were found in
the interstitial tissues apparently unrelated (or so a two dimensional
image makes it appear) to alveoli containing foreign material. Where
focal collections of cells made up the interstitial lesions these
latter were obvious to cursory examination. More detailed search was
required where the cellular deposits were not as dense but, as the
figure of twenty-four (out of twenty-nine) indicates, they were nearly
always to be found.

In two very immature foetuses (CASES 232 and 265) attention is drawn to Figures 42, 43 and 47 in which tiny inflammatory collections are present in the wide immature interstitial tissues. Each lived for a short period (less than 2 hours) but it seems probable from the appearances that the inferences to be drawn are somewhat different. In CASE 265 some of the clusters are obviously related to bronchioles while in CASE 232 the inflammatory cells are confined to the vicinity of blood vessels and are widely separated from air spaces. Both the lesions had almost certainly commenced to form before birth and it would appear in CASE 232 that the condition may have arisen as a result of a septicaemia.

Certain features described in these lungs require more detailed discussion and are considered under the following headings:

(1) intra-alveolar leucocytes

(2) degenerative epithelial changes in two cases

(3) lesions in the lumens and walls of bronchi and large bronchioles

(4) the incidence of epidermal particles in the lungs

(5) evidence of lymphatic activity

(6) attempted bacteriological studies

(1) Intra-alveolar leucocytes.

Leucocytes were present in the alveoli in varying numbers in twenty-three out of the twenty-nine cases. Almost without exception they were markedly lobed forms and often were lying discretely without any supporting fibrinous, or other, material. They were often present as well in alveolar ducts but the incidence of

their occurrence in terminal bronchioles, bronchioles and bronchi
diminished in ~~that~~ order through those structures. There were cases how-
ever, to be referred to later, in which masses of leucocytes were
present in the more proximal structures. The lesions in the inter-
stitial tissues associated, apparently, with these intra-alveolar
deposits were almost always made up of the small round type of cell
and only rarely were polymorphonuclears seen in the interstitial coll-
ections (see Figure 53).

The various types of lobed leucocyte formations seen
were:-

(a)   Individual cells lying widely separated
        in the alveoli without any supporting
        material and unrelated to cellular infil-
        trations, if any were present, in the surr-
        ounding tissues (see Figures 19, 28 and 34).

(b)   Leucocytes mixed with other cellular material.
        This consisted of masses of epidermal scales
        or cells, desquamated swollen alveolar epi-
        thelial cells and occasional bronchial col-
        umnar epithelial cells (see Figures 6, 16, 22,
        24, 25 and 36). Occasionally, more or less,
        globular homogeneous partly vacuolated vernix
        masses were also present.

(c)   Densely cellular leucocyte aggregations which
        appeared to be fused and mixed intimately
        with other cellular debris (see Figures 31,
        50 and 51).

(d)   Quite uncommonly, they were seen intermingled
        with the round cell of the interstitial lesions
        (see Figure 53).

The above varied appearances make it seem at least doubtful that these leucocytes are of foetal origin in all the cases described. Where they are intimately mixed with obviously aspirated material such as epidermal particles and, particularly, where similar mixed masses are present, in the same cases, not only in the alveolar ducts but in large bronchi, it seems probable that much of such material may be aspirated (see Figures 15,16,17,21). Occasionally polymorphonuclear cells are present in these proximal structures, but absent in the alveoli; and at the same time there are no obvious inflammatory lesions in the walls of the bronchi or bronchioles (see CASE 262). Such findings make it appear probable that aspiration of pus sometimes occurs into the alveolar spaces.

It is difficult to give an explanation for the frequent findings of lobed leucocytes in alveoli whose walls are infiltrated solely by round cells. It would seem that leucocytes should be seen migrating through the alveolar walls more often than they are if the intra-alveolar cells pass into the alveoli locally. On the other hand, in many of the lesions with various cellular elements present in the inflammatory exudate, the polymorphonuclears appear to be an integral part of the inflammatory process.

In conclusion, however, it seems impossible on morphological grounds to do more than suggest that some of the inflammatory cells are aspirated. For comparison of these two types of cellular reaction described see Figures 9 and 10,18 and 19,27 and 28.

(2) Degenerative epithelial changes in two cases.

The peculiar changes to be discussed are those seen in CASES 150 and 236, both live-born infants and both weighing approximately 1000 gms. These basophilic, partly structureless masses are not often seen in either foetal or infant lungs and in this series

similar material was found in six other cases, all premature and
living for a few, or more, hours. While references will be made
later to some similarity in some cases to the "alveolar membrane"
(asphyxial membrane) material seen in premature live-born lungs
mention is made here to the material because of its occurrence in
these two cases in association with inflammatory changes and be-
cause in CASE 150 there is quite marked evidence of some connection
between this material and the columnar epithelium of bronchioles.
Whether this material is related to that forming alveolar membranes
is not at the moment under discussion but it appears that in these two
cases its formation has some relation to the presence of inflammatory
cells in the lungs. In CASE 150 the leucocytes are not abundant in
any situation except in close association with the swollen disinte-
grating cells while in CASE 236 leucocytes are more numerous both in
the alveoli away from the material and mixed with the latter. In
this second case there may be no definite relationship between the
two lesions but in CASE 150 the occurrence of the two together and
their combined or un-related absences in other alveoli make it seem
that some vital process occurs in which inflammation occurs as a re-
sult of bronchial epithelial desquamation or, that this latter occurs
in response to some injurious agent which perhaps has been aspirated
in association with leucocytes. The second explanation, while insec-
ure, seems somewhat more likely .

(3)   Lesions in the lumens and walls of bronchi and large
        bronchioles.

Attention was paid to these structures to attempt
a correlation between their contents and the lesions in the more
distal parts of the lungs. Thus, where epidermal and inflammatory
cell collections occur in the bronchi as well as in the alveoli,

some support exists for the idea that leucocyte aspiration may in part account for some of the intra-alveolar cells where there is no good corroborative evidence for their having arisen locally.

Search was made consistently throughout the series for evidence of any inflammatory process in the bronchial submucosa. In only two cases was any such found but the lesions while of the most minimal nature, indicate that some noxious substance can act here as well as more peripherally in the lung. It seems peculiar, however that considering the large amounts of material that can be present in these situations, there is so little evidence of the initiation of an inflammatory process. (see CASES 198 and 282). Such lesions assist in diagnosis in CASE 198 in which the larger structures contain masses of epidermal debris free from mixture with leucocytes while the peripheral parts of the lungs, which also contain aspirated material, show widespread inflammatory processes. It is also, of some interest to note that while markedly lobed leucocytes are absent from the bronchi there are also very few lobed forms in the pneumonic lesions in the interstitial tissues. In CASE 247, where there is an established pneumonia, a small bronchus contains a large plug of partly fused cells, debris and fibrin and it seems more than probable that this structure was aspirated in its entirety rather than formed locally. Again in CASE 282 the highly cellular material in the bronchioles seems most likely to have occurred from aspiration and in the mass depicted in Figure 21 there were numerous leucocytes. In the majority of the cases, however, and particularly in the live-born, intra-bronchial structures were absent.

(4)   The incidence of epidermal particles in the lungs.

Out of the 137 cases in which the lungs were sectioned 79 (57%) showed aspirated epidermal particles. (This

figure is certainly below the true figure for this lesion on account
of the large number of sections omitted because of maceration changes).
In 22 of the cases there were large amounts of cornified material, and
of these 22, twenty were still-born. This latter fact is in support
of the contention that only the violent inspiratory attempts of asphyxia
cause such large amounts to be aspirated. In addition, it is interest-
ing to note the higher incidence in full-term foetuses. In the full-
term stillborn group, 39 showed epidermal aspiration (which was gross
in 14) while in the premature group 21 showed epidermal material (which
was gross in 6). With the discrepancy in the numbers sectioned (44
premature, 53 full-term) and that in the whole series more cases were
premature, this difference appears to be of significance.

Massive aspiration occurred only twice among the live-
born cases (19 of which showed epidermal material) and in each case,
one premature and one full-term, pneumonia was also found to be estab-
lished.

