OTITIS MEDIA AND MASTOIDITIS IN INFANCY.

A Thesis

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By

EDWARD C. ROSS COUPER,

M.B., Ch.B., F.R.F.P.S.

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ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 – 1346

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I. INTRODUCTION.

The problem of the "diarrhoea and vomiting syndrome" in infancy is one which has interested paediatricians for many years. The striking clinical picture, the definite seasonal incidence and the more or less complete failure to find a satisfactory bacteriological explanation make the problem one of peculiar fascination, while the high mortality rate and the unsatisfactory therapeutic results render it one of the utmost importance in paediatrics.

Of recent years, particularly on the Continent and in America, the conception has gained ground that a certain proportion of such cases, variously described as "diarrhoea and vomiting syndrome","cholera infantum", or "alimentary intoxication" may be due to a source of infection (parenteral) in the naso-pharynx, nasal accessory sinuses, middle ears or mastoid antra, special stress being laid on the middle ears and mastoid antra. It is suggested in addition that mastoiditis does not manifest itself with the classical picture so well recognised in the older child or adult, but remains "latent", thereby causing difficulty in diagnosis and treatment.

The present thesis is an attempt to assess:-

(1) the part played by otitis media and mastoiditis in the high morbidity and mortality rates of infancy;

(2) the value of certain methods of investigation;

(3) the value of treatment, operative and non-operative.

It is based upon an investigation of fifty infants under the age of one year suffering with an illness characterised by otitis media (sometimes with mastoiditis) and varying degrees of diarrhoea and vomiting.

II. SURVEY OF LITERATURE

In the year 1690 some years after the death of Sir Thomas Browne (Ref. 1) his "Letter to a Friend" was published. In it he quoted a certain Omnibonus Ferarius who "in Mortal Dysenteries of Children looks for a Spot behind the Ear". What exactly is meant by this is not explained, but it would indeed be interesting if this early observer had been nearer the truth than he imagined.

1897.

The earliest available reference to this subject is by Ponfick (Ref. 2) of Breslau who first made observations on his own children, some of whom developed gastro-intestinal upset, accompanied by diarrhoea which only ceased when oto-rrhoea began. He then analysed 100 post-mortems on children up to the age of four years, 75 per cent. of whom were under one year. These children had suffered during life from a great variety of illnesses and he found that 77 per cent. had bilateral otitis media, 14 per cent. unilateral and only 9 per cent. had uninfected middle ears. A great proportion of these children suffered from gastro-enteritis, and he came

to the conclusion that the gastro-enteritic symptoms were secondary due to toxic absorption from their infected middle ears. He commented upon the infrequency of spontaneous perforation, the percentage being less than five of all the tympanic cavities involved. He called attention to the fact that a tympanic perforation closes very readily with recurrence of the symptoms and described how the Eustachian tube becomes blocked by inflammatory swelling precluding drainage by that route. Staphylococcus albus and aureus and streptococci were the commonest organisms found.

1898.

In 1898 Hartman of Berlin (Ref. 3) published an article in which he drew the following conclusions:

(1) Acute feverish otitis causes loss of weight or standstill.

(2) Otitis with serious general symptoms can probably also cause diarrhoea.

(3) Acute feverish otitis in the course of intestinal disease can increase the symptoms of a general nature, and, by diminution of the resistance, can worsen the intestinal disease, cause recurrence, or simply delay recovery.

(4) Whether a slow otitis - only discoverable otoscopically - explains a classic atrophy must be determined by further investigations.

He described numerous cases of varying severity with diarrhoea and vomiting in whom paracentesis with release of pus caused improvement and cure, and dealt at length with methods and difficulties of diagnosis.

1904.

In 1904 Barbillion (Ref. 4) stated that "a great number of morbid states considered as primary infections of the digestive tract and treated as such are only septic naso-pharyngo-otitic infections, not obvious during life, which are revealed at autopsy". He also commented upon the frequency of such infections stating that their presence is the rule in infants who die and their absence exceptional. He considered the dyspeptic and general phenomena secondary, and while they could be rapidly fatal they could also subside and become cured with or without tympanic perforation and otorrhoea. His bacteriological investigations frequently revealed the presence of streptococci or a mixed growth of streptococci and staphylococci.

1910.

Gruning (Ref. 5) in 1910 stated that "those ear diseases which announce their arrival with great pain, high fever, perforation of the drum are readily recognised and cared for, while those insidious cases in which the pus remains in the tympanic cavity and either acts through the blood or infects the respiratory or gastro-intestinal tract, remain unrecognised and therefore do infinitely more harm".

Whiting (Ref. 6) emphasised the fact that infants develop temperatures very easily and often without obvious

cause and suggested that "the same rules governing the appearance of local inflammatory evidence in adults may, with equal safety be insisted upon in infants". He held the view that owing to the softness of the infantile bone, pus in the mastoid antrum readily demonstrates its presence by the development of periostitis and subperiosteal abscess, and advocated waiting until such signs appear before operating. Where good drainage had been established by myringotomy he advised waiting in spite of high temperatures. White blood counts were found to vary so much as to be almost valueless. Blood cultures were of assistance in cases of suspected sinus phlebitis. This author made no mention of the "latent" type of mastoiditis and its possible relation to the "diarrhoea and vomiting syndrome."

1917.

In 1917 Comby (Ref. 7) noted the frequency and latency of otitis media in infancy and suggested that a great number of morbid states considered as primary, e.g. disturbances of gastro-intestinal tract, infections of respiratory tract and meninges were often secondary to oto-naso-pharyngeal infection. He stressed the difficulties of diagnosis and advocated myringotomy in the absence of definite local signs in all doubtful cases. He believed that if the course of the illness does not allow of another explanation for the persistence of a septicaemic febrile state the ear ought to be held responsible.

1918.

Byfield (Ref. 8) in 1918 stated that infection of the accessory nasal sinuses is greater than has hitherto been suspected and observed it in a great variety of conditions, e.g. chronic digestive disturbance, persistent cough, occult temperatures, poor general health, etc. Elsewhere (Abt's Pediatrics (Ref. 9) he mentioned the relationship with gastro-enteritic disturbances and quoted six cases which were drained and recovered.

1921.

A much quoted paper is that by Maurice Renaud (Ref. 10) which appeared in 1921. This author described 70 autopsies in which there was extensive suppuration in the cavities of the ear and mastoid antra amounting to an osteomyelitis. Thirty of these cases had been previously treated for otitis media while the remainder showed no evidence of otitis media during life. The clinical picture he described is that of a toxaemic state of varying severity with vomiting, green diarrhoea and rapid emaciation. His post-mortem findings in gastro-intestinal tract were negative, both microscopically and macroscopically, and the brain showed intense congestion and oedema with distended subarachnoid spaces and vessels. Haemorrhages were present into the meninges and one case showed septic thrombosis of the superior petrosal sinus. He maintained that the cerebral pathology explains the restlessness

and torpor. The mastoid infection was almost always bilateral and the drum-heads varied from an acutely inflamed state to an apparently normal appearance. He stated that the presence of pus in a closed cavity like the mastoid may lead to death, (1) by a rapidly fatal illness characterised by grave intoxication with a predominance of nervous or gastro-intestinal symptoms and (2) by a more slowly progressing illness characterised by progressive emaciation - athrepsia, similar to that produced by closed suppuration elsewhere, e.g. liver abscess, empyema, etc. In a second paper Renaud advocated myringotomy and mentioned staphlococcus and streptococcus as the commonest organisms isolated from the pus obtained. In a further 50 cases which he has observed, he noted otitis media at first examination, a fact which he regarded as proof that pus in the ear and mastoid antra accompanies the whole illness and is not a terminal accident. He regarded the condition as an extension of inflammation from the naso-pharynx. He described results of treatment in 47 cases of whom 32 died and 15 recovered. Thirty-six were treated with myringotomy only and 14 recovered, while 10 were treated first with myringotomy and then antrotomy, but only one recovered. Nearly all the latter group were in extremis. In spite of the poor operative results he still considers operation justifiable as a last resort, and the impression is created that he goes as far as to hold otitis media and mastoiditis responsible for the majority of infantile deaths.

1923.

In 1923 McDougall and Knauer (Ref. 11) described five atypical cases of mastoiditis occurring in older children which did not show the classical symptoms. These cases showed extreme emaciation and lethargy without mastoid tenderness and no history of previous ear trouble.

1924.

Smith (Ref. 12) in 1924 reported bacteriological findings in otitis media and in 50 cultures found haemolytic streptococci in 25, staphylococci aureus in 5, and B. coli in 4. Other organisms occurred in much smaller numbers. Of 613 cases 33.4 per cent. either had otitis media on admission to hospital or developed it later and the most susceptible period was between the ages of three and 15 months. In this group more than 50 per cent. had otitis media. He found that more than 50 per cent. of children with pneumonia, dysentery, nasal diphtheria, pertussis, etc. developed otitis media.

In the same year, Southby (Ref. 13) commented upon the frequency of otitis media in infants and young children without accompanying signs and symptoms reporting 50 autopsies in which otitis media was found in 33 cases (60 per cent.). He also commented upon the rarity of intra-cranial complications.

1925.

In 1925 Lyman and Alden (Ref. 14), who are convinced

that obscure infection in the mastoids can cause gastro-intestinal disturbance, reported 15 cases upon whom they operated with eight recoveries and seven deaths. Nine of these cases were bilateral and six unilateral. The deaths occurred among the younger babies who were in extremis, and their operation cultures showed streptococci 11 times, pneumococcci once, and three cultures were lost. They called attention to the soft meso-dermal embryonic tissue which fills the antrum, attic and upper portion of the middle ear at birth, and which, as the child grows, is gradually absorbed. They stated that swelling of this embryonic tissue which takes place very easily, separates the antral cavities from the middle ear with the result that the mastoid antrum cannot be adequately drained by myringotomy alone. They also described how the tympanic annulus is incomplete in its superior portion with the result that any accumulation of fluid in the antrum will show as a downward bulge of the membranous floor of the antrum or upper wall of the external auditory canal. On account of this anatomical peculiarity they recommended incision of the membranous floor of the antrum as well as the upper part of the tympanic membrane.

Also in 1925 Marriott (Refs. 15 & 16) pointed out "the apparent relationship between infection of a special type and the severe nutritional disturbances characterised by severe watery diarrhoea, prostration, rapid loss of weight, failure to retain fluid even when given in large amounts, a grey colour of the skin

and acidosis". He stated that nutritional disturbances due to dietary faults, either quantitative or qualitative, are now fairly well recognised and can be satisfactorily treated, but that the theory of food or alimentary intoxication does not afford a satisfactory explanation of all these disturbances. His autopsies in a number of cases revealed streptococcus infection of the mastoid antra. Twenty infants suffering from the symptoms described above were operated upon and streptococcal pus obtained. In a large proportion of his cases operation gave almost immediate relief of the symptoms. The tympanic membranes showed some change and in all the cases there was a sagging of the superior meatal wall near the junction with the tympanic membrane. Swelling, redness and tenderness over the mastoid were never found. He stated that the condition may clear up without operation but that the presence of the embryonic tissue already described, causes blocking and renders spontaneous recovery unusual. He was of the opinion that infection with organisms other than the streptococcus does not give rise to the same general symptoms and suggested that the streptococcus toxin exerts a specific action on the capillaries of the body in general and of the gastro-intestinal tract in particular, the latter causing the characteristic hydrolability. He recommended a high caloric diet of undiluted lactic acid milk and corn syrup, and disapproved of any considerable restriction of diet.

Floyd (Ref. 17) (1925) was in entire agreement with

Marriott, describing a similar clinical picture, similar post-mortem findings, and reported satisfactory operative results, although his figures are not stated.

1926.

In the following year, Jeans and Floyd (Ref. 18) (1926) who agreed that mastoiditis is an etiological factor in the production of "cholera infantum", also inculpated the nasal accessory sinuses, in some cases, and drew distinctions between the effects of the two sites of infection. They stated that in mastoiditis the symptoms are more abrupt with rapid dehydration and intoxication, clearing up more rapidly after operation. Infection of the sinuses causes a longer illness characterised by few days stationary weight and short periods of diarrhoea. Their patients showed white blood counts varying from 13,000 to 30,000 per one cu. mm. and the urine often contained a trace of albumin. In another paper published the same year Jeans (Ref. 19) described the condition of masked mastoiditis and the gastro-intestinal symptoms to which it can give rise. He commented upon the rapidity with which improvement follows operation in those cases which recovered and described a case with similar symptomatology where improvement followed treatment of an acute paranasal sinusitis. What form this treatment took is not mentioned.

1927.

The year 1927 produced numerous writings on this subject. Dean (Refs. 20 and 21) published two papers and stated that the symptoms which lead to the discovery of otitis in infants are much more frequently paediatric than otologic, e.g. refusal of food, dehydration, diarrhoea, loss of weight, and are often factors indicating myringotomy or mastoidectomy. He stressed the importance of paranasal sinus disease as similar systemic symptoms can be produced by such infections. Otitis media and paranasal sinus disease often co-exist, and Dean thought it is often difficult to decide which is most influential. His practice is to perform myringotomy or mastoidectomy as required and treat the paranasal sinus disease conservatively, but he described a case in which the paranasal sinuses were drained as well as the mastoid antra with satisfactory results. Lyman (Refs. 22 and 23), also writing in 1927, believed that when the gastro-intestinal symptoms do not improve after drainage through the tympanic membrane, the mastoid antra should be opened. This he explained on anatomical grounds, stating that the cases which recover with myringotomy alone are those where the infection is confined to the lower part of the tympanic cavity where the embryonal tissue has disappeared. The cases which do not improve are those where the infection is in the attic as well, which is filled with embryonic tissue. As the antrum is also filled with this tissue, infection readily spreads and these

cases usually require drainage of the mastoid antra before satisfactory drainage can be secured. He also commented on the angle at which the infantile tympanic membrane is situated and stated that the downward bulge is probably due to bulging of the upper part of the tympanic membrane. His figures consist of mastoid operations on 43 infants under two years, 30 of whom had marked gastro-intestinal symptoms, and of these 22 recovered and eight died. Cultures were obtained from 67 mastoids and 17 different organisms were grown. There was no special relationship between organisms and severity of symptoms. He is of the opinion that organisms other than haemolytic streptococci can produce this clinical picture.

Alden (Ref. 24) explained the frequent absence of signs in the tympanic membrane by the fact that the infant's Eustachian tube is shorter and wider than in the adult and drainage can take place more easily by this route. He described classical mastoiditis in the infant, calling attention to the fact that constitutional disturbances are rare and that any which may be present rapidly diminish with the formation of a sub-periosteal abscess. There is also a low leucocytosis. He said that after operation such cases have a rapid and uncomplicated convalescence. In the "latent" type according to Alden, "constitutional evidences of absorption are the predominating clinical feature". His bacteriological studies showed a predominance of staphylococci and non-haemolytic streptococci in the classical types and

haemolytic streptococci in the latent type.

Schwartz (Ref. 25) has come to the conclusion that in infants up to the age of two years operations on the mastoid antrum should practically never be performed, but he made no mention of gastro-enteritis and the possible association of mastoiditis with gastro-enteritis.

Lierle (Ref. 26) stated that paranasal sinusitis may produce the same clinical picture of gastro-enteritis as otitis media and mastoiditis, and the two often co-exist. He was of the opinion that chronic mastoiditis may occur without apparent evidence of infection in the middle ear. White counts in his series of 100 cases varied from 10,000 to 40,000 per one cu. mm. with a high percentage of polymorphonuclear cells. Only four were breast-fed and 92 had bilateral involvement. The bacteriology of the meatal swabs, which he does not regard as of much value, showed a predominance of staphylococci, while his operation swabs from the mastoids showed a predominance of haemolytic streptococci.