As this lesion is a common one in stillborn and live-
born cases it seems peculiar that its presence should have such apparent-
ly different effects. In most of the cases its presence in the alveoli
seems harmless and not of itself (except in the massive depositions)
injurious to the new-born, while in others it appears to initiate an
inflammatory process in the lungs which must surely be a source of
future handicap to the live-born if atalectasis and pneumonia develop.
In those cases where inflammatory changes occur it seems most likely that
either a bacterial element is present in the aspirated liquor, or that
some of this aspirated material is from the lower birth canal, and
perhaps, that some of the squamous epithelial material is from the
cervix or vagina rather than from the skin of the foetus.

The conclusion as to the extent of intra-natal asphyxia

in the stillborn cases from the incidence of this lesion is that
more violent inspiratory efforts occurred in the cases showing
pneumonia. A total of 39 full-term cases showed aspirated material.
Ten of these were in the pneumonia cases and, of these 10, five
showed massive deposits. In the premature stillborn group, a total
of 21 showed aspirated material. Five were pneumonia cases and in
two of these there were massive deposits in the alveoli. These
findings are summarised in Table 2.

Table 2.

Cases	Number with sections	Aspirated material in lungs	Inflammatory cells in lungs	Aspirated Material (pneumonia cases)
Premature	44	21	5	5 (2)^{x}
Full-term	53	39	12	10 (5)

( )^{x} Cases with massive deposits.

(5)   Evidence of lymphatic activity.

In four cases, two stillborn and two liveborn,
lymphatics in the sub-pleural fibrous tissue or in the inter-lobular
fibrous tissue appeared to have been dilated and are stuffed with
lymphocytes. These lesions are illustrated in Figures 11,30 and 34.
They were found only in those cases in which inflammatory reaction
was occurring in the lungs. In three of these four cases (CASES
135, 202, 81 and 146) leucocytes were present in the alveoli; in
CASE 146 they were absent. Again, interstitial infiltrations were
present only in three, being absent in CASE 135.

(6)   Attempted bacteriological studies.

Sections were cut of the lungs in twenty of the twenty-nine cases and stained for organisms by either Gram's stain for organisms in tissues or by a simple stain using dilute carbol thionin (Besson's modification). Careful search failed to detect organisms in all but one case. This was in CASE 135. It is recalled in this case that labour had commenced thirty-six hours before attending hospital and the foetus was passing meconium. It was an obstructed labour with deep transverse arrest of the head, there had been no chemotherapy course given and at post-mortem early maceration changes were present. Evaluation of the pulmonary lesions was difficult because of these changes but there were certain evidences that an active inflammatory process had occurred prior to intra-uterine death. Clusters of cocci which appear to be Gram positive are scattered widely in the lung, mainly in the disrupted alveoli and sometimes as masses around free epithelial cells.

Altogether, the investigation appeared unsatisfactory although against control specimens it was fairly certain in the other nineteen cases that organisms were absent. Some workers found an incidence of about 50 per cent. positives and others stated that the procedure is unsatisfactory. It may be now, however, that the administration of routine antibiotic therapy to the mother has, as in many other bacterial examinations, altered the criteria for diagnosis. Of these nineteen cases eleven had some form of chemotherapy during labour.

A SUMMARY OF MATERNAL AND OBSTETRICAL CONDITIONS
WHICH WERE ASSOCIATED WITH INFLAMMATORY CELLS IN
THE TWENTY-NINE CASES IN THIS SERIES.

In spite of the fact that during the twelve month period 5901 patients had attended the Antenatal Clinic and 484 Emergency Admissions, only 15 of the 29 cases described here were from mothers who had had antenatal supervision at the hospital. Of course the usual explanations apply; namely, that a high prop -portion of the complicated cases are sent late in pregnancy or labour and that naturally the outcome for the foetus is more likely to be poorer in these cases. In the 172 cases of stillbirth, which were classified in the hospital records for the twelve months, 60 were from emergency admissions.

Twelve of the mothers were primiparas and fourteen were multiparas; in the other three this factor was not known.

In seven cases the mothers had significant assoc -iated diseases. One had intestinal obstruction from a carcinoma of the colon and came into premature labour shortly after operation (CASE 151). During the three day period a full course of chemother- apy was given. The possibility of a maternal bacillaemia as a cause of foetal infection does not seem remote. In another, the mother had hepato-splenomegaly of unknown cause (CASE 62). Another had a severe hypochromic microcytic anaemia with an haemoglobin concentr -ation of 8 gm.% (CASE 150). In CASE 277, the mother had an acute thrombo-phlebitis of the calf and thigh and abortion followed an accidental haemorrhage, which was the culmination of prolonged intermittent vaginal bleeding. Two had hypertension (CASES 5 and 274). One of these had had a sub-total thyroidectomy three years previously and the other's condition under anaesthesia during labour

was poor and recovery took two hours after completion of the delivery which was effected by forceps. In one case the mother had recently left a sanatorium before/be coming pregnant.

Four had pre-eclampsia. In three it was of mild severity and in one (CASE 10) the B.P. was 175/110, the urine contained one-eighth albumen and there was gross oedema. All four foe-tuses were stillborn.

Accidental haemorrhage occurred in six cases two were in cases resulting in stillbirth and of the four which resulted in liveborn babies one had a history of repeated miscarriages and one had repeated small vaginal haemorrhages for six weeks.

There was one case of hydramnios in which the membranes were ruptured artificially and large clear effusions were present in both pleural cavities of the live-born infant at post-mortem (CASE 146).

Malpresentation of the foetus occurred in nine cases. Of five breech presentations, four were extracted as such. The others included deep transverse arrest of the head, an occipito-posterior, an impacted shoulder and a face presentation. The membranes were ruptured artificially in two cases. One was in the case of hydramnios already mentioned and the other to terminate pregnancy in the severe pre-eclamptic (CASE 10). Forceps delivery was used in five cases, three of which were low applications. A destructive thoracotomy was performed in the case with impacted shoulders (CASE 143).

Foetal congenital abnormality was present in one case, an anencephalic monster which was live-born. One case was a twin, the other twin was a hydrocephalic which lived (CASE 150).

The duration of rupture of the membranes before delivery

was very variable. In seventeen cases the time was, more or less, accurately known varying between ten minutes and 192 hours (the average being 58 hours). In the other twelve cases the approximate duration was not known but in eight it was thought to be reasonably short. Chemotherapy was given to the mothers in fourteen cases. The course given consisted of penicillin 60,000 u. 3 hourly and a course of one of the sulpha drugs. These are listed with the length of rupture of the membranes in Table 3.

From a consideration of this it will be seen that in most of the cases (eight out of fourteen) the membranes had been ruptured for a long time. In six cases maternal infection was sus -pected. From three of these swabs were taken from the cervix and the organisms found were B. coli and a few B. Welchii in CASE 78, anaerobic streptococci and anaerobic Gram negative bacilli in CASE 81. In this latter case the maternal temperature was 101.8^{o} F. In two other cases mild pyrexia of unknown origin was present during labour (CASES 36 and 150) and in the third in which bacteriological examination was not carried out the maternal temperature was 100.2^{o} F, the pulse rate was 112 and intra-venous therapy was given to combat dehydration.

TABLE 3.

Case	Duration of rupture of membranes.	Chemotherapy
10	36 hours	Full course.
36	84 hours	Full course started after 50 hours.
38	29 hours	Full course 24 hours.
62	48 hours	Full course.
78	96 hours	Full course started after 48 hours.
151	5 minutes	Full course started 3 days before.
247	22 hours	Full course. Duration not certain.
274	192 hours	Full course for 8 days.
282	72 hours	Started before admission and continued.
300	2 hours	Full course. Details uncertain.
81	? long	Penicillin alone.
146	17 hours	Full course.
150	? short	Course given 8 days previously.
232	168 hours	Course discontinued 3 days before abortion.

A STUDY OF TEN CASES OF NEO-NATAL PNEUMONIA

IN WHICH THE INFANT LIVED MORE THAN SEVEN DAYS.

The following cases are presented to illustrate the types of lesion seen in inflammatory conditions in the lung later in the neonatal period. In the live-born cases in the present series (110) a total of thirty-seven showed pneumonic lesions on section of the lungs. Twelve of these died within 6 hours of birth and have already been described. Fifteen died during the first week of life and ten died after the first week. It is a description of some of the findings in these ten cases which follows.

CASE 2.   Age 24.   Para 3.   Grav. 3.   40 weeks.

Antenatal patient.

Summary of clinical notes:

Mother previously had a lower uterine segment Caesarean section for an obliquely contracted pelvis following onset of spontaneous labour. Elective operation performed for this baby.

Babe showed chest retraction and a whimpering cry from birth. Given penicillin prophylactically for the first 5 days. Four days later developed pneumonia (which was diagnosed clinically) and penicillin was re-commenced. Died 5 days later.

Lived for 14 days.

Post-mortem findings:

Weight 2490 gms.

Macroscopic: The left lower lobe was more or less solid and red. In the upper lobe this was less marked and in the right lung the appearances were more those of congestion.

Microscopic: Section through the lungs show that there are still areas of atalectasis. The alveolar capillaries show enormous congestion.

Most of the alveoli, alveolar ducts and occasional bronchioles are filled by masses of leucocytes and a finely granular material, somet -imes in strands, which appears to be fibrin mixed with cellular break- down products from epithelial cells which partly form the intra-alveolar masses. Many of the leucocytes are not obviously lobed forms and often are fragmented.

———————————————

CASE 24.   Age 38.   Para 4.   Grav. 4.   36 weeks.
                 Antenatal patient.

Summary of clinical notes:

        Mother said to have had syphilis. Breech delivery under chloroform anaesthesia.

        Babe showed slight generalised oedema and had occasional cyanotic attacks. General progress was not satisfactory. On the twelfth day it was suspected of having pneumonia and given penicillin but died two days later.

        Lived for 14 days.

Post-mortem findings:

Weight: 1700 gms.

Macroscopic: Extensive patchy consolidation was found mainly in the right lung and in the lower lobe of the left.

Microscopic: Sections through the lungs show that many of the alveoli are over-distended while others appear collapsed or in the foetal pos- ition. Some of the interstitial tissues are widened and contain dense infiltrations of small round cells. In some of the more collapsed areas many alveoli contain masses of cells with abundant cytoplasm and small, more or less, round nuclei most of which have an open chromatin network structure. In places these appear to be large mononuclear cells and

in others they have more the appearance of clumps of desquamated epithelial cells from the alveolar portion of the lung.

CASE 49.   Age 39.   Para 7.   Grav. 7.   38 weeks.
                Emergency admission

Summary of clinical notes:

Toxaemic hypertension. Given three weeks bed rest and routine conservative treatment. No elevation of temperature. External cephalic version performed and the membranes ruptured artificially. Labour commenced 60 hours later and lasted 3 hours. Normal vertex delivery under chloroform anaesthesia

Babe given a prophylactic course of penicillin. Its condition was poor and it deteriorated rapidly on the last day and died.

Lived for 10 days.

Post-mortem findings:

Weight: 3470 gms.

Macroscopic: The lungs were congested and felt patchily indurated.

Microscopic: Section through the lungs show that they are mostly well expanded but, in one large area in one particularly, somewhat compressed. The interstitial tissues are wider than normal, congested, and uniformly throughout show infiltrations by small round cells. Except for a few red cells in some areas, the alveoli are free from cellular or other material.

CASE 99.   Age 35.   Para. 2.   Grav. 2.   34 weeks.
                Antenatal patient.

Illustrations to CASE 49.

FIG. 54

Some of the alveoli and alveolar ducts are filled by
a cellular exudate in which polymorphonuclear forms are pres-
ent but do not predominate.   (x 100).

FIG. 55

An alveolar duct containing red cells and large monon-
uclear cells, some of which appear to be desquamated epi-
thelial cells. (x 400).
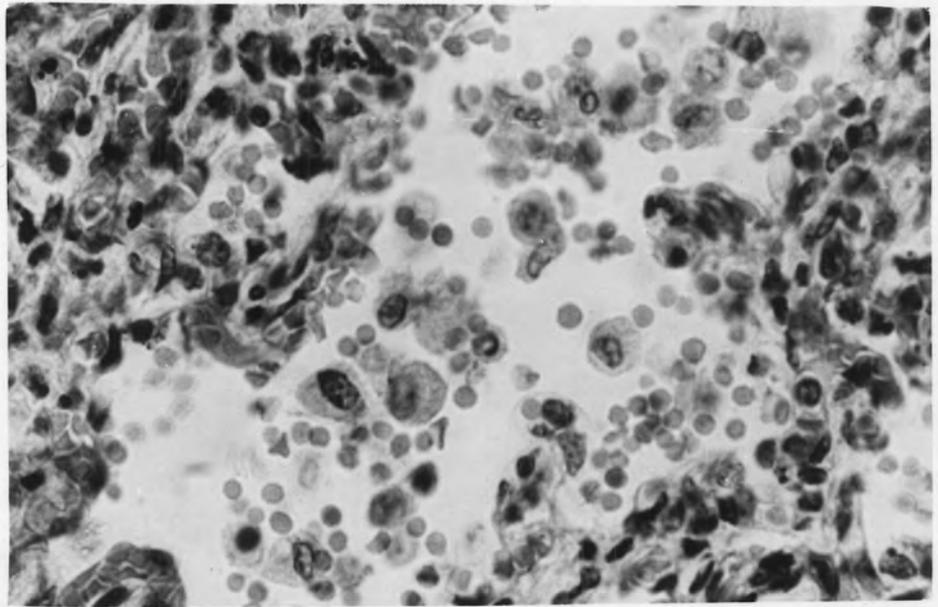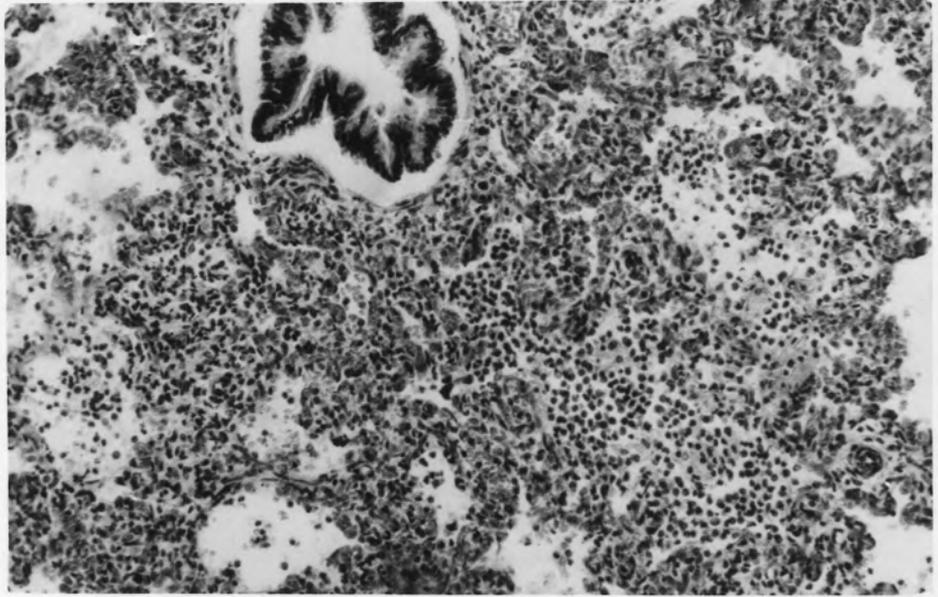
Illustrations to CASE 99.

FIG. 56.

The alveolar septa are widened from immaturity, con-
gestion and infiltration by small round inflammatory cells.
(x 100).

FIG. 57.