Marriott (Ref. 27) again writing in 1927 said - "within the past year we have found mastoid antrum infections in over 75 per cent. of all cases of severe nutritional and gastro-intestinal disturbances coming to our clinic. The regularity with which improvement has followed the operation of post-auricular drainage has served to convince us that mastoid antrum infections are responsible for the conditions mentioned and not

merely secondary". He repeated that haemolytic streptococci and B. coli are likely to cause severe symptoms of diarrhoea and vomiting and dessication, other organisms leading merely to a state of poor nutrition, failure to gain, lack of appetite and occasional vomiting. He found the leucocyte count always above normal, but the temperature may be only slightly elevated.

Coates' (Ref. 28) article gave an excellent summary of the literature and he discussed the pros and cons of the situation. He believed in operating upon classical cases but was doubtful about the "latent" variety. Yet he was in favour of myringotomy and, if necessary, antrotomy when there are otologic signs and when general symptoms are grave. He thought many cases of gastro-enteritis are primarily cases of ear infection and usually found a leucocytosis with 70 to 80 per cent. polymorphonuclears.

1928.

In 1928, Dick, Dick and Williams (Ref. 29) described an epidemic of enteritis associated with mastoiditis in infants, and came to the conclusion that the outbreak was primarily an intestinal infection due to Morgan's dysentery bacillus, describing how the outbreak was controlled by the adoption of rigid isolation precautions.

In the same year MacNeil (Ref. 30) published a paper in which he came to the conclusion that mastoiditis is a cause of diarrhoea and vomiting in children up to the age of two years.

He found a leucocytosis generally present, the highest being 39,000 per one cu. mm. and the average 15,000 per one cu. mm.

Odeneal (Ref. 31) was of the opinion that ear infections are secondary to malnutrition, and reported good operative results. He stated that where a good response does not follow antrotomy, associated sinus disease is almost certainly present. Also in 1928 McMahon (Ref. 32) described a series of 39 cases of mastoiditis in infants of whom 22 (56.4 per cent.) showed the symptom complex of increased temperature, diarrhoea and vomiting, loss of weight and athrepsia. From his histological studies of tissue taken from the mastoid antra at operation he concluded that the prognosis is bad in the presence of the diarrhoea and vomiting complex if oedema of the antral mucosa is found microscopically. The prognosis is good when there is fibrosis of the antral mucosa even though diarrhoea and vomiting are present. When diarrhoea and vomiting are not present the prognosis is good whatever the histological findings.

Dixon (Ref. 33) et alii, were reluctant to accept the small amount of pus found in the middle ear as a primary cause of death, calling attention to the very high incidence of middle ear and antrum infections, obviously secondary, in infants dying from every variety of acute and chronic infection accompanied by marked lowering of resistance and extreme debility. He stated that the mortality rate in infants with gastro-enteritis who had mastoidectomies is out of proportion to the usual

mortality rate.

Hartman (Ref. 34) conducted biochemical researches on infants with mastoiditis. All his cases (27) were infants suffering from diarrhoea and vomiting, dehydration, acidosis and presented a clinical picture similar to that of "alimentary intoxication". Almost all of them showed clinical evidence of infection in the ears and mastoids and of 13 cultures taken at operation, five showed B. coli, one B. pyocyaneous, one streptococcus viridans and in the remaining six growth did not occur.

Lastly in 1928 Freisner and Rosen (Ref. 35) advocated puncture of the mastoid with a needle for diagnosis and treatment by lavage. This more minor operation they had employed in 30 cases without untoward result.

1929.

Spahr (Ref. 36) in 1929 came to the conclusion that infants suffering from otitis media and showing constitutional symptoms of diarrhoea and vomiting and failure to gain often have infected mastoid antrums. Cultures from the middle ear showed the following organisms in order of frequency - staphylococcus, diphtheroids, haemolytic streptococcus, while in cultures from the mastoids the organisms appeared in order of frequency - haemolytic streptococcus, pneumococcus and staphylococcus. She was of the opinion that cultures from the middle ear are

valueless as indications of the causative organisms of an accompanying mastoiditis. Relatively few cases showed intestinal organisms and in these diarrhoea and vomiting seemed more prominent. The other organisms did not give rise to a characteristic symptomatology.

Sutton (Ref. 37) described a case of "Pseudomembranous enterocolitis in which the infant (6 months) later developed clinical evidence of infection of the middle ear and in which B. Morgan was isolated from the heart blood and from the middle ear.

Silver (Ref. 38) reported a case of pyloric stenosis with mastoiditis in which the vomiting was due to pyloric stenosis, but there was no diarrhoea. Culture from the right mastoid showed staphylococci mainly with streptococci and pneumococci, while the left was indefinite.

Writing also in 1929 Mitchell et alii (Ref. 39) described their findings. They concluded that there is no one cause of all cases of gastro-enteritis, and the majority of their cases of gastro-enteritis did not have middle ear infection preceding the gastro-intestinal symptoms. They found that otitis media and respiratory infections in general were not so prevalent at the season of the year when gastro-enteritis was prevalent, (i.e. July, August, September, October). At the same time they stated that "a surprising number of cases of otitis media occurred during these months".

The majority of infants brought to hospital primarily on account of otitis media did not have and did not develop gastro-enteritis. They found that drainage of pus from the middle ear and mastoids had little, if any, effect "than might be expected" on the general symptoms of fever and toxicity, and seldom any effect in ameliorating the gastro-intestinal symptoms. They then advocated drainage of the mastoid in cases of otitis media and mastoiditis with gastro-enteritis, "even though no immediate effect on the gastro-intestinal symptoms is to be expected". They believed that mastoid antrotomy performed on seriously ill cases does not materially increase the death rate. They recommended diagnostic myringotomy and stated that "cases presenting copious discharge almost certainly have mastoid involvement". Sixteen of their cases had double antrotomy and of these four died within four days, and four after a stormy post-operative course. One healed and later returned with recurrence of gastro-enteritis, from which it died. Of the 77 infants in their series, 30 (39%) developed otitis media after onset of gastro-enteritis. Streptococci were rare in these cultures, and stool cultures showed nothing remarkable except a few intestinal pathogens. They found no convincing correlation in the bacteriology of the ears and mastoids and of the stools.

1930.

Johnstone et alii (Ref. 40) in 1930 investigated 171 cases under two years. The majority were bottle-fed and the

highest death rate occurred in the age group 0 - 6 months, males being worse than females. They found a mixed bacteriology in the nasopharynx and felt that if intestinal intoxication is to be explained by masked mastoiditis a more uniform flora or one species should be found, yet they allowed a mixed intestinal flora as an explanation. In their cases 63.7 per cent. had otitis media and of 84 controls 63.1 per cent. had otitis media but no diarrhoea and vomiting, and 126 of their 171 cases had diarrhoea and vomiting on admission but no otitis media. They regarded these figures as "adequate ground for discarding the theory that masked mastoiditis is the (not "an", as is suggested by most writers) etiological factor in intestinal intoxication". They concluded that "intestinal intoxication is an enteral infection caused not by one specific bacterial species, but by a variety of bacilli which belong to the colon-typhoid-dysentery group", having demonstrated the presence of immune bodies in the serum of some patients.

Coates (Ref. 41) believed that there is a certain type of gastro-intestinal disorder accompanied by and probably caused by infection in the middle ear and mastoid antrum, and that all gastro-intestinal disorders in infants do not have this etiology. He maintained that treatment should be mainly conservative, operation only being resorted to in the presence of definite surgical indications. Radical surgery may be employed on slight indications when other methods fail. He suggested that

the differences of opinion on this subject might possibly be explained by a geographical difference in the incidence of otitis media and mastoiditis.

Wishart (Ref. 42) in an extensive study of the subject came to the conclusion that "infection of the mastoid antrum is not the cause of acute intestinal intoxication in infants". He noted that the onset of the disease was rarely heralded by a "cold" and that the majority of the infants had no clinical evidence of upper respiratory infection at the time they were toxic and many did not develop ear infection throughout the whole course of the illness. He believed that such infections were ante-mortem in origin but were usually terminal and due to forcible ejection of material up the Eustachian tube. When mastoid infection exists he maintained it was the result and not the cause of the lowered condition of the infant. Operative treatment was a failure and autopsies showed that mastoid infection was not common. The condition is, in his opinion, of intestinal origin. Forty-one cases in 1928 and 127 cases in 1929 were studied and 20 post-mortem examinations performed. The mastoid antrums were unhealthy in eight and negative in 12. All his cases showed evidence of intestinal infection. One hundred and five (62%) of 168 toxic cases developed infections of the ears while in hospital and 47 (64%) of 73 control cases had one or both ears infected. Thirteen operations were performed with only one recovery. He admitted the presence of pus in the

mastoid antrum but no bone reaction and did not believe that such a small focus of infection could be responsible for such profound general symptoms.

Also in 1930 the entirely opposite view is expressed by Halsolaw et alii (Ref. 43), who are supporters of ear infection as a factor in producing diarrhoea and vomiting in infants. They advised early myringotomy when any evidence of infection exists, followed by early antrotomy if improvement does not quickly follow. Their series consisted of 24 cases all under three months of age, all foundlings and all artificially fed. Eight died without operation, and of the 16 operated upon eight died. Sixteen cases afforded definite history of upper respiratory infection as long as three weeks before onset of diarrhoea and intoxication. White counts were between 8,000 and 25,000 per one cu. mm., the average being 16,000 per one cu. mm. Average neutrophilic count was 58 per cent. and average haemoglobin 77 per cent. Seven had albumin, hyaline or granular casts in the urine. In 11 cases urine cultures corresponded with those from the mastoid antra. Blood cultures were positive in five of the 16 fatal cases while in five cases stool cultures corresponded with mastoid cultures. Pus obtained at myringotomy grew the same organisms as the mastoid cultures in five cases. The infection was bilateral in 17 and unilateral in seven. Cultures often showed more than one organism and in order of frequency they were haemolytic streptococcus, non-haemolytic

streptococcus, streptococcus viridans, pneumococcus, staphylococcus and B. coli. They found X-rays of no value in diagnosis. In their fatal cases, where little or no pus was found at operation, it was found at post-mortem that the mastoid cells were aberrant or had not been properly cleaned out. No post-mortem examination abnormality was found in the gastro-intestinal tract.

Helwig and Dixon (Ref. 44) performed 173 post-mortem examinations and found changes in the middle ear or mastoid antra in 57 (32.8%). In only 17 of the 57 was there evidence of enteritis and in the remaining 40 they found almost every other common disease of infancy. According to them the incidence of otitis media and mastoiditis is higher in non-enteritic than in enteritic infants, and only in three cases of the 57 did they feel justified in considering the mastoid infection as the primary cause of death. In 57 cases 41.1 per cent. of the infants suffering from diarrhoea died following operation and the bony changes were slight or almost negligible. The history of diarrhoea preceded that of the ear infection. They concluded that ear infection is a common terminal event, that enteritis antedates the ear infection, and that while surgical mastoiditis does occur in infants, its importance has been greatly exaggerated.

Carmark's (Ref. 45) report is based on 28 infants,

under two years of age, operated upon for mastoiditis and suffering from varying degrees of intestinal upset. Twenty recovered and eight died. Six cases, whose mastoid antra were filled with pus and very thick oedematous mucosa, were in extremis. Of these three died and three recovered after a very stormy convalescence. His most unsatisfactory results were obtained in very ill cases. In 21 cases both mastoid antra were operated upon at the same time, and in seven, in which only one side was operated upon, the other side had to be operated upon at a later date. Nineteen contained swollen mucosa, pus, granulation tissue and debris, while the other nine were sclerotic in type. Bacteriologically 12 cases gave haemolytic staphylococcus aureus and 16 haemolytic streptococcus. His conclusions are in general agreement with those who hold that mastoiditis can cause diarrhoea and vomiting syndrome, and his most interesting conclusion is that "operation, except in the occasional case, should not be attempted during the violent gastro-intestinal crisis."

1931.

In 1931 Dodds (Ref. 46) described a case of otitis media with purulent meningitis in an infant nine days old. The autopsy revealed the middle ear and surrounding bone soft and filled with greenish pus from which a mixed growth was obtained and causal orgsnisms could not be satisfactorily isolated. She commented upon the rarity of perforation of the drum, meningitis and sinus thrombosis in such cases.

Johnstone (Ref. 47) surveyed the literature and gained the impression that the so-called gastro-intestinal-mastoiditis syndrome in infants does exist. His own findings coincided with this impression, and he recommended operation if there are definite objective signs in the middle ear. It is difficult to refrain from quoting his comment on Wishart's paper - "If we follow this advice (i.e. Wishart's - that operation on the mastoid should not be done on those cases unless there are symptoms of true clinical mastoiditis), I am sure that a very small proportion of these infants will ever be operated upon; death will relieve us of this task."

1932.

Findlay (Ref. 48) in 1932 commenting on the frequency of diarrhoea and vomiting as a symptom of almost any infection stated that "although the gastro-intestinal symptoms may dominate the picture, when these are secondary to some non-alimentary disease, they are never of the severity of true gastro-enteritis, nor are they usually accompanied by the coma, dehydration and hippocratic facies so characteristic of that condition." Discussing the social incidence he called attention to the fact that gastro-enteritis is a disease of the hospital class, occurring almost exclusively in bottle-fed infants, and that in ten years of private practice only 12 cases of gastro-enteritis occurred, while there were 32 cases of uncomplicated otitis media.

Also in private practice the seasonal incidence differed, showing 12.5 per cent. in the gastro-enteritis months and 50 per cent. in winter and spring. In hospital drums were incised in all cases in which pus was suspected and rarely did any marked improvement occur especially if gastro-enteritis was marked. Results were apparently much more satisfactory in cases without gastro-enteritis. He experimented by treating the ears in one ward and leaving them alone in another. No satisfactory response to treatment was observed. Nine cases had double antrotomy with seven deaths and two recoveries. The two which recovered and five of those who died were not seriously ill. Autopsies were performed on 15 infants with otitis media and pus was found in one or both antra only in four, i.e. 26 per cent. This author came to the conclusion that "focal sepsis, especially otitis media is not a serious responsible factor."

Asherson (Ref. 49) was of the opinion that otitis media and mastoiditis is a terminal lesion - agonal otitis media - stressing the indolence of the condition, absence of inflammatory signs and reaction of surrounding parts, absence of temperature, and local heat. He considered the matter still undecided and then described two cases, one case of diarrhoea and vomiting, in which the gastro-intestinal symptoms cleared with bilateral antrotomy, and another which had been suffering from diarrhoea and vomiting for nine days. Right myringotomy released pus and with its release vomiting ceased and recurred, when the other ear was incised. This second case

died and came to post-mortem, when both antra were found to be full of pus. He concluded that myringotomy was not sufficient and antrotomy should have been performed. Another type he described as "Otitis Media of Infancy" in which temperature is the chief guide to treatment and myringotomy is advised if temperature, even if only on one occasion, reaches 100° F. The importance of meningismus as an indication of earache, nuchal rigidity and convulsions was stressed. He concluded that an infant may have a tympanic membrane of apparently normal colour and yet have pus deep to it. If myringotomy reveals the presence of pus in cases of gastro-enteritis antrotomy should be performed.

Campbell (Ref. 50) emphasised the importance of associated sinusitis which he found in 97.5 per cent. of 85 infants with otitis media and suggested more active treatment for sinus infection which has an important bearing on gastro-intestinal conditions.

Also in 1932 Maybaum (Ref. 51) investigated 39 cases of whom 22 died. Abnormalities of the tympanic membranes were observed only in six. Seventeen recovered and of these ten showed abnormalities in the tympanic membranes. This writer was in entire agreement with Wishart that otitis media has no bearing on gastro-enteritis and then stated "no one will dispute the claim that every infant with or without signs pointing definitely to the ears, who has fever, diarrhoea lasting more than a day or two

or any intestinal disturbance should have a careful and thorough aural examination. If infection of the ear is found, prompt institution of drainage is indicated and if myringotomy with free drainage fails to relieve the situation, post-auricular drainage is indicated if aural examination warrants such a procedure. Copious, prolonged, increasing or at least non-diminishing aural discharge is in itself suggestive of mastoid involvement. In the vast majority further evidence of post-auricular involvement will be found on careful examination." He concluded that intestinal intoxication is not of aural origin. Acute infection of the middle ear and mastoid antra frequently occurs in infants and yet gastro-enteritis symptoms are uncommon. In a number of cases the acute suppurative diseases of the middle ear had no bearing on the symptoms of intestinal intoxication, occurring either before or during the presence of these symptoms. Accumulations in the middle ears and mastoid antra are ante-mortem but frequently agonal.