The same under higher power showing occasional in-
flammatory cells. (x 400).
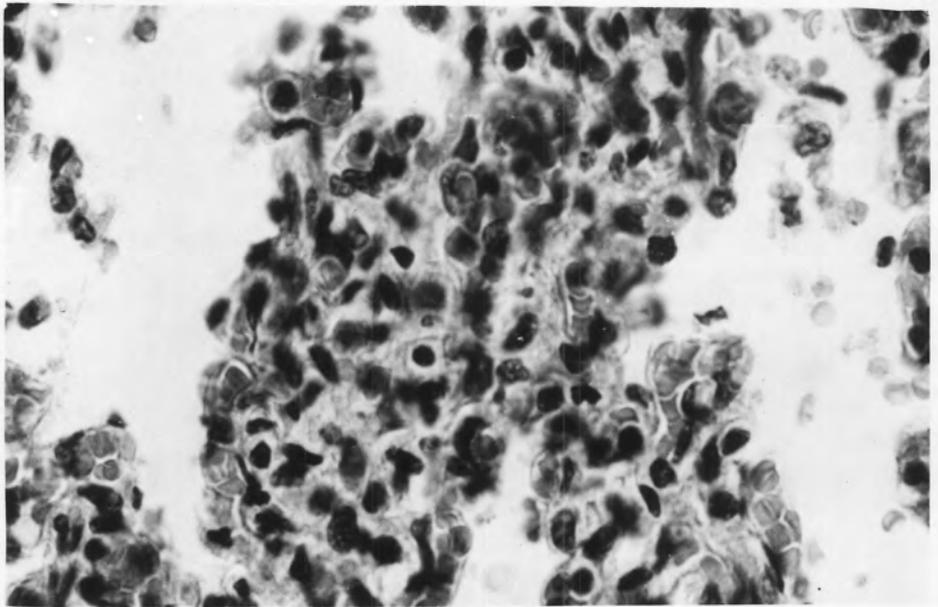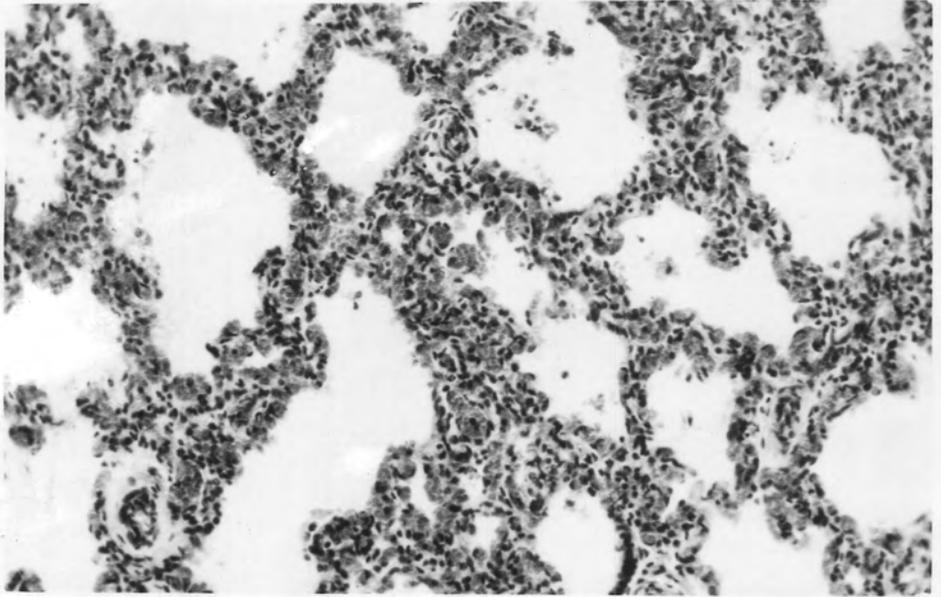
FIG. 58.

Showing red cells in the
alveoli. (x 100).

FIG. 59.

The peculiar basophilic masses
of compressed and degenerating bron-
chiolar epithelial cells.
(x 100).

FIG. 60

A mass of desquamated alveolar epithelial
cells lying in a bronchiole. (x 400).
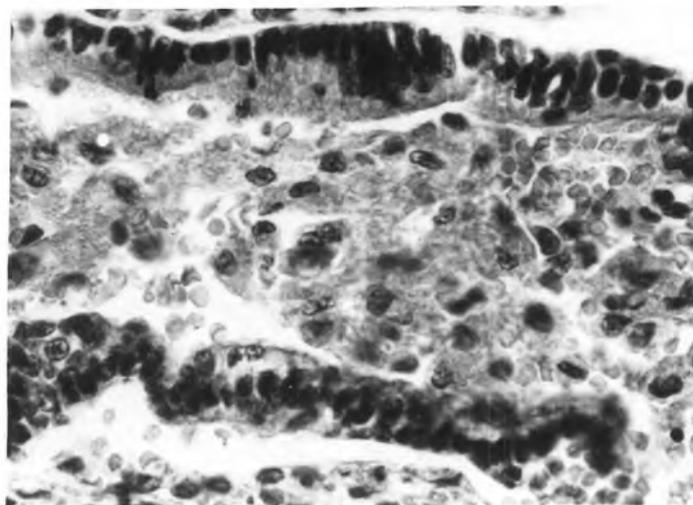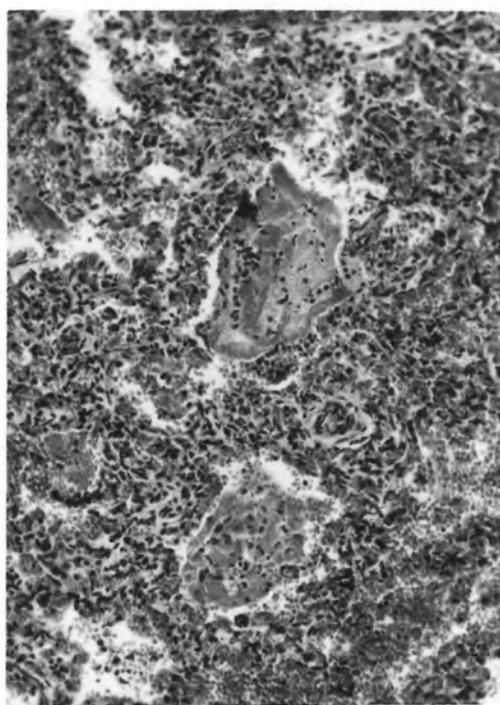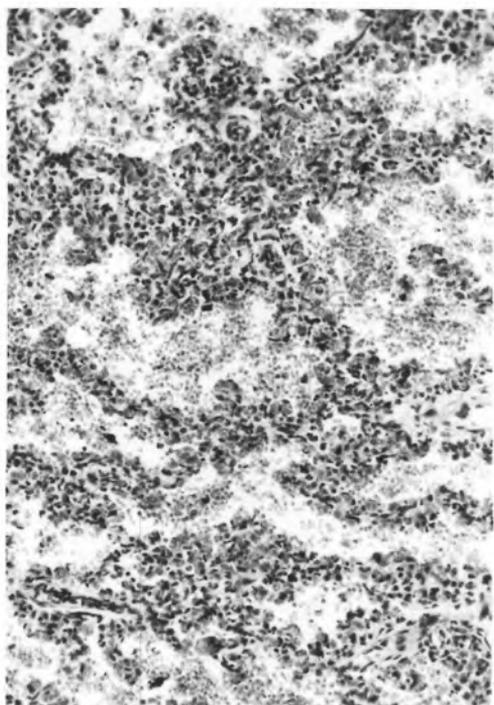
Summary of clinical notes:

Small ante-partum haemorrhage, membranes were ruptured for six hours. Normal labour and delivery followed.

Babe well for 8 days and then developed signs of an over-whelming pneumonia. Given penicillin and streptomycin but died on the following day.

Lived for 9 days.

Post-mortem findings:

Weight: 2280 gms.

Macroscopic: The lungs showed congestion and patchy consolidation mainly in the lower lobes.

Microscopic: Sections through the lungs show widespread congestion and occasional areas in which many alveoli are stuffed with red cells. The interstitial tissues show scattered infiltrations by small round cells and scattered alveoli contain large mononuclear cells. A few alveoli in the haemorrhagic areas contain basophilic masses of de-generated epithelial cells (possibly of bronchial origin and not re-sembling epidermal particles) which have mostly lost their nuclei. A few leucocytes are mixed in these masses.