Druss (Ref. 52) stated that "while it is the rule for cases of intestinal intoxication to run their course without aural involvementm at times the latter condition may co-exist, appearing before, during or after the onset of the illness." He thought there were no specific pathological changes in the middle ear or mastoid characteristic of intestinal intoxication, and concluded "from a review of the literature and from a clinical and pathological study of the cases, the preponderance

of evidence favours the view that the otitic condition is not the etiological factor responsible for the intestinal intoxication." He did not favour operative treatment.

Morris and Smith (Ref. 53) described six infants in whom an infection of the upper respiratory tract invariably preceded the operation on the mastoid by from 8 - 14 days. Their bacteriology showed staphylococcus aureus four, streptococcus three, staphylococcus albus one, B. coli three, no growth two. Five of the six recovered from acute intestinal intoxication after operation and they concluded that the onset of toxaemia coincides with involvement of the mastoid antrum and that the bacteriology does not influence the clinical picture.

1933.

In a report of the three-year period 1930 - 1932, Marriott et alii (Ref. 54) observed 318 cases of diarrhoea, of whom 118 (37%) were true dysenteries due to organisms of the dysentery-paratyphoid-colon group. Thus the incidence of dysentery was seen to be low as compared with other types of diarrhoea. They became numerous in June, increasing in numbers to a peak in August and September, and decreasing with the beginning of winter. In the series classified as dysentery parenteral infections complicated the picture in 66 per cent. of the cases - broncho-pneumonia, otitis media, mastoiditis and pyelitis being the most common infections. The mortality rate was 28 per cent. in the complicated cases and only 10 per cent.

in the uncomplicated cases. The cases of non-dysenteric diarrhoea were observed during the months of August, September and October, the peak month being September and occurred in infants "whose nutrition had suffered during the summer months and who, with the beginning of fall, contracted upper respiratory infections which served as the final precipitating factor." In this group Marriott found evidence of parenteral infections in the rhinopharynx, ears and mastoid antra in 83 per cent. at the time of admission to hospital. In a previous series he found acute middle ear or mastoid infections preceding the development of diarrhoea in 93 per cent. of the cases. Frequently the infant was admitted in a state of extreme dehydration and did not show evidence of infection in the ears, but when its fluid balance was restored the tympanic membranes showed sufficient evidence to warrant myringotomy which released pus. Non-dysenteric diarrhoea was observed most frequently in under-nourished children, the preceding feeding error being one of qualitative or quantitative under-feeding. In such cases the symptoms were more severe and the mortality rate higher. The mortality rate in the group of non-dysenteric diarrhoea was 35 per cent. and over three-quarters of those were due to the parenteral infection rather than to the effects of diarrhoea. There was a third small group (17%) in which neither enteral nor parenteral infection could be found. The illness in this group was of short duration with low mortality rate (5%).

Rabbiner (Ref. 55) was of the opinion that infants with otitic infections, in whom paediatric treatment failed, should be subjected to mastoid operation - in all cases bilateral even in the presence of indefinite otoscopic findings.

1934.

Cullom (Ref. 56) in 1934 stressed the importance of sinus infection, finding 85 per cent. of cases of any age with mastoiditis also showed a cloudy sinus usually on the same side.

Page (Ref. 57) reported an extensive bacteriological research on cultures taken at myringotomy in 300 cases of acute infections of the middle ear. He found haemolytic streptococcus in 30.6 per cent., pneumococcus III in 17 per cent., staphylococcus aureus in 12.7 per cent., haemolytic staphylococcus in 5.3 per cent., staphylococcus albus in 5 per cent., staphylococcus albus and aureus in 3 per cent., and numerous other organisms in much smaller percentages. Twenty-two per cent. of his cultures showed no growth and two operation cases out of 16 had no growth.

Campbell (Ref. 58) studied the incidence of sinusitis in pneumonia in 130 patients, 52 of whom were under one year old, and found sinusitis in 100 per cent. He also reported a high incidence of otitis media (70%) in these patients.

Maizels (Ref. 59) wrote: "It seems clear that otitis is rarely the primary cause of intestinal intoxication. On the other hand once secondary otitis or mastoiditis has occurred a new obstacle to recovery has arisen and one may well doubt if resolution of the intestinal lesion is possible in the absence of free aural discharge. Our small series of cases suggests that adequate aural drainage definitely reduces the mortality and possibly better results might have been obtained with earlier operative treatment." Of 72 cases of diarrhoea and vomiting 37 recovered and of 68 fatal cases "pus-like" material was found in the middle ears in 41, and in other diseases only ten times in 33 autopsies. In 37 cases, whose ears were examined, aural infection was bilateral in 25, unilateral in 12. Red tympanic membranes were found in 29 with bulging in nine. Posterior superior meatal wall was red and swollen in 15 cases. Maizel's blood counts showed that high leucocytoses and high percentages of polymorphonuclear cells occurred more frequently in cases with otitis than in cases without otitis. His results of treatment are interesting. Of 17 untreated cases only three recovered, two having drained and one having resolved spontaneously, giving a mortality of 80 per cent. Of 20 treated cases ten recovered, all of whom had paracentesis and five had antrotomy which was bilateral in two instances. Ten died, all of whom had paracentesis and five had antrotomy which was bilateral in one case. The mortality rate was 50 per cent. In 35 cases without otitis the

mortality rate was 31 per cent. This author then described five typical cases of diarrhoea and vomiting of whom three recovered and two died, in all of whom pus was found in the mastoid antra either at operation or at autopsy. Maizels also wrote: "We are of the opinion that the significance of otitis varies in different patients. In three cases otitis preceded enteritis and in these paracentesis gave good results. In a little more than half the cases, signs of aural infection were present soon after the diarrhoea and vomiting began and were observed within four days of the patients' admission to hospital (vide Marriott's explanation in 1933). The remaining instances of aural infection were late and sometimes were only noticed for the first time when death was imminent."

1936.

The Parisian school published results in 1936. Ribadeau-Dumas et alii (Ref. 60) described 109 cases. Sixty-five cases were operated upon, of whom 38 recovered and 27 died. They found the high death rate among cases of mastoiditis complicated by broncho-pneumonia, meningitis and the enteritic syndrome, and they are convinced that "there exist incontestably cases of mastoiditis which manifest themselves only by a change in the general condition notably by an enteritic syndrome with a more or less elevated temperature." Evidence of mastoiditis was discovered only at autopsy in 14 of their cases, and seven of these were cases of the "enteritic syndrome" without other

clinical expression. They suggested that cases presenting a grave picture of alimentary intoxication without obvious cause should suggest "latent mastoiditis" and failing improvement in two to three days with medical treatment antrotomy should be performed. They found this type of case in 10 per cent. of cases. They reported rapid cessation of serious symptoms after operation. Ten cases were examined bacteriologically and pus was found to be pneumococcal in four cases and streptococcal in six. They commented on the relatively rare occurrence of classical mastoiditis with retro-auricular swelling, redness, etc. as seen in the adult, and, except in one case, they always found some abnormality of the tympanic membrane. Other observations included the "habitual bilaterality" of the lesions and the frequently negative results of myringotomy in cases which were subsequently found to have pus in the mastoid antra at operation. They explained this by suggesting that the "otitic phase" of the infection may have passed without notice some days or weeks before.

Le Mée (Ref. 61), in the discussion which followed this paper, described how in the infant the Eustachian tube, middle ear and mastoid antrum is really a single cavity in the infant - a "cul-de-sac." He divided the infective processes into three stages. (1) Otosalpingitis or infection of the Eustachian tube and explained negative myringotomies on this basis. (2) Primary purulent otomastoiditis, in which he

explained the lack of spontaneous tympanic rupture by the mxyomatous lining of the infantile tympanic membrane, which renders it thicker and less liable to rupture. He suspected this variety of otitis in cases of inexplicable pyrexia, persistence of pyrexia in such cases as broncho-pneumonias, in cases where treatment of a digestive disturbance gave only temporary relief, and in cases in which an infant seems to be in pain and suffers from persistent insomnia. If myringotomy failed to produce adequate drainage he recommended antrotomy. (3) Osteitic otomastoiditis - accompanied by bone lesion - suppuration, necrosis and sometimes sequestration. Also in the same discussion Weill-Hallé (Ref. 62) adversely criticised the views of the previous writers, stating that mastoiditis is relatively rare. In 1935 of 796 infants only 66 showed suppurative otitis media and 12 mastoiditis, and in 1934 in 816 infants only 105 showed otitis media and 12 mastoiditis. He regarded the severe diarrhoeas as due to over-feeding with cow's milk and did not think that hypothreptic states were caused by a deep focus of infection, reporting good results from conservative treatment.

Also in 1936 Csapo (Ref. 63) published an elaborate classification of his cases, in which he divided the toxic cases into four sub-groups:-

(a) To the first belong those cases in which, in addition to some slimy stools, without any alimentary injury the acute, classical toxicosis sets in.

(b) The second group includes those cases where, without alimentary injury, there are thin, watery stools (parenteral dyspepsia). The infant is exsicated and there are disturbances of consciousness and respiration.

(c) The third group are those cases of long, drawn-out sub-acute toxicosis in which, even with the most careful feeding, the general condition steadily deteriorates.

(d) In the fourth group are those cases which, if carefully fed, maintain their condition; but where food is difficult to assimilate and, especially in rather large quantities, is badly borne. This results in loss of weight, apathy, vomiting, probably watery stools - an alimentary injury is superimposed on the parenteral.

He advocated operation in groups (a) and (b) if myringotomy fails and in (c) and (d) if necessary, and reported some good results.

Gyorgy (Ref. 64) described how the development of otitis or antrum empyema associated with some other disease may cause a severe toxic condition and is an advocate of operation to open the closed purulent focus.

1937.

In the "Proceedings of the Royal Society of Medicine" Ebbs (Ref. 65) gave a very full report of his findings. He found otitis media in 61 per cent. of infants dying during the first year of life and that its incidence rapidly increases

during the first three months and then remains stationary throughout the first year. Infection of other sinuses was a frequent occurrence. Organisms were isolated in the following order - streptococcus 50.5 per cent.; pneumococcus 17.8 per cent.; staphylococcus aureus 12.7 per cent.; staphylococcus albus 8.7 per cent. with the other organisms in much smaller percentages. He found otitis media present in 81.4 per cent. of cases of gastro-enteritis and classified cases of the diarrhoea and vomiting syndrome into three groups:

(1) The largest - with diarrhoea and vomiting secondary to an upper respiratory infection leading to otitis media.

(2) Also large - with a great variety of parenteral infections, e.g. pneumonia, abscesses, erysipelas, etc.

(3) The smallest - true dysenteries.

He stated: "The aetiological factor in the parenteral group is in the majority of cases an infection somewhere in the respiratory tract. I do not consider that infection is confined to the middle ear and mastoid antrum as some have tried to show. An infection anywhere in the body of the infant is capable of producing the diarrhoea and vomiting syndrome, while otitis media may not in every case be the initiating cause of this condition, it may develop during the course of it and the toxic effects of a mastoiditis may not only prolong the diarrhoea but be the factor which determines the fatal outcome of the illness."

Also in 1937 Cooper (Ref. 66) published his observations on gastro-enteritis and found that otitis media was by far the commonest parenteral infection (26%) but came to the conclusion that it did not have a markedly lethal effect. In his description of the post-mortem findings no mention is made of the condition of the mastoid antra, and he observes that "the degree of inflammatory reactions shown by the bowel did not in many instances bear any relationship to the severity of the symptoms."

1938.

Writing again in 1938 Ebbs (Ref. 67) investigating the incidence of infection in different sinuses fount otitis media the most common (56.4%). Only 33 cases had infected sinuses without an associated otitis media. Infection of one or other sinuses or middle ears was found in 63.1 per cent.

Also in 1938 the present writer (Ref. 68), in collaboration with a colleague, made a purely clinical and statistical enquiry into otitis media and mastoiditis in all the infants admitted to hospital during the year 1936. A clinical classification was suggested which has been found useful, viz:

I. Secondary.
   1. Otitis media associated with respiratory infections.
   2. Otitis media associated with nutritional disturbance.
   3. Otitis media associated with nasopharyngitis, etc.
   4. Mixed group.

II. Primary.
   A. Classical mastoiditis.
   B. Otitis media and latent mastoiditis.
      1. Toxic cases.
      2. Mild cases.

SUMMARY OF THE LITERATURE.

The earliest writings on the subject of otitis media and mastoiditis and its relationship to the "diarrhoea and vomiting syndrome" are by German and French writers, particularly German. In later years there is a large mass of literature, mostly of American authorship. The majority of these authors are of the opinion that there is an etiological relationship between the two conditions, otitis media and mastoiditis being held responsible for a certain number of cases presenting the clinical features of the "diarrhoea and vomiting syndrome." There is, however, a minority of American opinion which is opposed to this view. The German and French authors of later years also continue to support the possibility. The British writings are not very numerous and while there are adherents to both views, some do not appear to have reached a definite decision.

III. DESCRIPTION OF CASE-TAKING AND INVESTIGATIONS.

The fifty cases in the present series were investigated as follows:-

Family History: with special reference to recent influenza, sore throats, nasal or aural discharge, etc.
Housing Conditions: with reference to over-crowding.

Obstetrical History.

Previous Illnesses of Child.

Previous Feeding of Child.

History of Present Illness.

Condition on Admission and periodic clinical examinations while in hospital.

Investigations:

1. Father and Mother - Throat and nose swabs.
2. Baby - Throat, nose and ear swabs.
   Urine.
   Faeces.
   Blood Cultures.
   Mantoux Reactions.
   Operation Swabs and Post-mortem findings.
   Blood counts.

It will be understood that it was not always possible to obtain all this information and complete all these investigations satisfactorily owing to complications such as, illegitimacy of the child, separation of the parents, short and fatal illness of the child, removal of the child from hospital against advice, etc.

The system of case-taking and most of the investigations are quite straightforward and require no further description, but having regard to the well-known differences in the infant's blood pictures and to the particular type of blood counts performed some further detail is necessary on this subject.

It was thought that some indication as to prognosis, whether the mastoid antrum was involved or not, an optimum time for operation, etc. might be obtained from one of the more elaborate systems of counting the white cells. For this purpose the Schilling Count has been employed throughout. The Schilling Count is a modification of Arneth's original method of classifying the polymorphonuclear cells into young and old. Arneth's (Ref. 69) classification consisted of five main groups and many sub-groups, so that its application by persons not accustomed to this type of work was almost impracticable, and in 1911 Victor Schilling (Ref. 70) devised a simplified classification which is more capable of application to clinical medicine. The most important work done in this country on this subject is that by Cooke and Ponder (Ref. 71, 72), in 1927, who have also simplified Arneth's method into what they term the "Polynuclear Count". They are convinced of the value of this method of investigation, but none of their illustrative cases is an infant, and most of their work has been done on cases suffering from various types of tuberculosis. Schilling, on the other hand, does deal with the infantile blood picture. In 1924 Pons and Krumbhaar (Ref. 73) described their experience and suggested a

simplified method, and Weiss (Ref. 74) in 1927 concluded that the percentage of immature cells gives more valuable information than simple total white counts with percentages of neutrophilic cells. Piney (Ref. 75, 76) commented favourably on the value of the Schilling index, and in 1929 compared the work of Cooke and Schilling, coming to the conclusion that individually they are both defective and should both be included in a complete blood count to produce the greatest accuracy. Also in 1929 Niehaus (Ref. 77) reported satisfactory results in the use of the Schilling Count. Farley et alii (Ref. 78) in 1930, using the title "Filament and Non-Filament Polymorphonuclear Neutrophile Count", came to the conclusion that "the most delicate method of studying the reaction of the bone marrow in infection of all types is the estimation of the young forms of polymorphoneuclear neutrophiles." In 1933 Feldman (Ref. 79) stated that the "left shift" occurs even before the leucocytosis shows itself, and that a similar shift is seen normally in infants during the first week of life. He made no mention of infants up to one year or of Schilling's method of classification.

In the present work additions to the Schilling Count, elaborated by Crocker and Valentine (Ref. 80) in 1934, have also been employed. Schilling divided the polymorphonuclear cells into four groups, i.e. segmenters, stabs, juveniles and myelocytes, the segmented cells being regarded as old cells and the others as young forms.

(I) Segmenter. (Figs. 1 & 4, x 1150). The nucleus in this cell is divided into several distinct segments numbering from two to five. These segments either show no visible connection or are connected by thin threads of chromatin. The nucleus is well-stained and the cytoplasm pale with numerous neutrophilic granules.

(II) Stab. (German - Staff). (Figs. 2, 3 & 4, x 1150). The nucleus is narrow and cylindrical without any complete segmentation. Partial segmentation may be present but the connecting bands are much wider than the chromatin thread seen in the fully segmented cell. This undivided nucleus may assume various shapes resembling most commonly the letters U. V. S. T. and takes on a dark purplish or dark blue stain. The cytoplasm is the same as in the segmented cell. These cells appear to be neutrophile cells matured without segmentation. They are described in Gradwohl's translation of Schilling's work (Ref. 70) as "mature cells, that did not partition the originally sausage-shaped nucleus into segments, due to degenerative inhibition of development." They are, therefore, regarded as a cell of degenerative type.

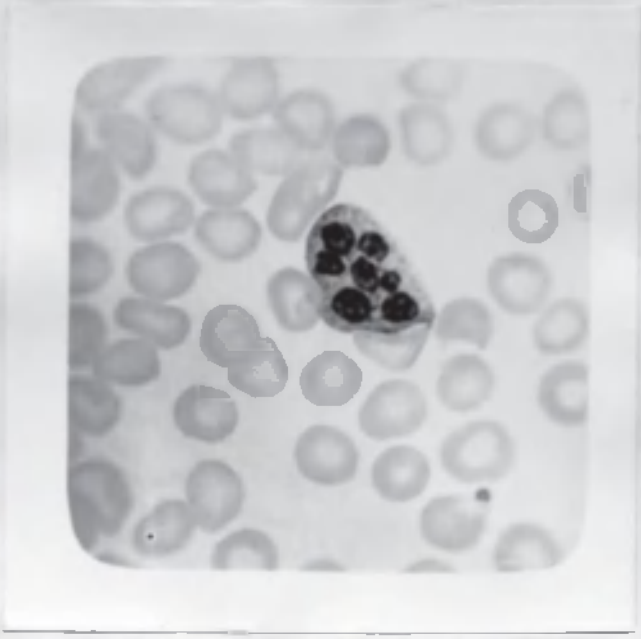


FIGURE 1.

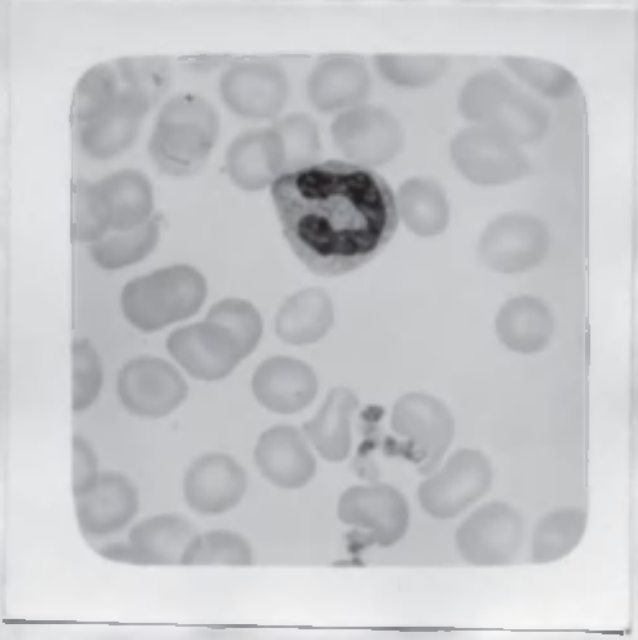


FIGURE 2.

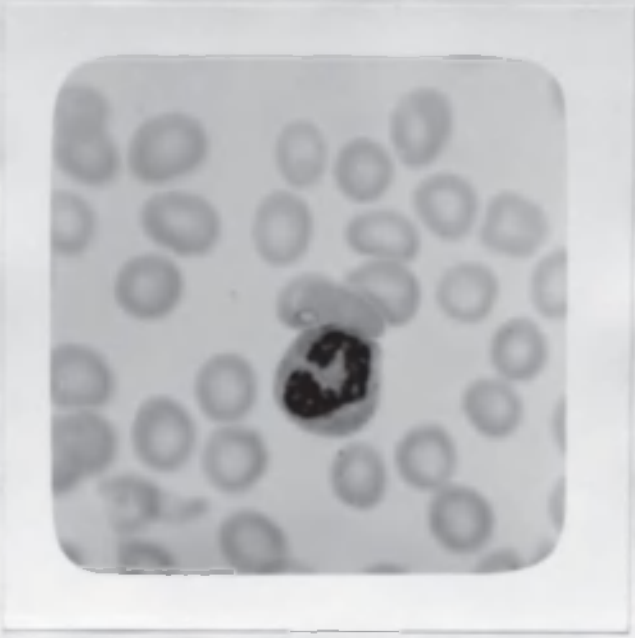


FIGURE 3.

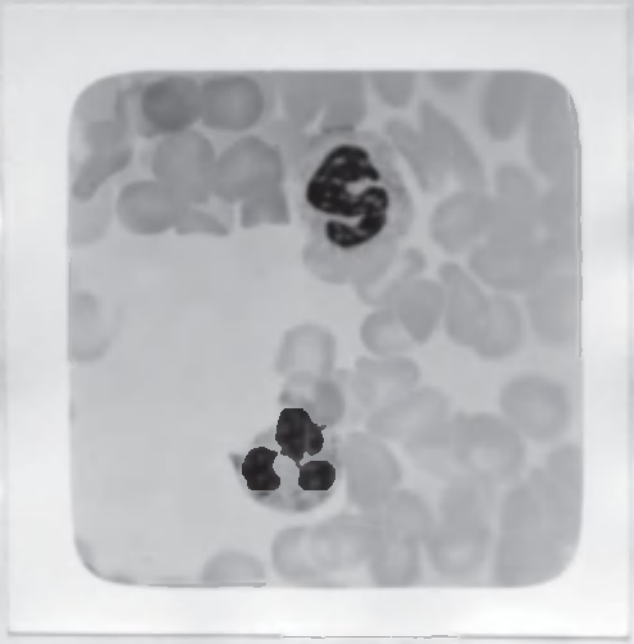


FIGURE 4.

(III) Juveniles. (Fig. 5, x 1150). The nucleus is deeply indented or U-shaped but is wider than the stab and is not so intensely staining as the stab. The depth of its indentation distinguishes it from the myelocyte. The cytoplasm is the same as in the segmented cell.

(IV) Myelocyte. (Fig. 6, x 1150). The nucleus is large, oval, and may be slightly notched but the indentation is not so marked as in the juvenile cell, and it is darkly-staining. The cytoplasm is the same as in the segmented cell.

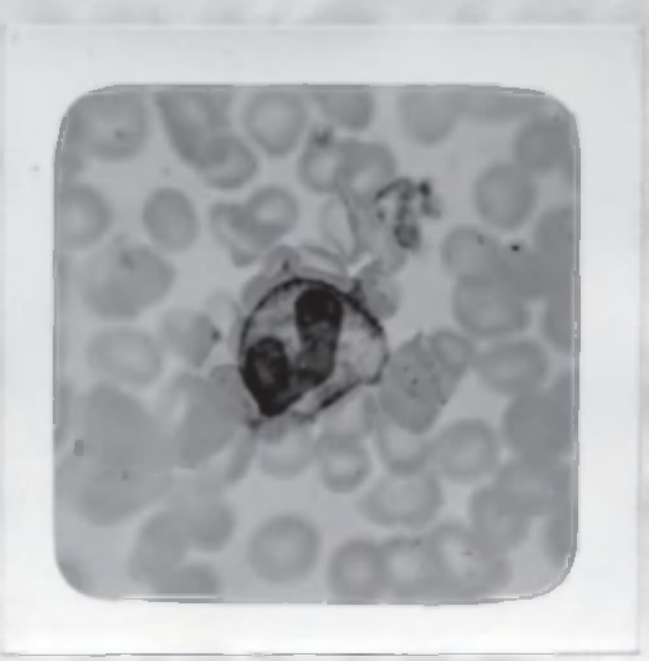


FIGURE 5.

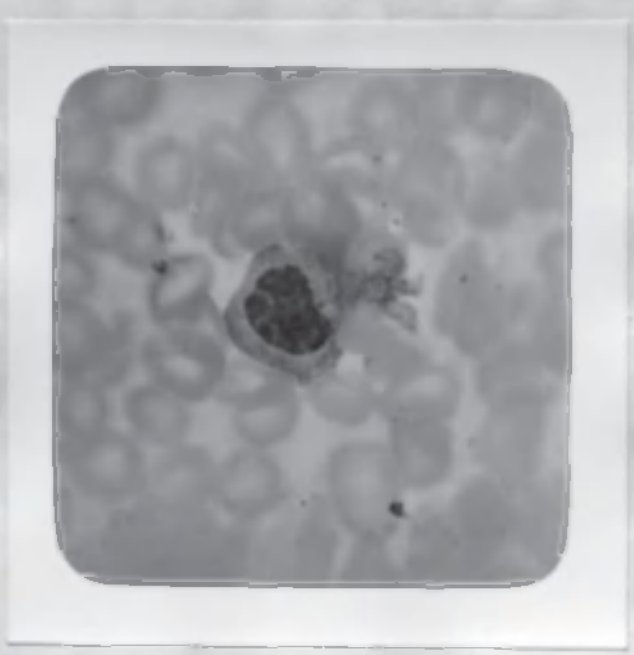


FIGURE 6.

The division of the cells into these four groups gives a qualitative analysis of the neutrophilic cells available to combat the infection. The normal adult picture shows no myelocytes, no juveniles, four stabs and 64 segmenters, a total of 68 neutrophiles in each 100 white cells, and an increase in the number of young forms, i.e. myelocytes, juveniles and stabs with a decrease in the number of segmenters constitutes the well-known "left shift", the degree of "shift" indicating the severity of the stimulation or irritation undergone by the bone marrow. Conversely an increase in the number of segmenters with a fall in the number of young forms indicates a return to normality. If the type of "left shift" consists only of stabs it is termed degenerative, if of stabs, juveniles and a few (4) myelocytes regenerative, if more than five myelocytes appear leukaemoid, and the type of shift is a measure of the intensity of the intoxication. The Schilling index is the ratio of combined shift cells to segmenters, i.e. in the normal adult 4 : 64 or 1/16, .06. The multiple index (Ref. 80) is the Schilling index multiplied, quite arbitrarily by sixteen, giving a normal of one, a simpler number to work with. The Lethal index (Ref. 80) is the ratio of myelocytes to segmenters, or in the absence of myelocytes, the ratio of half the juveniles to segmenters. The nearer it approaches to one the worse is the prognosis (Ref. 80).

The total white count and the ordinary differential count afford information regarding the quantitative strength of the white cells, i.e. the total white count is an estimation of the total number of white cells available in the circulation and the ordinary differential count gives the percentage of neutrophiles in the total white count. In other words these two counts indicate the reproductive power of the bone marrow for producing neutrophilic cells to combat the infection. On the other hand the Schilling count is an estimation of the qualitative strength of the cells in the circulation, i.e. the marrow "threshold", a mechanism whereby the maturity of the cells passing into the blood stream is controlled. The marrow threshold is depressed when a large number of immature cells are allowed to escape into the blood stream, producing a "shift to the left."

The actual technique employed in performing the counts was as follows:- Heel blood was invariably used because (i) a more satisfactory flow of blood without having resort to rubbing or pressure may be obtained from this area, (ii) the cases under investigation were cases of otitis media, frequently with discharge, rendering the use of the lobe of the ear inadvisable. The blood was taken off in glass pipettes and immediately conveyed to glass tubes containing the requisite amounts of diluting fluids (.1% Sodium carbonate for the haemoglobin estimations and 3% acetic acid + gentian violet for the

total white counts). Total red counts were not done except in a few cases. The films were spread on ordinary microscopic slides employing a "spreader". The "spreader" consisted of a microscopic slide, two adjacent corners of which had been cut off, giving an edge somewhat narrower than the width of an ordinary slide. Films thus prepared were narrower than the slide bearing them, and the two edges were available for inspection. One series of films were stained with Leishman's Stain and another with Wright's Stain, but the same stain was employed throughout any one case. The haemoglobin estimations were made with a Fleischl-Miescher haemoglobinometer and the total white counts with a Türck Ruling. Two total white counts were done at each estimation and an average taken. The differential counts and Schilling counts were done by the "meander" method, covering the greater part of each film. Two hundred cells were counted in each differential count and percentages calculated therefrom. The neutrophile cells were then "Schillingised" by counting an additional two hundred neutrophiles. The Schilling index or ratio of shift cells to segmenters was calculated from the figures so obtained and the multiple index obtained by multiplying the Schilling index by sixteen. The lethal index was calculated as described, but the conclusion was reached early in the investigation that, as the lethal index depends on the presence of myelocytes, cells which do not often appear and might be missed even in a count of two hundred cells, the multiple index was a much more valuable index. Thus in each

film the differential count and the Schilling count involved the counting of four hundred cells.

All the foregoing remarks and references are applicable to the adult and it is now necessary to consider the differences encountered in the infants' blood picture. According to Schilling there are haematologically three groups:-

1. The new-born infant,
2. The nursling, and
3. The child from 1 to 6 years.

The blood picture in the nursling, from which group all the present cases are drawn, remains constant in the first year and up to the middle of the second, after which it changes gradually towards the adult picture, which is attained about the sixth year. The total white count in the nursling group is somewhat higher than in the adult.

The following are the figures quoted by Schilling:-

Gundobin	9,000 - 15,000
Benjamin	8,000 - 12,000
Romiger	9,200 - 23,700
Hoffman & Walker	6,200 - 21,600

Washburn (Ref. 81, 82) found that the total white count varied from 5,000 to 24,000, the majority being between 8,000 and 16,500. A high proportion of lymphocytes is characteristic and certain authors describe a slight left shift. Others deny the existence of this slight shift in the normal infant, notably Ockel (Ref. 83) and Schüssler (Ref. 84). Ockel stated that "a left shift in the Arneth sense is not observed in completely normal infants or in the application of the Schilling method", and Schüssler said

"only exceptionally have I encountered an increase of stab-nuclear forms over 4 - 6 per cent. without it being possible to find an explanation for it from the condition of the child". He concluded that degree of shift is quite independant of age. These authors give their figures and it has been possible to work out the Schilling index as it has been done in the present work. Figures so obtained have been added to the following table of comparative figures, which is quoted from Schilling:-

Author	Bas.	Eos.	Myel.	Juv.	Stabs	Seg.	Lymph.	Mon.	Sch.I.
Ockel	0.5-1	1-5	-	0-1	0-5	15-40	49-75	3-12	.05
Hoffman) Welker)	0-1	0-7	-	0-2	0-9.5	5-49	42.5-90.5	0-16	.23
Schüssler	-	2	-	-	2	29	61	6	.06
Romiger	0-1	2-4	-	0-5	8	16	62-69	6	1.2
Adult Schilling	0-1	2-4	-	0-1	3-5	51-67	21-35	4-8	.08

In view of all these conflicting figures a series of 20 normal infants was investigated. These infants were admitted for the operation of circumcision, inguinal hernia, etc. and were carefully examined for the presence of infection. The results of this investigation are recorded in Table I (Normal Counts) and from this it will be seen that the average total white count was 11,990 per one cu. mm. and the differential count coincides with findings elsewhere. The results of the Schilling count were found to agree with those who deny a normal left shift, the

TABLE I.