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CASE 116.   Age 23.   Para 1.   Grav. 1.   30 weeks.
                Antenatal patient.

Summary of clinical notes:

Mother syphilitic. Given a course of 1,560,000 units of penicillin during the week before delivery. Labour 4 hours, nor-mal delivery without anaesthetic.

Babe given 1000,000 units of distiquaine daily for 10 days. Condition continued to be poor from birth. Stools became

Illustrations to CASE 116.

FIG. 61.

Masses of basophilic cellular debris (probably of
bronchiolar origin) lying in alveoli. In one of these
there are inflammatory cells partly surrounding the
material.   (x 100).

FIG. 62.

Showing greater detail in the inflammatory cells,
which are mostly unlobed. (x 400).
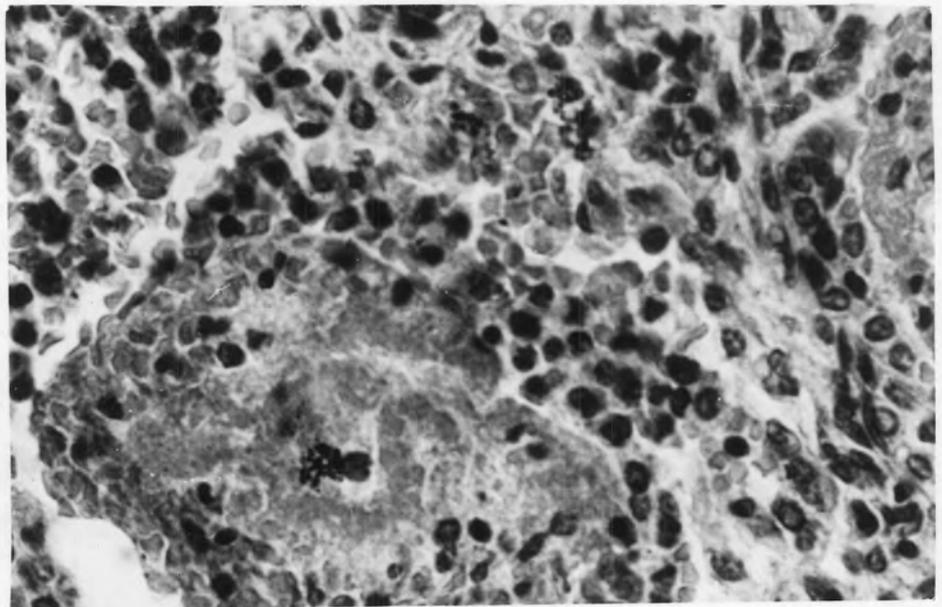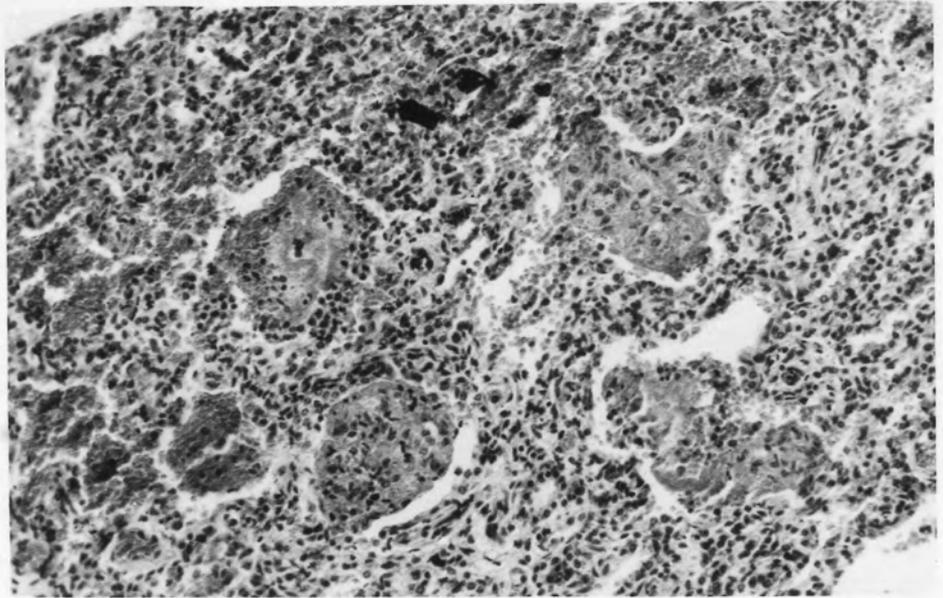
pale on the 13th day. Thought to have hepatitis. Then given penicillin, aureomycin and streptomycin. A swab from the nose showed the presence of staph. pyogenes, B. coli and a few non-haemolytic streptococci. Haemoglobin 10.5 gm.%. Died 8 days later.

Lived 22 days.

Post-mortem findings:

Weight:　1120 gms.

Macroscopic: The lungs showed patchy congestion throughout. (No macroscopic or microscopic evidence in liver and bones of congenital syphilis.)

Microscopic: Sections through the lungs show that many alveoli are over-distended and in a few places groups are stuffed with red cells. The interstitial tissues are wide and in places throughout contain small round cell infiltrations. A few alveoli contain almost homogeneous fibrinous material and others masses of epithelial debris which appears to be of bronchial origin.

CASE 153.　　Age 27.　Para 3.　Grav. 6.　26 weeks.
　　　　　　　Emergency admission.

Summary of clinical notes:

Admitted as an inevitable abortion, os dilated ¾. Foetus expelled in 2 hours without anaesthetic.

Babe apparently quite well until it developed recurrent cyanotic attacks on the 11th day and died.

Lived for 11 days.

Post-mortem findings:

Weight:　　950 gms.

Microscopic: Sections through the very immature lungs show that, in many areas, the alveoli are collapsed and the large vessels appear congested.   Fine round cell infiltrations are scattered widely in the interstitial tissues.

CASE 181.   (Maternal details unknown)

Summary of clinical notes:

Watery vaginal discharge 5 days before delivery.   Membranes ruptured 9 hours.   A swab from the cervix showed the presence of anaerobic streptococci and Gram negative bacilli.   Breech delivery.

Babe given 20 mgm. streptomycin 6 hourly from the first day.   Cyanotic attack occurred on the 21st day.

Lived for 26 days.

Post-mortem findings:

Weight: 1350 gms.

Macroscopic: The lungs showed dark congestion of the lower lobes.

Microscopic: Section through the lungs show alternating areas of atalectasis and emphysema.   The alveoli contain particles of aspirated material.   Inflammatory cells are more or less widespread in the interstitial tissues.

CASE 182.   Age 29.   Para 1.   Grav. 1.   32 weeks.
            Antenatal patient.

Summary of clinical notes:

Mother had attended the Sterility Clinic. Came into spontaneous premature labour, lasted 5 hours (membranes ruptured 4 hours). Vertex delivery without anaesthetic.

Babe's condition satisfactory until the fifth day when it became cyanosed and jaundiced. Cyanotic attacks followed. Given 40 mgm. streptomycin twice daily and aureomycin. Large fluid bowel action on 8th day. Isolated. Vomiting. Condition deteriorated on the ninth day and died. Lung puncture performed. No organism isolated.

Lived for 9 days.

Post-mortem findings:

Weight: 1900 gms.

Macroscopic: The lungs showed extensive patchy congestion of all lobes with induration at the bases.

Microscopic: Sections through lungs show alternating areas of atalectasis and emphysema. Many of the alveoli are filled by red cells and occasional ones contain masses of inflammatory cells. There are fairly extensive round cell infiltrations in the interstitial tissues.

CASE 216.   Age 42.   Para 2.   Grav. 2.   32 weeks.

Antenatal patient.

Summary of clinical notes:

Mother syphilitic (Wassermann, Kline positive). Admitted for penicillin and N.A.B. course. On the ninth day came into spontaneous premature labour.

Babe's hands and feet peeled. Given 150,000 units of penicillin daily from birth. Condition poor throughout. Numerous

Illustrations to CASE 216.