No.	AGE. Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	5/12.	71	13800		·64	·04			4	96	4140	30	9·5	53 5	7383	5 5	1·5			
2.	7/12.	71	13300		1·4	·09			9	91	2394	18	11	67	8911	3	1·5			
3.	5/12.	71	12900		·64	·04			4	96	2644	20·5	7 5	68 5	8836	2	·5			
4.	3/12.	62	12500		·96	·06			6	94	3375	27	8	58 5	7312	6	·5			
5.	5/12.	65	13400		·80	·05			5	95	5092	38	6·5	60	8040	1				
6.	4/12.	50	14100		·64	·04			4·5	95·5	3666	26	7·5	53·5	7543	12	1			
7.	4/12	69	10000		1·4	·09			8 5	91·5	1950	19·5	15 5	60·5	6050	4	·5.			
8.	10/12.	68	12400		1·1	·07			7	93	2418	19·5	15 5	64	7396	1				
9	3/12.	72	8600		1·7	·11			10	90	1591	18·5	14 5	65 5	5633	1·5				
10.	5/12.	70	8700		1·6	·10			9·5	90·5	2697	31	18	42	3654	8	1			
11.	4/12.	63	11700		1·2	·08			7 5	92·5	3042	26	8	64	7488	1·5	·5			
12.	11/12.	62	11100		1·6	·10			9·5	90 5	3552	32	8·5	56 5	6271	3				
13.	3/12.	73	11700		·64	·04			4·5	95·5	4095	35	7·5	55·5	6493	2				
14.	3/12.	74	10400		·96	·06			6	94	1820	17·5	10 5	66·5	6916	4·5	1			
15.	6/12.	65	8700		·80	·05			5	95	2044	23 5	12 5	59	5133	3·5	1·5			
16.	6/12.	62	13800		1·7	·11			10	90	5037	36·5	4·5	54 5	7521	4·5				
17.	4/12.	54	10300		1·4	·09			9	91	2008	19 5	14	63	6454	2·5	1			
18.	9/12.	69	16700		1·6	·10			9 5	90 5	5511	33	5 5	54 5	9101	6 5	·5			
19.	6/12.	53	15200		1·1	·07			7	93	4560	30	8 5	58	5816	3	·5			
20.	5/12.	55	10600		·80	·05			5 5	94·5	3710	25	7·5	51·5	5459	5·5	·5.			C1
AVERAGE		64	11990		1·1	·07			7	93	3094	26	10	58	6902	4	·5.			

average Schilling index being .07. No juveniles or myelocytes were found. The multiple index throughout has been obtained by multiplying the Schilling index by sixteen. The arbitrary figure sixteen has been used, but it will be obvious that it is of no consequence what figure is used provided the same figure is used throughout the series. The only advantage of the multiple index is that it gives more convenient numbers to work with than the Schilling index.

Except in the case of the first count, which was taken at whatever hour of the day the child happened to be admitted, the blood for this series was taken between 10 a.m. and 11 a.m., i.e. shortly after the 10 a.m. feed. In view of this it was considered advisable to investigate what, if any, effect feeding had upon the various estimations. A series of counts were therefore taken before and after feeds. The blood was taken half-an-hour before each feed and one hour after the commencement of each feed, the feed lasting from 15 to 20 minutes. As each infant was fed at 10 a.m., 2 p.m. and 6 p.m., six counts were obtained throughout the day. Four normal infants were so investigated and the results are recorded in Table II. It will be seen that feeding appears to exert no systematic influence on these estimations. This is in agreement with the work of various authors. In 1900 Japha (Ref. 85) conducted experiments on 14 healthy infants, i.e. infants who had recovered from a variety of illnesses, and came to the conclusion that "in the

TABLE II.

No.	~~Date~~	Hb.	Total W. B. Cs.	L I.	M.I.	Sch I.	M.	J.	St.	Seg	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1. 10 a.m.	BEFORE	49	12500		1·2	·08			8	92	3687	45·5	3·5	47·5	6937	2	1·5			
	AFTER	47	9200		1·2	·08			8	92	3174	34·5	3	62·5	5750					
2 p.m.	BEFORE	55	17600		·96	·06			6	94	4312	24·5	7	62·5	11000	1				
	AFTER	52	12700		·96	·06			6	94	5143	40·5	3·5	56·5	7175					
6 p.m.	BEFORE	54	13300		1·1	·07			7	93	2992	22·5	7·5	69	9177	1				
	AFTER	53	15400		1·1	·07			7	93	4389	28·5	6·5	65	9471	3·5				
2. 10 a.m.	BEFORE	58	13900		·96	·06			6·5	93·5	5073	36·5	7	55·5	7714	1				
	AFTER	56	10300		·64	·04			4·5	95·5	3450	33·5	6·5	56	5768	3·5	·5			
2 p.m.	BEFORE	55	9400		·80	·06			5	95	3243	34·5	10	54	5076	1	·5			
	AFTER	58	10600		1·1	·07			7	93	3710	35	9	51·5	5469	3·5	1			
6 p.m.	BEFORE	55	12700		1·1	·07			7	93	3653	29	8·5	62·5	7810	1				
	AFTER	57	9500		1·2	·08			8	92	3563	37·5	8	52	4840	2	·5			
3. 10 a.m.	BEFORE	55	13400		1·9	·12			11·5	88·5	3618	27	13	57·5	7705	2·5				
	AFTER	56	14800		1·6	·10			9·5	90·5	4248	26	11·5	62	9176	·5				
2. p.m.	BEFORE	58	14700		1·4	·09			9	91	3895	26·5	12·5	58	8526	3				
	AFTER	57	13600		1·9	·12			11·5	88·5	2788	20·5	11·5	66	8976	1·5	·5			
6 p.m.	BEFORE	58	15500		1·6	·10			9·5	90·5	2635	17	14	67·5	10462	1·5				
	AFTER	65	10400		1·7	·11			10	90	4680	45	9	45·5	4732	·5				
4. 10 a.m.	BEFORE	60	9200		·96	·06			6	94	2892	26	7	67	6234					
	AFTER	61	9100		1·4	·09			9	91	1410	15·5	11·5	73	6552	1				
2 p.m.	BEFORE	60	12700		1·1	·07			7	93	2159	17	6	77	9779					
	AFTER	65	9200		1·4	·09			9	91	2697	29	10·5	60	5560	·5				
6 p.m.	BEFORE	64	12200		1·4	·09			9	91	2379	19·5	5·5	75	9150					
	AFTER	61	13100		1·7	·11			10	90	3602	27·5	9	63·5	8518					

infant digestive leucocytosis cannot be regarded as a phenomenon occurring with any regularity." A similar finding was recorded among sick children. Mitchell (Ref. 86) in 1915 came to the conclusion that bottle-fed babies do not constantly show digestive leucocytosis. Sabin et alii (Ref. 87), 1925, made no mention of infants. In 1927 Fletcher and Mitchell (Ref. 88) said that there are marked daily variations but "any variation in the leucocyte count, which can be interpreted as a digestive leucocytosis, is inconstant." Washburn (Ref. 81), 1934, stated that "there is no demonstrable correlation between the variations in the number of white cells and such factors as intake of food, digestion, sleep, increased activity or minor external disturbance."

Rogatz (Ref. 89), 1930, commented favourably on the use of the Schilling count in a series of cases, the majority of which were under one year. In 1934 Klenerman (Ref. 90) found much higher proportions of "band" forms in infantile bloods, and went so far as to state that very few polymorphs show true segmentation. Martin and Ellenberg (Ref. 91) in 1935 confirmed the usefulness of the Schilling count in children, but Washburn (Ref. 92) thought the method too time-consuming.

There is little to be found in the literature regarding the effects of aural infection on the blood picture especially in infancy, and a large proportion of the work done deals with older children and adults. The earliest available work, applying haematology to otology was by Darling (Ref. 93) in 1908. He

concluded that "the number of leucocytes per cu. mm. was an indication of body reaction while the polymorphonuclear percentage indicated the degree of infection." Repeated examination he found of greater value than a single estimation. This work was done on patients of all ages. Also in 1908 Dench (Ref. 94) came to the conclusion that the differential count was of no value as an aid to diagnosis. Gale (Ref. 95) in 1928 found "left shifts" and an index calculated therefrom unreliable in making a diagnosis in otological complications, e.g. perisinus abscess, etc. and of no help in determining when to operate. In 1931 Rossenwasser and Rossenthal (Ref. 96) found total white counts and ordinary differential counts inadequate and the Schilling count of great value as a diagnostic aid in otitic infections. Applied to ear infections Weiss (Ref. 97) found also in 1931 that "staff" counts were useless as a diagnostic aid, or an indication for operation, as cases of acute otitis media often showed higher "staff" counts than cases of mastoiditis, but when used in a series they are of "inestimable importance in prognosis". Boies (Ref. 98) reported similar findings. Alden and Demotte (Ref. 99), 1931, who are in agreement regarding the usefulness of the "staff" count, stated that it "offers a much more reliable index of the patient's condition than does the polymorphonuclear percentage of the total white count and particularly in children, than the pulse and temperature variations." No work has been found on the application of these counts to otitis media and the so-called latent mastoiditis of infancy.

IV. EPITOME OF CASE RECORDS.

This section contains an epitome of the case records. Each case consists of (1) a short clinical résumé of each case, giving dates of admission and discharge, age, sex, result, history, condition on examination and progress while in hospital. In the majority of cases there follows (2) a graph, plotting the infant's weight, total white count, total polymorphonuclear count and multiple index and showing dates upon which myringotomies or posterior drainage were performed, viz:-

Weight curve	----------------
Total white count	________________
Total polymorphonuclear count	················
Multiple index	—·—·—·—·—·—·—

At the bottom of each graph a simple line indicates the dates during which the infant's ear or ears were discharging, viz:-

Ears Discharging

Below this line a block graph indicates the number of stools passed per diem, viz:-

4)
3) Stools per diem.
2)
1)

Lastly follows (3) a detailed account of all blood counts taken in each case. The following is a list of the abbreviations used:-

No.	= Number of count.
Hb.	= Haemoglobin percentage.
Total W.B.Cs.	= Total white blood cells per cu. mm.
L.I.	= Lethal Index.
M.I.	= Multiple Index.
Sch. I.	= Schilling Index.
M.	= Myelocytes.
J.	= Juveniles.
St.	= Stabs.
Seg.	= Segmenters.
P.	= Percentage polymorphonuclear cells.
W.	= Percentage monocytes.
L.	= Percentage lymphocytes.
Total Lymph	= Total lymphocytes.
E.	= Percentage eosinophiles.
M.	= Percentage mast cells.
R.P.	= Reproductive power.
T.	= Threshold.
D.	= Depressed.
S.D.	= Severely depressed.
St.	= Stimulated.
S.St.	= Severely stimulated.
Reg.	= Regenerative.
Deg.	= Degenerative.

Name:- P.D. No:- 1. Sex: Male. Age:- 3½ months.

Admitted:- 9.10.36. Died:- 12.10.36.

History:- This was an illegitimate child admitted from a Convent Home. He had been in hospital two months previously suffering from bilateral otitis media and enteritis, which had responded to treatment. The present history was that of diarrhoea and vomiting of 24 hours duration, loss of weight, restlessness and refusal of food.

Condition on Examination:- The infant was very toxic and dehydrated with sunken eyes and fontanelle. The tympanic membranes were both red and lustreless, but there was no discharge. Temperature was 101.2° F.

Progress:- Two days later child was very ill and lost weight markedly. The fontanelle was sunken and both tympanic membranes were as before. On 11.10.36 bilateral posterior drainage of the mastoid antra was performed. The bone on both sides was unhealthy, on the left side a small amount of pus and on the right a considerable quantity. On the following day it was much worse and shortly before death temperature rose to 103° F.

Blood Investigations:- Only two estimations were made on this case, one before operation and one after. The total white counts were not raised and the neutrophilic response was not marked. In the first estimation the multiple index was not unduly raised and rose after operation.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	10·10·36	68	12000		4	·25			20	80	7280	56	4·5	39·5	1235			St	D.	Deg.
2.	12·10·36	71	13500	·02	8·7	·54		3	32	64	9685	71	2	26	3510	·5		S. St	D.	Reg.

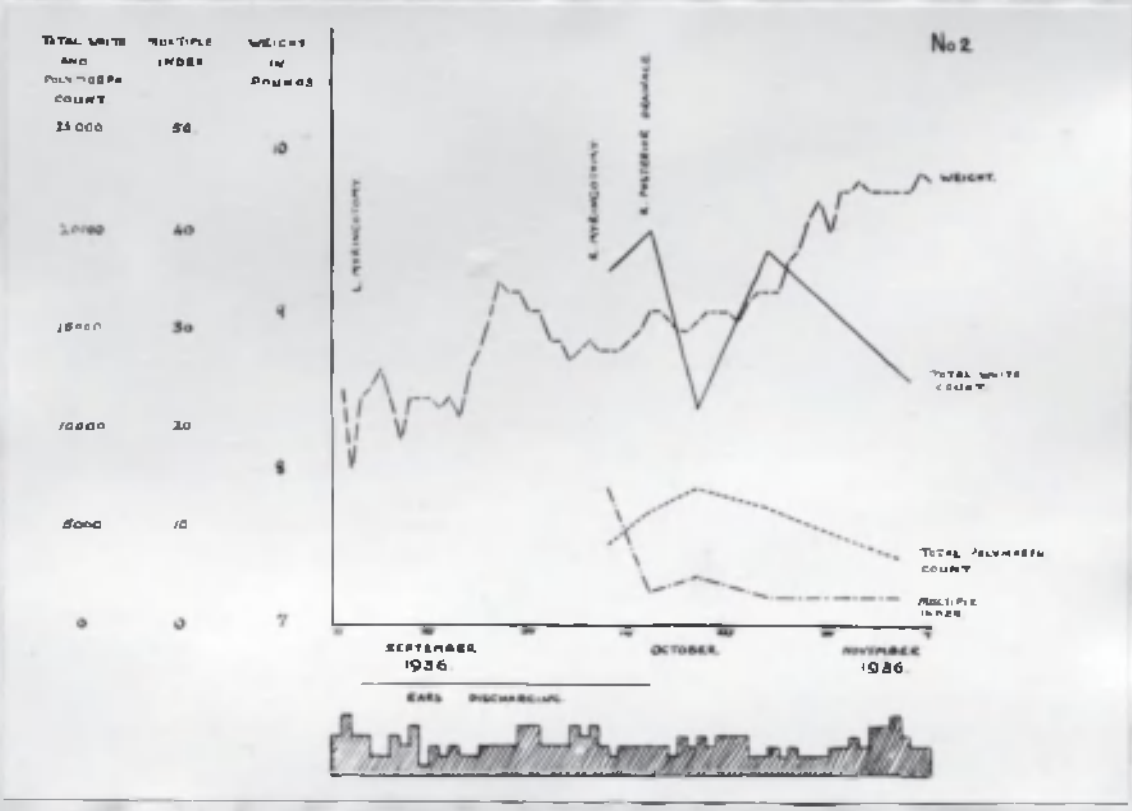
Name:- T.D. No:- 2. Sex:- Male. Age:- 8½ months.

Admitted:- 11.9.36. Discharged:- 8.11.36.

History:- This child was admitted with a history of diarrhoea and vomiting three weeks previously and stools had been much worse during last two weeks. The infant had lost weight considerably.

Condition on Examination:- This child seemed fairly well. Ears were full of debris and tympanic membranes looked unhealthy. Stools were very loose and green and temperature was 99.2° F.

Progress:- Two days later temperature was 99.4° F. and child did not look so well. Right tympanic membrane was red and left tympanic membrane was red and bulging. Left myringotomy was performed and thin pus obtained. On 21.9.36 child was not gaining weight and left ear was discharging profusely. On 29.9.36 some weight had been gained and right ear was also discharging. On 7.10.36 right tympanic membrane was bulging. Right myringotomy was performed and pus obtained. This unsatisfactory state of affairs continued and on 12.10.36 left tympanic membrane was pink and discharge had ceased, but right ear was still discharging profusely. Right posterior drainage was performed and thick pus found in antrum and aditus. Weight still remained somewhat unsatisfactory and left tympanic membrane was pale. On 25.10.36 there was very little meatal discharge and wound was clean. By this time gain in weight had commenced and the infant was discharged well on 8.11.36.



Description of Graph:- Investigations on this case were not commenced until the infant had been in hospital some time. The first estimation took place a few days before the operation when the multiple index was elevated. A sharp fall in the multiple index followed the operation and then it fell to almost a normal figure. On 17.10.36 multiple index was slightly elevated and fell from that date, at which time final gain in weight commenced. Total white count rose after the operation and the curve has a second peak when multiple index has fallen - i.e. multiple index reflected the infant's condition more accurately. There was never any marked neutrophilic response.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	8.10.36	55	18000		14	·88			47	53	4140	23	12	60	10800	5		St.	D.	Deg.
2.	12.10.36	65	20000		3·8	·24			19·5	80·5	5800	29	2·5	61	12200	7		St.	D.	Deg.
3.	7.10.36	55	11000		5	·3			25	74	7040	64	2	25	1750	8	·5	St.	D.	Deg.
4.	24.10.36	76	19000		3	·20			17	83	6080	32	9·5	41·5	7885	16·5	·5	St.	D.	Deg.
5.	7.11.36	68	12400		3	·20			17	83	3590	29	17	42	5208	12			D.	Deg.

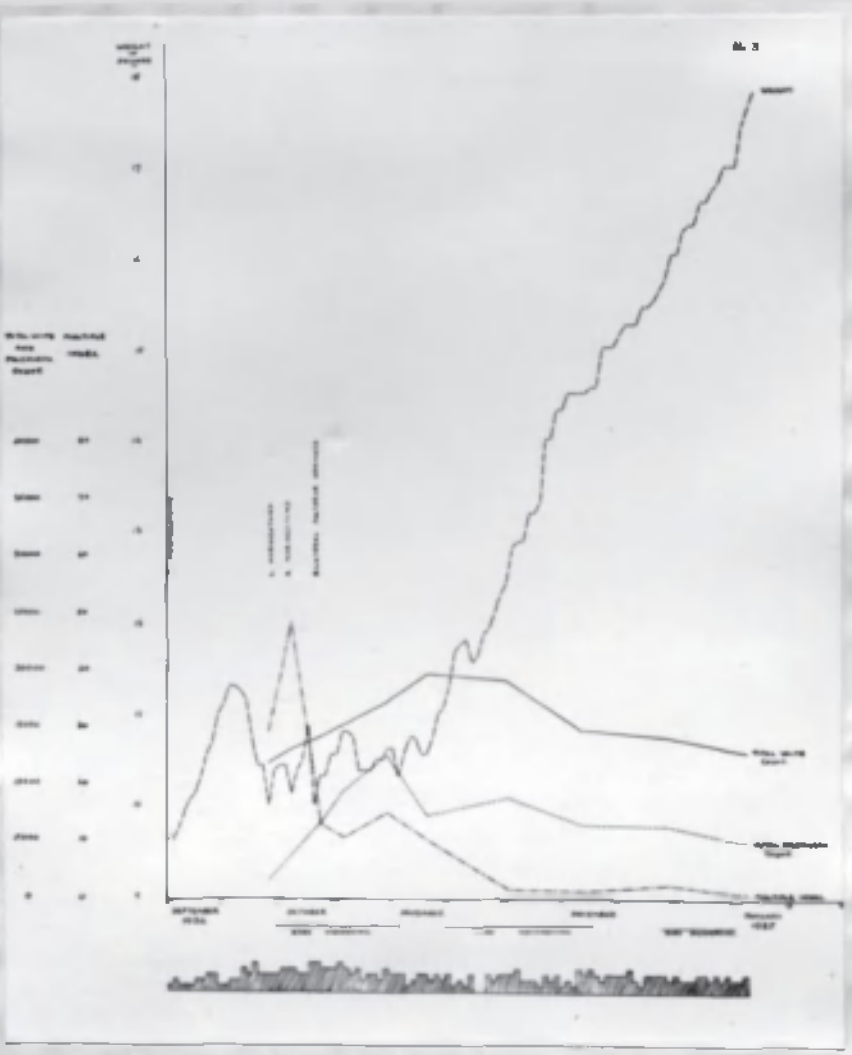
Name:- M.M. No:- 3. Sex:- Female. Age:- 9½ months.

Admitted:- 26.9.36. Discharged:- 4.1.37.

History:- This child was admitted with a history of two loose, green stols the evening before admission. The infant had been taking its feeds well.

Condition on Examination:- The infant was in fair condition, with no dehydration. The right tympanic membrane was injected and bulging but other examination was negative. Temperature was 99° F.

Progress:- Right myringotomy was performed but no pus was obtained. Condition then improved until 12.10.36 when temperature rose to 99° F. and weight loss began. Both tympanic membranes were very injected and the right was bulging slightly posteriorly. On 14.10.36 left tympanic membrane was bulging and left myringotomy was performed and pus released. On 17.10.36 further weight loss occurred and the right tympanic memorane was still very red and bulging somewhat. Right myringotomy was performed but no pus obtained. On 21.10.36 the infant lost 14 ozs. in weight. Bilateral posterior drainage was performed and on the left side the bone was hyperaemic while there was pus on the right side with rather soft bone. On 29.10.36 both wounds were satisfactory and there was still slight discharge from the left meatus. On 3.11.36 temperature rose to 103° F. and stools were loose. Both wounds looked satisfactory, the right being almost healed. There was slight discharge from the right ear. On 9.11.36 the child was apyrexial but weight was stationary. On 23.11.36 infant was gaining weight steadily, both wounds were healed, but there was still slight left otorrhoea. Condition continued satisfactory until 5.1.37 when she was discharged from hospital.



Description of Graph:- Investigations on this case were unfortunately not commenced until the child had been in hospital for some time. The multiple index was high at first estimation and rose sharply. It then fell considerably and was actually falling at time of operation. Decision to operate was made on the heavy weight loss which occurred on 21.10.36 and the child's poor general condition. It was becoming toxic. The fact that multiple index was falling at time of operation and although it remained elevated but at a lower figure, suggests that possibly the infant might have recovered without operation. It will be noticed that the beginning of the fall of multiple index to normal coincides with the commencement of its final gain in weight, i.e. the two curves diverge. The total white count was never markedly elevated and was rather on the low side in the more acute stage of the illness. There was good neutrophilic response following operation.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	13·10·36	54	11700	·08	29	1·8		1	44	35	1638	14	5	80	9360	1			D.	Reg.
2.	17·10·36	47	12900		48	3·0			71	23	3870	30	10	57	7353	2·5			S. D	Deg.
3.	22·10·36	85	14000		13	·82			46	54	6440	46	13·5	36·5	5110	3	1	St.	D.	Deg.
4.	26·10·36	70	15800		10·5	·66			24	76	9225	61·5	6	31	4898	1·5		St.	D	Deg.
5.	3·11·36	65	17700	·009	14·7	·92		1	47	52	12410	73	6·5	16	2832	4·5		S. St.	D	Reg.
6.	10·11·36	66	19500	·004	10	·63		·5	38·5	61	7117	36·5	9·5	38	7410	15·5	·5	St.	D	Reg.
7.	24·11·36	51	18900		1·9	·12			11	89	8788	46·5	12	31·5	5953	9·5	·5	St	D.	Deg.
8.	7·12·36	65	14600		1·2	·08			7·5	92·5	6424	44	10	35·5	5183	10·5		St		
9.	22·12·36	50	14000		2·2	·14			12·5	87·5	6370	45·5	12·5	35·5	4970	6	·5	St.	D	Deg.
10.	5·1·37	62	12600		·64	·04			4	96	4914	39	11	45	5670	4·5	·5			

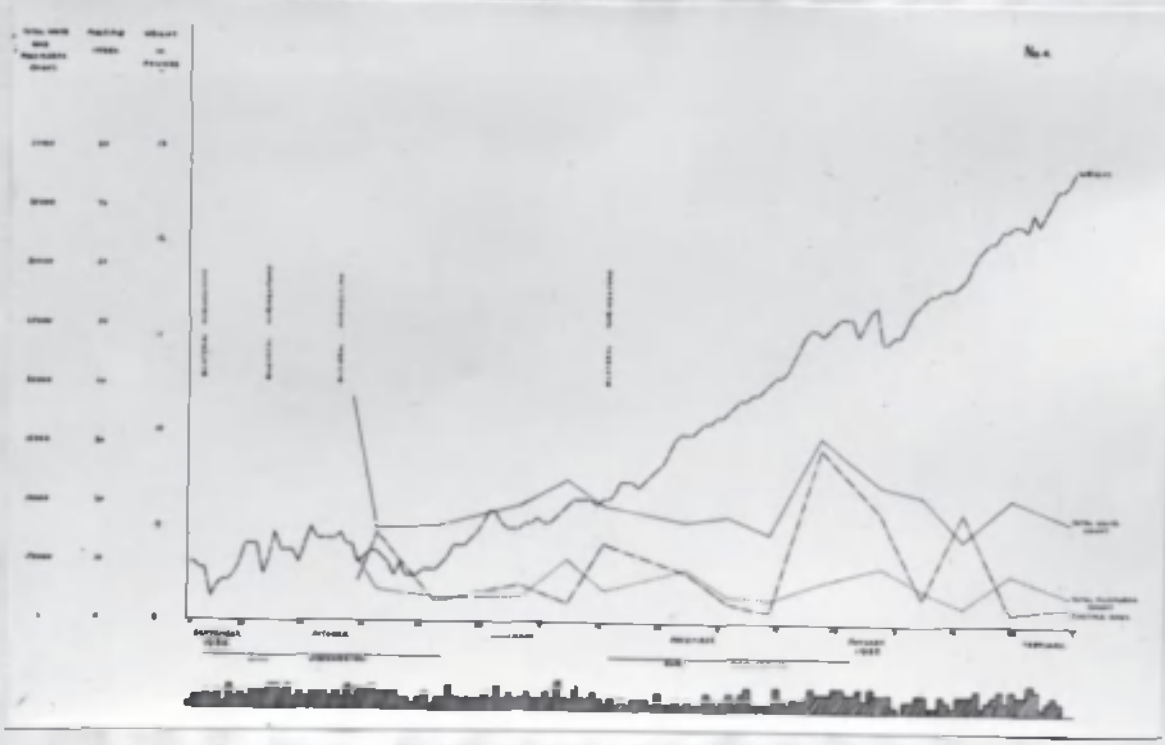
Name:- J.H. No:- 4. Sex:- Female. Age:- 4 months.

Admitted:- 11.9.36. Discharged:- 5.2.37.

History:- This child was admitted with a history of having vomited all day of admission, also on the previous day. Diarrhoea occurred day before admission.

Condition on Examination:- The child was not emaciated or dehydrated. Vomiting and hiccough were present. Other examination was negative.

Progress:- On the following day the right tympanic membrane was found to be red and lustreless and left tympanic membrane bulging slightly. On 13.9.36 bilateral myringotomy was performed and pus obtained from the right ear. On 22.9.36 the child developed temperature of 101° F. and both ears were discharging freely. Temperature rose to 103° F. on 24.9.36 and there was very little discharge. Bilateral mryingotomy was repeated and pus obtained from both ears. Weight remained stationary during this time and on 6.10.36 both ears were again red and bulging. Bilateral myringotomy was repeated and pus released from the right ear. On 17.10.36 stools were still loose and the infant was not gaining weight satisfactorily. The right ear was discharging profusely and the left tympanic membrane was slightly injected. Discharge ceased on 23.10.36 and the infant began to gain slowly, but not satisfactorily. Bilateral myringotomy was performed on 20.11.36 and pus released from both ears, particularly the left. Both ears continued to discharge until 21.12.36, when the right ear became dry and the left only slightly moist. Slow gain in weight had been taking place all this time. On 1.1.37 blood appeared in stools and continued throughout 2.1.37 but general condition remained good. Organisms grown from stools were B. pyocyaneous on 5.1.37 when blood and mucus recurred and B. Morgan I on 6.1.37. Serum agglutinated cultures of B. Morgan I in dilutions up to 1/50. Blood culture was sterile. The infant then progressed satisfactorily until its discharge on 5.2.37.



Description of Graph:- Blood investigations were commenced in this case some time after admission. It will be seen that the multiple index was elevated at the first estimation and rose slightly while the total white count fell. At this time the child's condition was unsatisfactory so that the multiple index was a more accurate index of its condition than the total white count. The multiple index remained elevated, while the ears were not discharging and rose sharply on 19.11.36. Bilateral myringotomy was performed on the strength of this and pus found in both ears. Thereafter the multiple index gradually settled and weight curve rose slowly. Suddenly on 26.12.36 the multiple index rose sharply, coincident with a spell when gain in weight ceased, and on 1.1.37 the attack of acute enteritis occurred. The rise of multiple index heralded this by almost one week. There had also been a rise in total white count but not such as to give rise to alarm. The multiple index subsided but again rose on 20.1.37. No satisfactory explanation for this second peak was ever discovered. Throughout this case the multiple index was a reliable guide as to progress.

No.	Date	Hb.	Total W. B. Cs.	L I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	8·10·36	57	19000		7	·4			30	70	5130	27	13	58	11020	2		St.	D.	Deg.
2.	12·10·36	59	8000	·02	15	·9		2	47	50	2920	36·5	7	56·5	4520				D.	Reg.
3.	22·10·36	69	8200		3·6	·23			19	81	2173	26·5	9	56·5	4633	7	1		D.	Deg.
4.	5·11·36	70	10000		6·7	·42			33	77	2200	22	20·5	54	5400	2	1·5		D.	Deg.
5.	18·11·36	58	12200		3·5	·22			18·5	81·5	5429	44·5	15·5	42	5124	3		St.	D.	Deg.
6.	19·11·36	75	10000		13·2	·83			45·5	54·5	2950	29·5	22·5	47	4700	1			D.	Deg.
7.	3·12·36	62	8600		8·8	·55			35·6	64·5	4644	54	18	26·5	2279	1	·5	St	D.	Deg.
8.	10·12·36	65	9200		3·6	·23			19	81	2484	27	18	52·5	4830	1	1·5		D.	Deg.
9.	17·12·36	63	7600		2·0	·19			16·5	83·5	2128	28	19	50	3800	2·5	·5		D.	Deg.
10.	26·12·36	54	15800		28·8	1·8			63·5	36·5	3713	23·5	31	44	6954	1·5			D.	Deg.
11.	5·1·37	57	11800	·01	19·2	1·2		1·5	54	44·5	4897	41·5	19·5	38	4484	1		St.	D.	Reg.
12.	12·1·37	60	11000		4·8	·30			23·5	76·5	3135	28·5	14	56	6160	1	·5		D.	Deg.
13.	19·1·37	60	7300	·01	19·2	1·2		1·5	54	44·5	1642	22·5	19·5	50·5	3696	1·5	1		D.	Reg.
14.	27·1·37	65	10800		2·8	·18			15·5	84·5	4482	41·5	16·5	38·5	4158	3	·5	St.	D.	Deg.
15.	6·2·37	70	8900		3·5	·22			18·5	81·5	2670	30	10·5	57	5073	2·5			D.	Deg.