FIG. 63.

Showing the solid appearance of the lung and over-
distended alveoli.   (x 25).

FIG. 64.

The densely cellular inflammatory exudate in which
there are some lobed and degenerating leucocytes.
(x 100).
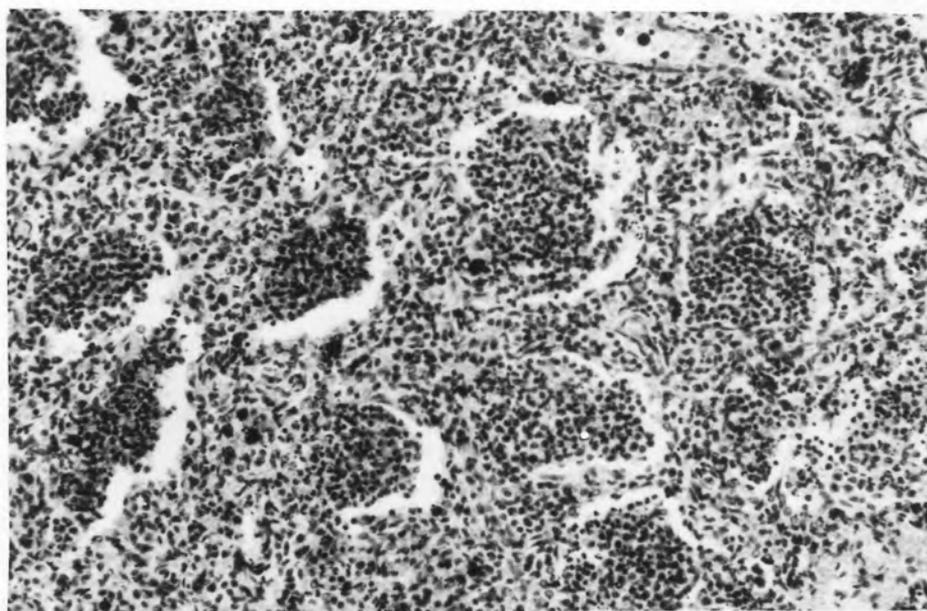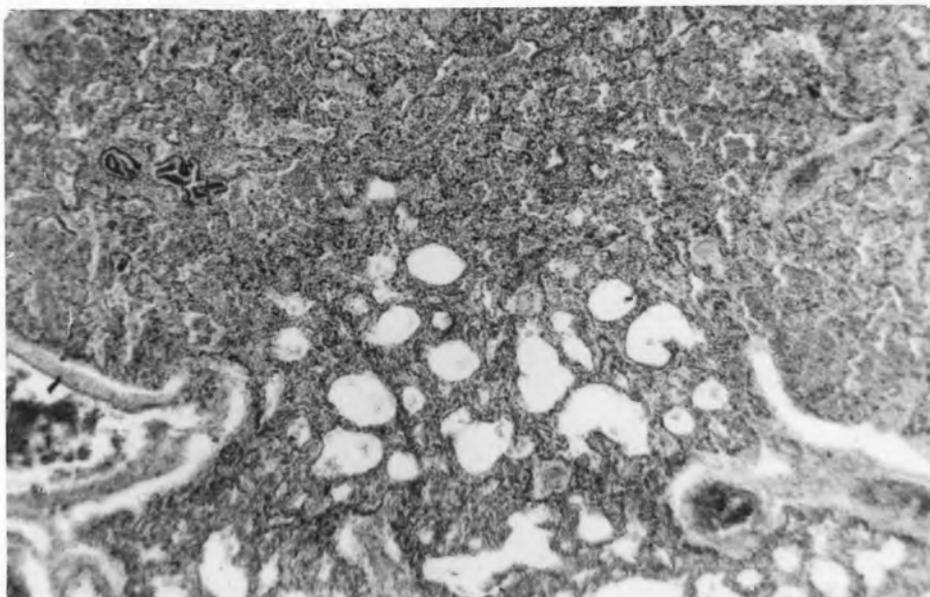
cyanotic attacks. Stools pale and bulky for one day.

Lived for 11 days.

Post-mortem findings:

Weight: 1170 gms.

Macroscopic: Some bruising of the tentorium cerebelli on both sides.
Infected hydrocoele of the right testis, the pus from which yielded
a pure growth of B. coli. The lungs showed congestion in their post-
erior portions. (There was no macroscopic or microscopic evidence in
liver and bones of syphilis.)

Microscopic: Sections through the lungs show that they have an al-
most solid appearance. Occasional alveoli are somewhat over-distended.
The solid appearance is due to the presence of densely cellular pus
in the alveoli, alveolar ducts and bronchioles. The cells making up
exudate are often polymorphonuclears in the band and early lobed stages.
There are scattered desquamated epithelial cells in the alveoli and
an occasional cornified particle.

———————————

CASE 271.   Age 35.   Para 1.   Grav. 3.   30 weeks.

Emergency admission.

Summary of clinical notes:

Normal delivery of twins. This one, the first, a vertex
delivery after a 6 hour labour.

Respirations established in 2 - 3 minutes after birth.
Recurrent cyanotic attacks occurred daily.

Lived for 12 days.

Post-mortem findings:

Weight: 1140 gms.

Illustrations to CASE 271.

FIG. 65.

Showing detail of the leucocytes. While polymorphon-
uclears are present, they do not dominate the picture.
(x 400)

FIG. 66.

The same.
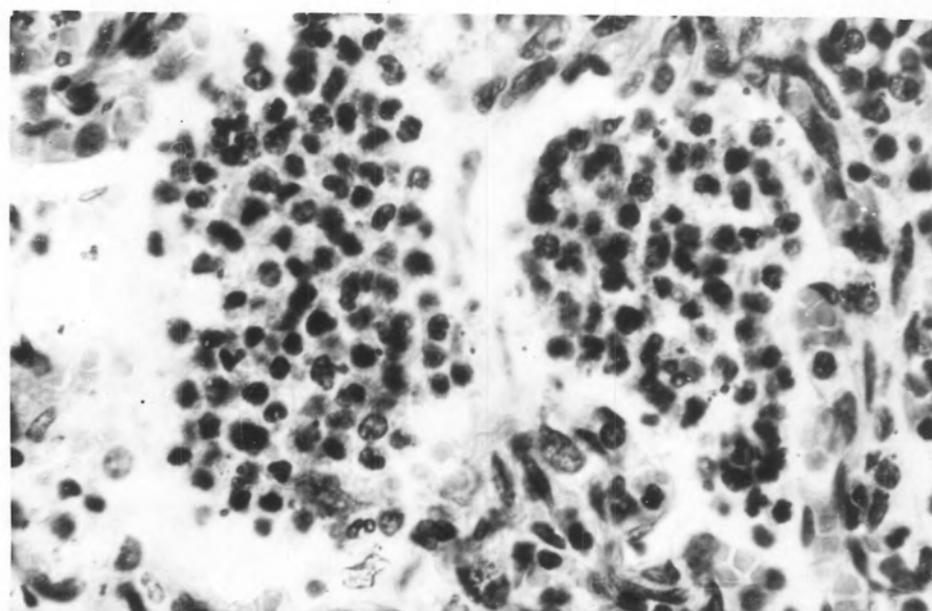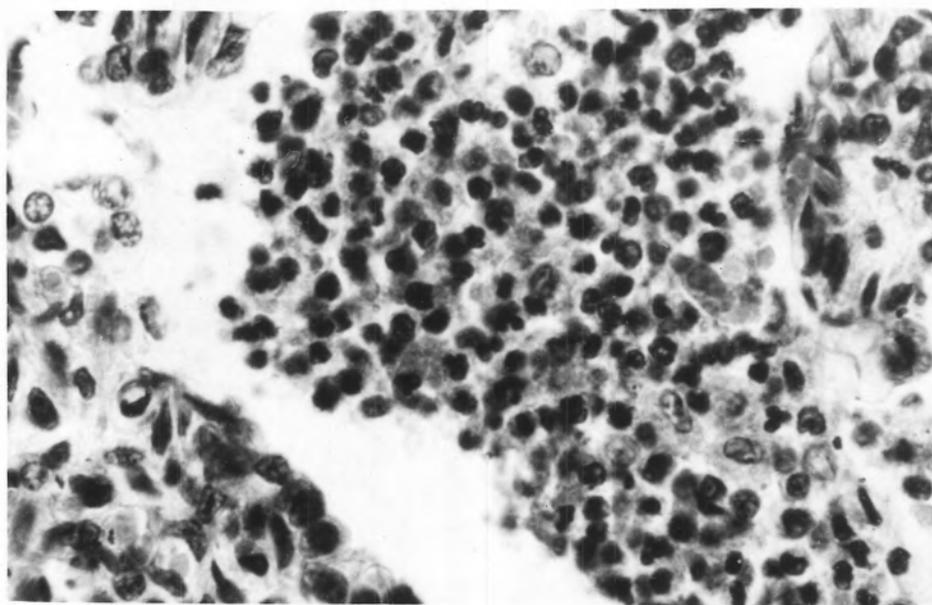
<u>Macroscopic</u>:   A common arterial trunk arose from the ventricles.
(The specimen was inadvertently discarded before dissection.)   The
lungs showed congestion throughout and were slightly indurated in
a patchy fashion.