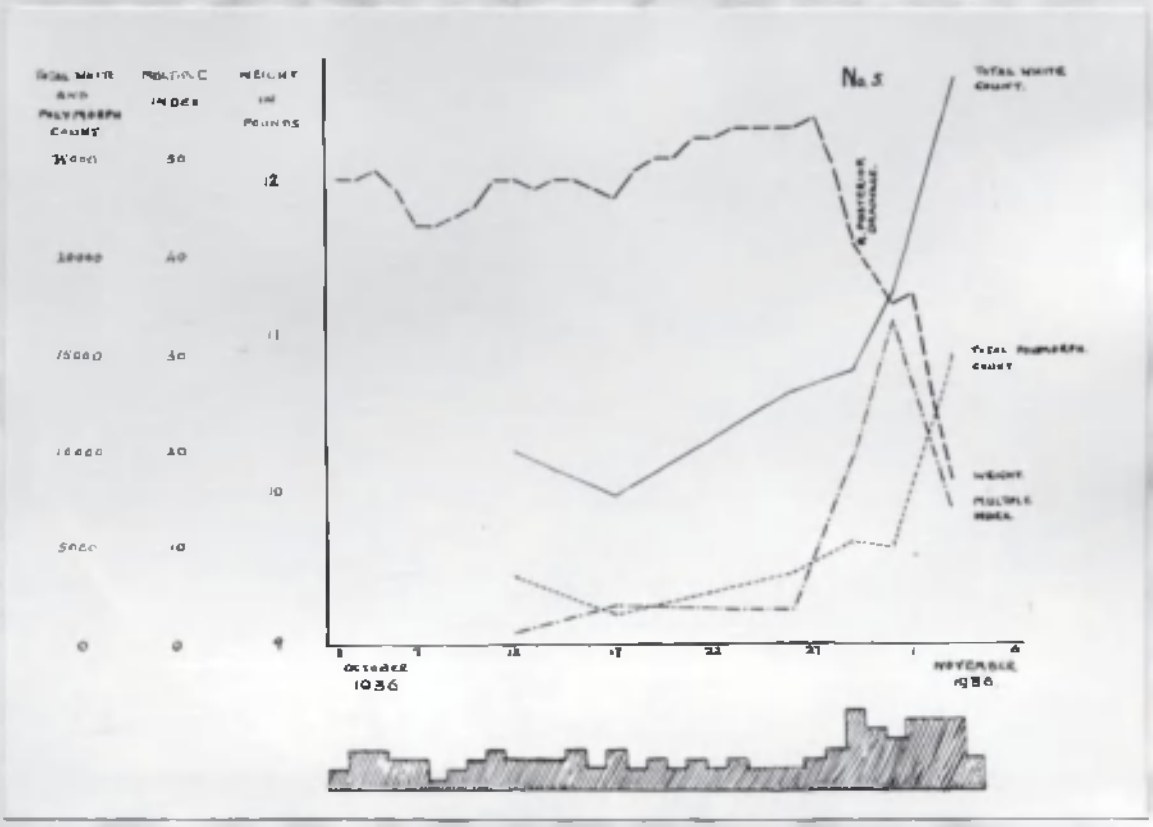
Name:- L.W. No:- 5. Sex:- Male. Age:- 4 months.

Admitted:- 3.10.36. Died:- 5.11.36.

History:- This child had been ill for two days with vomiting and diarrhoea. He was very fretful and the mother thought he had lost some weight, but there was no history of otorrhoea.

Condition on Examination:- The child was fretful, but there was no dehydration and no toxicity. There was a small umbilical hernia, and other examination was negative. The temperature was 99.9° F.

Progress:- On the day after admission stools were very loose and the right tympanic membrane was slightly injected. A few days later the right tympanic membrane was red and unhealthy. Weight remained stationary for the next 18 days and both ears were red. On 27.10.36 weight loss began and by 29.10.36 the infant had lost 13 ozs. Right posterior drainage was performed and thick pus found in mastoid cells. The additus and middle ear appeared to be full of pus. Further weight loss occurred on 1.11.36 and 2.11.36 and temperature rose to 101.2° F. Death occurred on 5.11.36.



Description of Graph:- At the first examination the total white count was not raised but the multiple index was slightly elevated. The multiple index rose sharply prior to operation but the total white count did not and there was a poor neutrophilic response. The multiple index here gave an earlier and more accurate prognosis and its curve corresponds with the fall in weight curve, i.e. the weight and multiple index curves converged indicating a bad prognosis. The multiple index rose again after the operation and then fell abruptly before death.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	12-10-36	45	10.000		1·2	·07			7	93	3500	35	4	60	6000	·5				
2.	17-10-36	60	7700		4	·28			28	71	1694	22	11	64	4928	2·5	·5		D	Deg.
3.	26-10-36	87	13000		3·6	·23			19	81	3770	29	8·5	57·5	7475	4·5	·5		D	Deg.
4.	30-10-36	67	14,100	·05	19·2	1·2		2·5	53·5	44	5146	36·5	14	49	6909		·5		D	Reg.
5.	31-10-36	72	18,000	·04	33	2·1		3	65	32	4950	27·5	16·5	55·5	9990	·5		Sc.	S.D	Reg.
6.	3-11-36	61	28300	·009	14	·88	·5	5	41·5	53	14999	53	6	41	11603			S.Sc.	D	Reg.

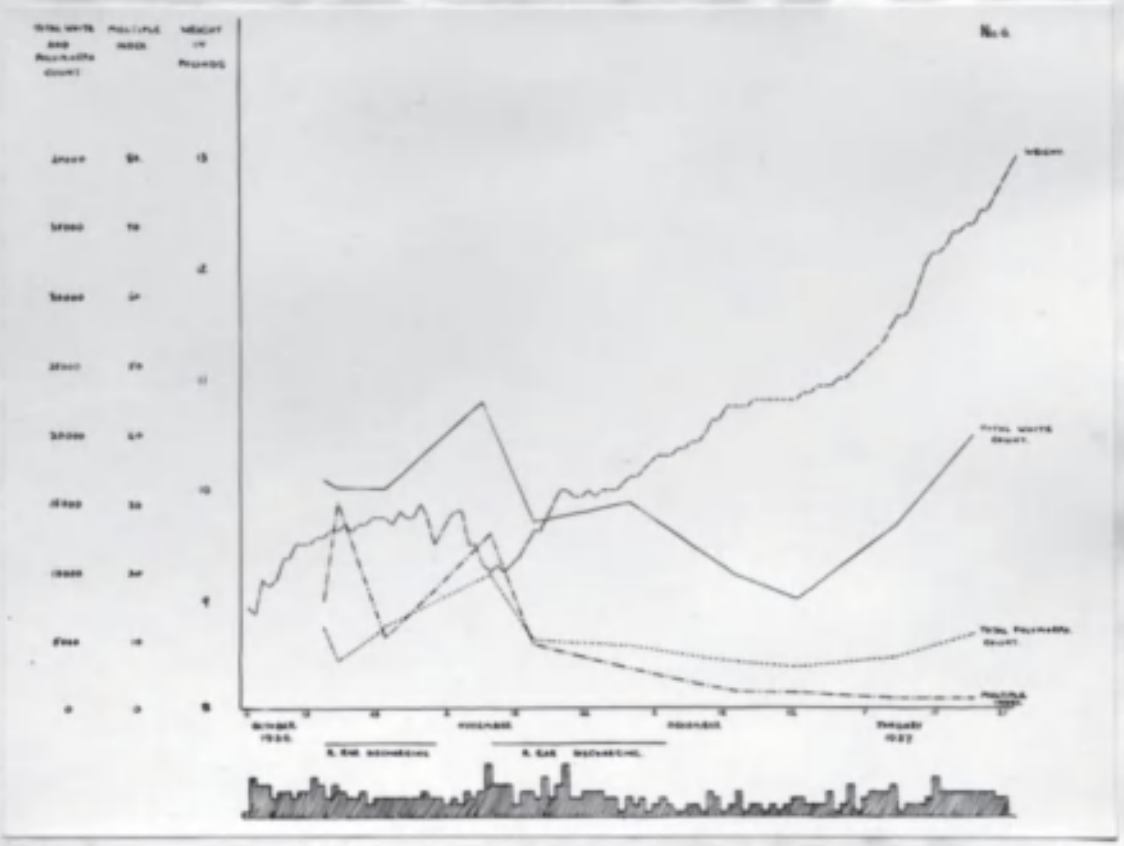
Name:- W.S. No:- 6. Sex:- Male. Age:- 2 months.

Admitted:- 4.10.36. Discharged:- 20.1.37.

History:- This child was admitted with a history of refusal of feeds for one week and vomiting of three days' duration. Stools were loose and there was some loss of weight. Infant was not unduly fretful.

Condition on Examination:- Left tympanic membrane was red but otherwise examination was negative. Temperature was 99° F. and stools very loose and frequent.

Progress:- Temperature subsided but stools continued loose and child did not gain weight satisfactorily. On 15.10.36 there was copious right otorrhoea with a very injected tympanic membrane. Left tympanic membrane was slightly injected but there was no bulging. On 28.10.36 general condition was better but gain in weight was unsatisfactory although the stools had improved. Right tympanic membrane was slightly injected but there was no discharge. On 4.11.36 weight loss began and temperature rose to 99° F. and on 7.11.36 right ear was again discharging profusely. Discharge continued for some time and weight gain continued. On 21.12.36 tympanic membranes were lustreless with no discharge and general condition was much improved. General condition then improved until discharge from hospital on 20.1.37.



Description of Graph:- The multiple index was raised at the beginning and remained so throughout the period when gain in weight was unsatisfactory. It fell and rose again as otorrhoea ceased and weight fell. It fell again on 14.11.36 and continued to do so until it became normal and from that date weight began to go up - the two curves diverged. The total white count was not high to begin with when the multiple index was a more accurate guide, and its rise preceded the rise of total white count on 8.11.36. The total white count was actually rising when the child was discharged but the multiple index was normal and it was considered safe to discharge the infant. Throughout the multiple index reflected the clinical condition of the child much more accurately than the total white count or total polymorphonuclear count.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	6. 10. 36	59	16700	·01	16	1·0		1	49	50	6012	35	8·5	54·5	9101	1			D.	Reg.
2.	17. 10. 36	59	16300	·02	30	1·9		1·5	64	34	3749	23	8	67	10921	1	·5		S. D.	Reg.
3.	24. 10. 36	61	16100	·015	10·5	·66		2	38	60	6279	39	13	44·5	7164	3	·5		D.	Reg.
4.	7. 11. 36	66	22300		25·5	1·6			62·5	37·5	9923	44·5	9	45	10035	1·5		S.	D.	Deg.
5.	13. 11. 36	65	13700	·01	9·6	·6		1	36·5	62·5	5206	38	15	45·5	6244	1	·5		D.	Reg.
6.	28. 11. 36	58	16000		6·0	·38			27·5	72·5	4725	31·5	15	49	7350	4	·5		D.	Deg.
7.	13. 12. 36	66	9800		2·8	·18			15·5	84·5	3528	36	11	52	5096	·5	·5		D.	Deg.
8.	22. 12. 36	75	8300		2·5	·16			4·5	85·5	3112	37·5	14·5	46	3518	1·5	·5		D.	Deg.
9.	5. 1. 37	60	13300		1·9	·12			11	89	3857	29	9·5	57·5	7647	4				
10.	16. 1. 37	50	19900		1·9	·12			11	89	5572	28	13	58	11542	·5	·5			

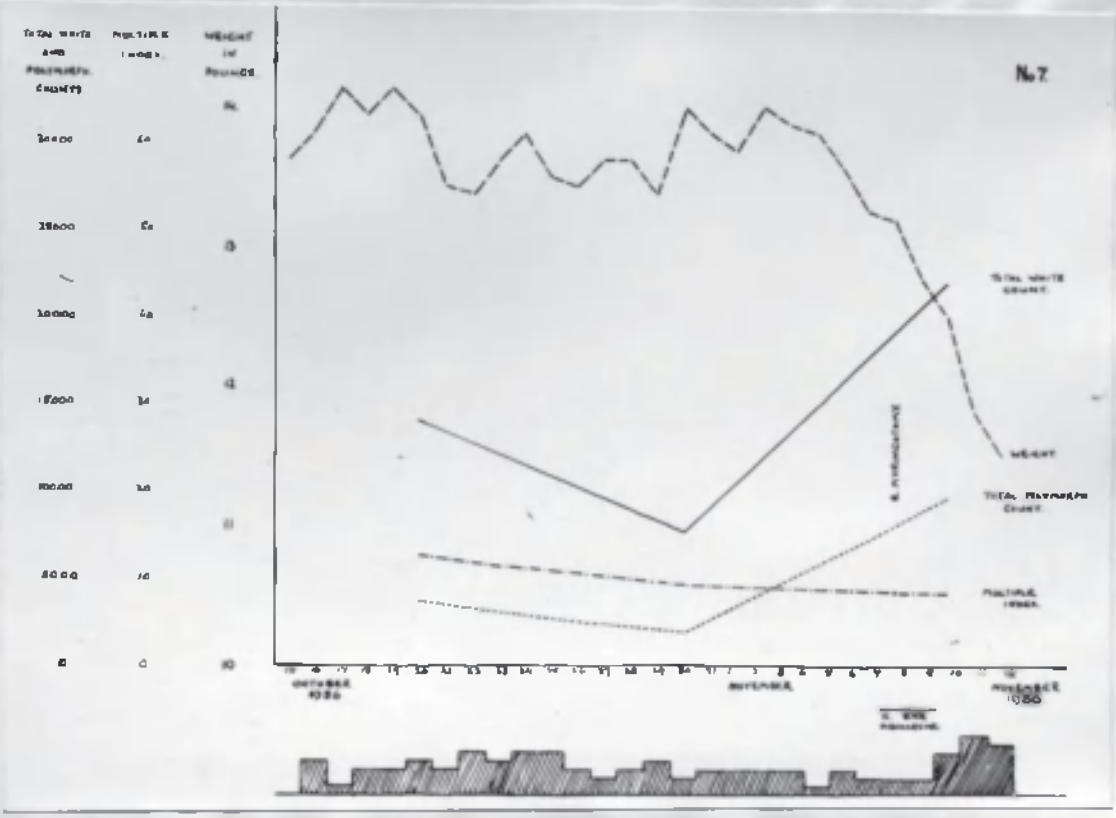
Name:- R.J. No:- 7. Sex:- Male. Age:- 10 weeks.

Admitted:- 25.10.36. Died:- 12.11.36.

History:- This child was admitted with a history of three convulsions the day before and one convulsion on the morning of admission. It had been taking its feeds well but its stools had been frequent and green. There was no vomiting and its temperature at home was 103° F.

Condition on Examination:- The child seemed in fair condition. The fontanelle was slightly full but there were no meningeal signs and the ears and other systems appeared normal.

Progress:- A few days later the child lost weight and both tympanic membranes were found to be injected and lack lustre. Loss of weight continued and there was mild pyrexia - 99° F. and frequent loose stools. Weight then remained stationary for about a fortnight but the general condition was improved. The tympanic membranes remained slightly injected. On 5.11.36 weight began to fall again and on 7.11.36 right myringotomy was performed with discharge of thin muco-pus. Weight continued to fall and on 9.11.36 temperature rose to 101.2° F. There was no discharge from right ear. The child rapidly became very toxic and ill and ultimately died on 12.11.36.



Description of Graph:- At the first estimation the total white count was slightly elevated but the neutrophilic response was poor. The multiple index, although not excessively high, was elevated. The second reading showed a marked fall in total white count, but the multiple index remained elevated, giving a more accurate prognosis. The total white count rose before death with a more satisfactory neutrophilic response and the multiple index remained stationary.

No.	Date	Hb.	Total W. B. Cs.	L I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R P.	T.	Type of Left Shift
1.	19-11-36	67	20900	·009	12·6	·79	·5	2	43	54	3616	27	6	60	12540	·5			D.	Reg.
2.	30-10-36	76	7700	·007	9·1	·57		1	36	63	1925	25	15	55·5	4273	3	1·5		D.	Reg.
3.	9-11-36	65	21900		8·1	·51			34	66	9636	44	11	43·5	9526	1	·5	S. St	D.	Reg.