<u>Microscopic</u>:   Sections through the lungs show that they are almost
solid.   The immature interstitial tissues are widened and congested.
The alveoli, alveolar ducts and occasional bronchioles are filled by
densely cellular exudate consisting mainly of polymorphonuclears in
early lobed stages.

        Summarising these findings in ten cases of neo-natal
pneumonia in which the infants lived more than seven days from birth,
all but one (CASE 49) were premature.   Mostly they were very pre-
mature, the average weight over-all being 1750 gms.   In four of the
cases some areas of atalectasis were still present, associated with
moderate degrees of surrounding emphysema.   Aspirated material was
found in two cases in the form of cornified epidermal particles.
In two cases there were masses of degenerating columnar epithelial
cells probably derived from bronchioles.   Mononuclear cells were
the main constituents of the inflammatory exudate in the alveoli in
two cases.   The exact origin of these is uncertain but they have all
the appearances of being large mononuclear inflammatory cells although
in some places they resemble the lining cells of the alveoli.

        Leucocytes were present in the alveoli in seven
cases and in the interstitial tissues in six.   There was a definite
tendency for the intra-alveolar cells to be mainly un-lobed forms,
although they were often in the band and two lobed stages; and for

the interstitial cells to be mainly of the round cell type. Actual amorphous exudate material supporting the inflammatory cells, apparently of fibrinous nature, was present in two cases. In the two cases in which basophilic masses were present there were occasional leucocytes mixed in these structures.

Sections were stained for organisms in three of the cases showing leucocytes in the alveoli (CASES 182, 216 and 271). Organisms were found only in CASE 216. It will be recalled that this was a premature baby whose mother had syphilis and that it had an infected hydrocoele of the right testis which yielded a pure growth of B. coli on culture. The organisms in the lung were pleomorphic bacilli with a marked tendency to barred staining of their cytoplasm and these possibly are also B. coli.

Certain differences exist between the lesions seen in these neo-natal cases and those seen in the congenital pneumonia cases. The obvious marked expansion of the lungs in most areas and the absence of masses of aspirated material are the most outstanding differences. The presence of interstitial infiltrations is a feature common to both but in the neo-natal cases these lesions occur in the walls of expanded alveoli and are not inrelation to deposits of material in the alveoli; such as the masses of cornified material seen in the congenital type of pneumonia.

The leucocytes in the alveoli in the neo-natal cases are much less markedly lobed than those in the congenital cases but, it must be noted, all but one of the former group are grossly premature. However in more premature foetuses in the congenital group there were often markedly lobed leucocytes in the alveoli. Inflammatory exudate was mostly absent in the congenital group but present, to quite some extent, in two of the neo-natal cases with cells in the alveoli.

CONCLUSIONS

(1)   In a series of 302 autopsies on stillborn foetuses and live-
born infants, inflammatory cells were found in the lungs in
54 cases. Seventeen per cent. thus showed pneumonia.

(2)   To study the lesions which arose in the uterus or during
birth, the lungs of stillborn foetuses and of infants
dying within six hours of birth were examined microscop-
ically. Twenty-eight cases in these two groups showed
inflammatory cells or infiltrations in the lungs. In
twenty-six, these changes can be described as congenital
pneumonia. Sixteen, of the twenty-eight cases, were
stillborn and twelve liveborn. Of the sixteen stillborn
cases, two are regarded as being doubtful cases of pneumonia
but in the other fourteen there were certain evidences of
a foetal pulmonary inflammation.

(3)   The sixteen stillborn cases, including the two doubtful
ones, were among the 172 stillbirths in the twelve-month
period described. Taking the fourteen cases of certain
pneumonia, the occurrence of congenital pneumonia is 8.1%
of stillbirths in this series. Nine of the fourteen cases
weighed more than 2500 gms.

(4)   Twelve of the neo-natal cases dying within six hours of
birth showed pneumonia which is regarded as congenital.
One of these cases was sent by an outside doctor. Thus,
out of 110 neo-natal cases examined from the Women's Hospit-
al, eleven (10%) died within six hours of birth and showed
inflammatory changes in the lungs of congenital origin. In one
of the eleven the lesions were actually only in bronchi.

Only three of these weighed more than 2500 gms.

(5)   The most certain evidence of foetal pulmonary inflammation
       is the presence of cellular infiltrations in the interstit-
       ial tissues. These were present, in varying degrees, in
       twelve of the stillborn cases and in all twelve liveborn
       cases. Such infiltrations occur either as scattered single
       cells or as small clusters of cells.

(6)   Interstitial infiltrations of inflammatory cells sometimes
       occur, as quite characteristic lesions, outside bronchioles.
       These were seen in seven cases, six of which were premature.

(7)   Leucocytes were present in the alveoli in twenty-three cases;
       in five of these the cellular concentration was minimal. It
       has been impossible to determine whether the origin of these
       cells is actually foetal or whether some of them, like the
       cornified epidermal particles, are aspirated. Out of 15
       stillborn cases showing leucocytes in the alveoli some reason-
       able doubt exists in six that the cells are of local origin.
       Out of eight of the liveborn cases, doubt exists in three.

(8)   Evidences of an asphyxial type of death were found in the
       lungs of sixteen of the stillborn cases. In eight cases there
       were haemorrhages into the interstitial tissues or alveoli and
       in thirteen the alveolar capillaries or larger vessels showed
       congestion.

(9)   Peculiar necrotic changes in bronchiolar epithelial cells,
       most probably due to some noxious substance, which also causes
       inflammatory changes, were found in two of the liveborn cases.

(10)   Seven of the stillborn cases showed an associated degen-
         erative change in the alveolar epithelial cells. This
         change consists firstly, in vacuolation of the cytoplasm
         to be followed later by desquamation of the cell, the
         cytoplasm of which subsequently becomes granular. These
         are well known results of maceration changes in the lung
         but would also appear, in some cases, to be caused by the
         same factors which cause inflammatory changes.

(11)   In all but four cases, aspirated epidermal particles
         were present in the lungs showing inflammatory changes.

(12)   Congenital pneumonia is held to be due to aspiration
         of some noxious substance in the uterus or birth canal.
         In two cases, there seemed to be the possibility that
         the lesions may have arisen as a result of blood stream
         infection; but the evidence is only in the types and dis-
         tributions of the lesions.

(13)   Bacteriological investigations by staining sections of
         the lungs for organisms were considered unsatisfactory
         but organisms were found in the inflammatory exudate
         in one case which showed early maceration changes.

(14)   Prolonged rupture of the membranes was a significant
         associated feature in the stillborn cases and this applied
         particularly in foetuses weighing over 2500 gms. in which
         group the average duration was 65 hours. In the liveborn
         group the times were not accurately known but were mostly
         short. In one case the duration was 168 hours.

(15)   There were otherwise no constantly associated abnormal

obstetrical conditions but in twelve of the sixteen still-
born cases showing inflammatory cells, labour was abnormal.
Eight of these were long labours, mostly with a long dur-
ation of rupture of the membranes.

(16)   In the liveborn group, long labour is not a prominent
associated abnormal obstetrical condition. It was present
in one case. Mostly, with a short duration of rupture
of the membranes, premature birth was the principal ab-
normality. This was due, in four cases, to accidental
haemorrhage; in one, to interference; in one, to severe
anaemia; in one, to spontaneous premature labour, and
in another there was a history of repeated miscarriages.
In only one case was there evidence of maternal infection
in this group. This is emphasised because of the absence,
in some of the liveborn group, of the abnormal obstetrical
conditions which characterised most of the stillborn cases.

(17)   It is difficult to compare figures in this series with
others to ascertain the effect of chemotherapeutic drugs
on the incidence of congenitally acquired pneumonia. In
some series the incidence of pulmonary infection in still-
born or recently born liveborn cases has been acurrately
stated: Hook and Katz (50%), Kaldor (30%), possibly all
congenital, Warwick (7.5%), Macgregor (13%), Benner (26%)
and Helwig (less than 7%).

In this series 8.5% showed certain evidences of congenital
pneumonia. Penicillin and sulpha drugs (or penicillin alone)
were given to the mother before and/or during labour in
fourteen of the twenty-eight cases which showed pneumonia
subsequently in the foetal or infantile lungs.

While the figure of 8.5 is lower than some, it is not significantly different from the figures quoted by Helwig (1933) and Warwick (1934).

(18)   The incidence of congenital pneumonia is not higher in foetuses with other gross abnormalities. Only one of the stillborn congenitally malformed foetuses (out of fifteen) showed pulmonary inflammation. Five of the congenital pneumonia cases showed evidence of intra-cranial injury.

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ACKNOWLEDGEMENTS

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APPENDICES

A SUMMARY OF THE FINDINGS IN FIFTY-SEVEN CASES IN

WHICH THERE WAS EVIDENCE OF INTRA-CRANIAL INJURY.

As far as is possible from the post-mortem records made at the time (which leave a few of the lesions un-classified) the following is a list of the various evidences of cerebral damage occurring either before or during birth:

Tearing of the tentorium cerebelli	19
- unilateral	11
- bilateral	8
Tear at the posterior end of the falx cerebri	1
Bruising of the tentorium cerebelli at the site where tearing usually occurs.	3
Free blood around the brain or cerebellum	14
- above the tentorium	8
- below the tentorium	6
Subarachnoid haemorrhage	3
Sub-dural haemorrhage	3
Intra-cerebral haemorrhage	1
Intra-ventricular haemorrhage	15
Kernicterus	4

Of the cases which make up the lesions listed above 23 were at full-term and 37 premature. In this latter group intra-ventricular haemorrhage was the outstanding lesion. Fifteen only of the fifty-seven were stillborn and in four of these there were pneumonic lesions in the lungs.

Although delivery was normal in thirty-one cases there was some abnormal condition of the mother (general or obstetrical) in forty-eight. These included hypertension, pre-eclampsia, accidental haemorrhage and premature spontaneous labour as the commonest conditions.

In 23 cases of abnormal delivery, forceps extract
-ion was used in ten instances of which one was a difficult high app
-lication, one was by the use of Kieland's rotating forceps and one
was to extract the after-coming head in a breech delivery. Twelve
were breech deliveries and another was delivered by a lower uterine
segment Caesarean section operation. Precipitate labour occurred in
one.

In 17 out of the 42 live-born babies there were
cerebral signs present either immediately after birth or later.
These included slowness in establishing respiration, pallor, cyanosis,
cerebral cry at birth; and repeated cyanotic attacks, disordered res
-piratory function, drowsiness, head retraction and general unsatisfact-
ory progress later in the neo-natal period.

Tearing of the tentorium cerebelli was the commonest
of all lesions, occurring in 19 cases. Bruising of this structure
was found in another four. Eight of these twenty-three cases of ten-
torial damage were stillborn. Of the live-born cases (15) eleven had
signs referable to cerebral damage. Free blood was present above the
tentorium in 7 cases and below in 4, and of these 11 cases (of which
three were stillborn) 6 had cerebral signs. From an analysis of these
figures it will be seen that, while intra-cranial haemorrhage is
more commonly present in those cases of tentorial injury which have
cerebral signs during life, a finding of free blood in the skull is
not absolutely necessary to establish that the tentorial lesion is
an indication of cerebral trauma.

A SUMMARY OF THE FINDINGS IN TWENTY-FOUR CASES
WHICH SHOWED CONGENITALLY MALFORMED STRUCTURES.

Twenty-four cases in this series showed congenital abnormalities, fifteen were stillborn. Anencephaly was the commonest abnormality found, being present in nine of the cases. It was occasionally associated with other abnormal findings, apart from those of deficient suprarenal tissue and small lungs (which findings were, more or less, invariable). In one case, there was an associated exomphalos in a stillborn premature foetus. In another, the testes were undescended and the penis rudimentary. Two others were twins, one weighed 380 gms., the other 1060. The latter lived five minutes and the former was stillborn.

Two cases were hydrocephalic monsters, both at full-term. One was delivered after perforation of the skull. The membranes had been ruptured for 96 hours but no section was taken of the lungs. The other also showed mild changes described as "Leuken-schadel" on X-ray of the skull and had an associated spina bifida. It was stillborn and delivered as a breech. This latter is CASE 247, which showed inflammatory lesions in the interstitial tissues of the lungs and large cellular casts in the bronchi.

Seven cases showed abnormalities in the renal tract. These included two cases in which the kidneys and ureters were absent, two cases in which one or both kidneys were at the level of the pelvic brim, one case in which the left kidney was polycystic, one case in which there were gross genito-urinary abnormalities in a stillborn female foetus weighing 2460 gms. and one case of symmetric-al horse-shoe kidney.

Abnormalities of the gut were seen in three. One an exomphalos, already mentioned, in association with anencephaly.

One was a case of imperforate anus with a misplaced kidney. The third, which lived five days, was a case of duodenal artresia (at the level of the third part of the duodenum). The lungs showed much aspirated material and pneumonia.

Three cases show abnormalities in the heart and great vessels. One showed the changes of a pure Fallot's Tetrology (lived 45 hours). One showed ventricles which were separated by an incisura 0.7 cms. long at their apices and the third, which was lost for dissection, showed gross abnormality in the origins of the great vessels.

Two showed talipes and one of these had multiple abnormalities of the limbs including supernumerary digits on the hands.

Five cases showed abnormalities in the lungs. Three of these were examples of gross underdevelopment of the organs which otherwise appeared normal and one showed cystic spaces at the sides of vessels microcopically. In one case the left lung was imperfectly divided into lobes, the inter-lobar fissure being represented by a shallow groove on the lateral surface.

One case showed typical mild mongoloid features. It was the case with Fallot's Tetralogy.

A SUMMARY OF THE ASSOCIATED CONDITIONS IN SEVENTY-
THREE CASES IN WHICH MACERATION CHANGES WERE
PRESENT.

  The duration of death in utero in these cases
varied between 17 hours and six weeks. In one case which showed
the mildest changes the foetal heart was said to have heard just
before delivery. Excluding 33 cases in which the duration of foe-
tal death was not certain the maximum incidence (in the arbitrary
groupings below) was between 7 and 28 days. The numbers in the
various time interval groups were as follows:-

Less than two days	9
Between two and seven days	11
Between seven and twenty-eight days	14
More than twenty-eight days	6
Unknown	33
Total	73

  Of the seventy-three stillborn foetuses 32
weighed more than 2500 gms.

  Associated findings, either separately or
in combination, were as follows:-

Parental Rh incompatibility	14
Hypertension	20
Accidental haemorrhage	10
-with hypertension	2
-without hypertension	3
-with toxaemia	5
Toxaemia	16
Hydramnios	7
Diabetes	4
Syphilis	2
Severe anaemia	2
Malpresentation causing difficult labour	5
Breech presentation	11
Twin pregnancy	4