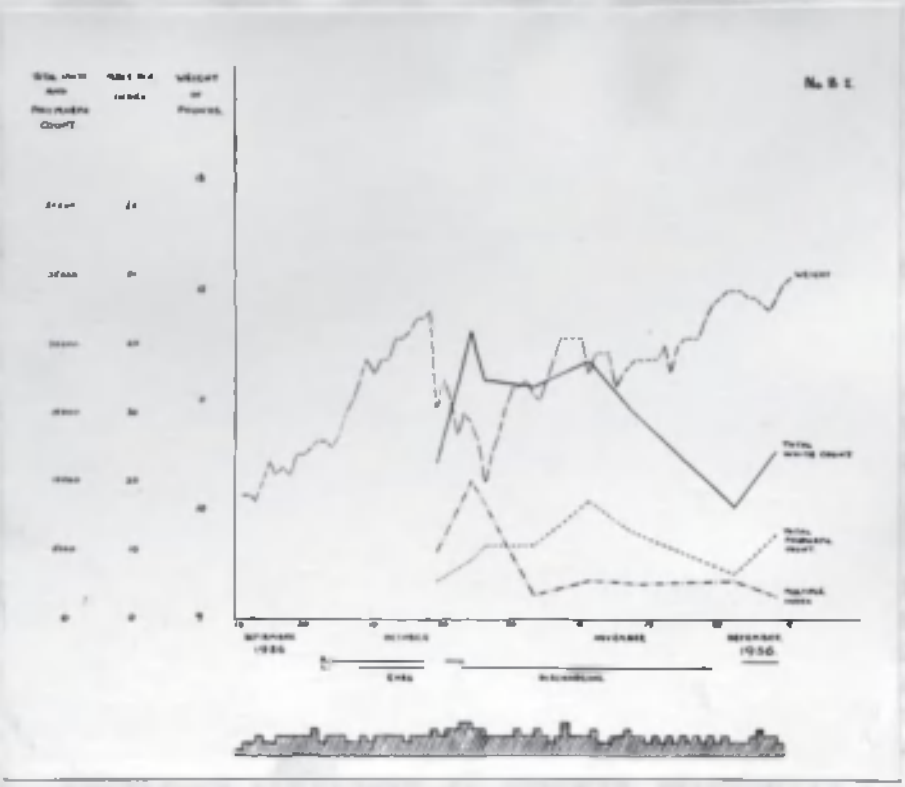
Name:- G.C. No:- 8. Sex:- Male. Age:- 4 months.

I. Admitted:- 20.9.36 Discharged:- 9.12.36.

History:- This child was admitted with a history of watery, frequent motions, which had commenced the day before. Vomiting had occurred once. Cough had occurred for two weeks previously. Child had appeared "feverish" for 24 hours, and had been twitching on evening of admission.

Condition on Examination:- The child was not dehydrated and tension of fontanelle was normal. There were numerous rhonchi and patches of harsh breath sounds throughout lungs and few crepitations. Other examination was negative and temperature was 101° F.

Progress:- Two days later temperature had subsided, slight gain in weight had occurred, and ears seemed normal. On 8.10.36 weight was going up satisfactorily but there was then discharge from both ears, and on 19.10.36 temperature rose to 103° F. and the infant lost weight severely. Right tympanic membrane was pink and there was a large perforation in left tympanic membrane but not much discharge. Loss of weight continued and child was very ill and toxic. Left otorrhoea continued. On 27.10.36 general condition had improved, stools were more formed, there was no vomiting and temperature had settled. Left ear showed a perforation with some discharge, while right tympanic membrane was pale. On 2.11.36 infant was much improved, gain in weight had occurred and left ear was still discharging profusely. This situation continued until 3.12.36, when profuse discharge was observed from right ear. Meanwhile left ear had ceased to discharge. The infant was unfortunately taken home by its parents on their own responsibility on 9.12.36.



Description of Graph:- (First Admission).

This was a case of otitis media, associated with bronchitis and investigations were not commenced until the infant was reasonably certain to be free from respiratory symptoms.

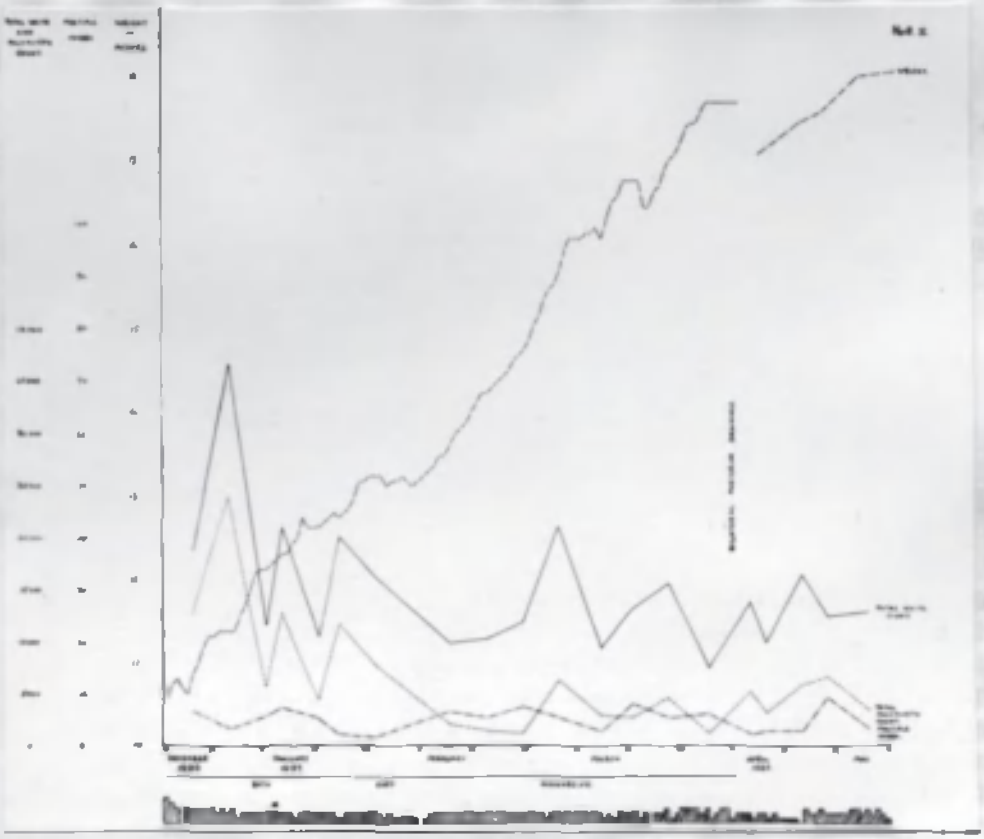
The first count was taken at the point where temperature rose again and a severe weight loss occurred. Both ears had been discharging prior to this and it is possible that the advent of symptoms of toxicity coincided with involvement of the mastoid cells. Multiple index was elevated and rose with further weight loss and fell where gain in weight was re-established. It did not fall completely to normal and was still elevated when the infant was taken out of hospital by its parents. Total white count was somewhat elevated, but total polymorphonuclear count did not rise until much later. Acute illness coincided with cessation of otorrhoea for a few days and recovery took place when drainage was re-established.

II. Re-Admitted:- 21.12.36. Discharged:- 13.5.37.

History:- The infant was re-admitted with history of vomiting for two days and green stools, cough and loss of weight.

Condition on Examination:- Child was slightly dehydrated and suffering from bilateral chronic suppurative otitis media. Temperature was 100° F. and stools were loose.

Progress:- Temperature continued in the vicinity of 99° F. for four days, during which there was profuse otorrhoea and loose stools. General condition then improved and gain in weight commenced. This situation continued until 12.1.37, when there was a pyrexial bout which quickly subsided. The child's general condition continued to improve throughout January, February and March, but otorrhoea with mild elevations of temperature continued, and on 9.4.37 bilateral posterior drainage was performed. Meatal discharge ceased soon after but discharge continued from wounds which gradually healed with slight moisture in meati. Infant was discharged well on 13.5.37.



Description of Graph:- (Second Admission).

The infant was mildly pyrexial at first and the total white count and total polymorphonuclear count both showed considerable increase, but multiple index was not markedly raised corresponding with the child's general condition, which was fairly good. Total white count fell to within normal limits, but multiple index stayed at its original level, indicating the presence of infection. It fell to normal but soon rose again. Operation was performed on 9.4.37 after which it fell slightly, but rose again. Several counts taken as an out-patient showed multiple index normal.

III. Re-Admitted:- 11.6.37. Discharged:- 25.6.37.

The infant was re-admitted with temperature of 99° F. and profuse bilateral otorrhoea. The condition gradually settled, and the child was discharged with both ears dry on 25.6.37.

IV. Re-Admitted:- 22.7.37. Discharged:- 2.12.37.

The infant was re-admitted with history of left otorrhoea for last three weeks. On examination right ear appeared quiescent but left ear was discharging profusely, and on 17.8.37 left posterior drainage was re-opened. Satisfactory progress was made, and on 11.9.37 wound was healing well, but there was still profuse meatal discharge. On 2.10.37 both ears were discharging profusely and there was a small abscess in right mastoid scar. This was incised and pus released. On 20.10.37 right posterior drain was re-opened. On 24.11.37 there was still profuse bilateral meatal discharge and on 16.11.37 temperature rose and a bronchopneumonia patch was found in the chest. This cleared satisfactorily.

The question of radical operations was considered, but it was decided that the child was too young for this. It was then discharged to attend the Out-Patient Department.

Description of Blood Investigations.

Third Admission:- The one estimation performed showed a raised total white count and mildly raised multiple index.

Fourth Admission:- Throughout this admission the multiple index was persistently raised, indicating the presence of infection, the multiple index fell after re-opening of left posterior drainage on 17.8.37 and rose sharply with abscess formation in right mastoid scar, falling again after this was opened. It rose again and fell with re-opening of right posterior drainage to a normal figure, rising again on 18.11.37 with the onset of broncho-pneumonia.

	No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
I	1.	19·10·36	72	11400	·008	10	·67	·5	1·5	39	58	2850	25	5	69	7866		·5		D.	Reg.
	2.	24·10·36	68	21000	·06	20	1·3		5	52	43	4410	21	5·5	72	15120	1·5		S. St.	D.	Reg.
	3.	26·10·36	60	17500	·03	16·9	1·06		3	51	48	5300	36	13·5	48	8400	1·5		St.	D.	Reg.
	4.	2·11·36	65	17000		3·6	·23			19	81	5355	31·5	12·5	53·5	9095	2·5		St.	D.	Deg.
	5.	10·11·36	70	18900		5·7	·36			36·5	73·5	8694	46	5	48·5	9166	·5		St.	D.	Deg.
	6.	16·11·36	70	15400		5·1	·32			24·5	75·5	6545	42·5	2	54	8316	1·5		St.	D.	Deg.
	7.	1·12·36	62	8200		5·92	·37			27	73	3485	42·5	9	47	3854	1·5		St.	D.	Deg.
	8.	7·12·36	57	12200		3·5	·22			19·5	80·5	6282	51·6	11·5	35·5	4331	1	·5	St.	D.	Deg.
II	9.	16·12·36	56	19400	·007	6·7	·42		·5	29·5	70	12910	60·5	8	25	4850	·5		S. St.	D.	Reg.
	10.	2·1·37	47	36700	·006	3·3	·21		·5	17	82·5	24038	65·5	6	28·6	10459			S. St	D.	Reg
	11.	9·1·37	43	11700	·002	5·9	·37		·5	27	72·5	6850	50	13·5	36·5	4270			St.	D.	Reg.
	12.	12·1·37	35	21000	·01	7·3	·46		1·5	31	67·5	12915	61·5	11	27·5	5775			S St.	D.	Reg.
	13.	19·1·37	59	10500		5·2	·33			25	75	4515	43	11·5	44	4620	1	·5	St.	D.	Deg.
	14.	23·1·37	60	20200		2·2	·14			12·5	87·5	11817	58·5	10	31	6262	·5		S. St.	D.	Deg.
	15.	30·1·37	56	16300		1·9	·12			11·5	88·5	7905	48·5	10	40	6510	·5	·5	St.		
	16.	13·2·37	53	10000		6·7	·42			30	70	2100	21	17	60	6000	1	1		D.	Deg.
	17.	20·2·37	65	10400	·006	5·4	·34		1	25·5	73·5	1508	14·5	21·5	60·5	6292	2·5	1		D.	Reg.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
18.	27.2.37	86	12000		7.8	.49			33	67	1320	11	14.5	72.5	8700	1.5	.5		D.	Deg.
19.	6.3.37	80	21200		5.6	.35			26	74	6466	30.5	8	58.5	12401	3		S. St.	D.	Deg.
20.	14.3.37	80	9200		3.0	.19			16	84	3040	32	8	59	3606	1			D.	Deg.
21.	20.3.37	89	13,300	.003	8.3	.52		1	34	65	2926	22	14	62	8246	1	1		D.	Reg.
22.	27.3.37	40	15800	.006	5.7	.36		.5	26	73.5	4740	30	10	57.5	9085	2.5			D.	Reg.
23.	3.4.37	83	7700		6.4	.40			29	71	1386	18	8	70	5390	3.5	.5		D.	Deg.
24.	12.4.37	35	14000		2.4	.15			13.5	86.5	5460	39	11	49	6860	1			D.	Deg.
25.	15.4.37	44	10100		3.0	.19			16	84	3333	33	17	49.5	4999	.5			D.	Deg.
26.	22.4.37	31	16600		3.0	.19			16.5	83.5	6059	36.5	8	55.5	9881	2			D.	Deg.
27.	27.4.37	49	12600		9.6	.60			38	62	6930	56	8	34.5	4347	2.5		St.	D.	Deg.
28.	5.5.37	37	13100		3.8	.24			19.5	80.5	3608	28	13.5	57	7467	.5	.5		D.	Deg.
O.P. 29.	10.5.37	47	15800		.8	.05			5.5	94.5	8372	34	10	54.5	8611	1	.5			
30.	18.5.37	38	12200		1.1	.07			7	93	2745	22.5	9.5	64	7808	3.5	.5			
31.	15.6.37	63	23000		.96	.06			6	94	6612	28.5	13	57	13224	1.5		St.		
III. 32.	23.6.37	46	22100		2.5	.16			14	86	9392	42.5	4	51	11271	2		S. St.	D.	Deg.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
33.	16·8·37	38	9300	·006	3·3	·21		1	16·5	82·5	2278	24·5	11	60·5	5626	4			D.	Reg.
34.	18·8·37	33	13000		3·5	·22			18·5	81·5	7995	61·5	7·5	30·5	3965	·5		Sl.	D.	Deg.
35.	25·8·37	38	14100		1·4	·09			8·5	91·5	4935	35	10·5	51	7191	3·5				
36.	1·9·37	40	15400		4·0	·25			19·5	80·5	5467	35·5	14·5	55	8470	4·5	·5		D	Deg.
37.	8·9·37	42	10300	·01	6·0	·38		2	26	72	4738	46	11·5	38	3914	3·5	1	Sl.	D.	Reg.
38.	15·9·37	58	16400		1·4	·09			9	91	4428	27	13	59·5	9758	·5				
39.	22·9·37	56	17400		5·4	·34			25·5	74·5	9917	45·5	11·5	41·5	7221	1·5		Sl.	D.	Deg.
40.	29·9·37	43	15300	·014	33·6	2·1		3	65·5	31·5	5508	36	11	52	7936	1			S.D	Reg.
41.	1·10·37	40	31100	·009	12·8	·80		1	43·5	55·5	15083	48·5	10·5	37·5	11061	3·5		S. Sl.	D.	Reg.
42.	9·10·37	51	16300		4·6	·29			22·5	77·5	5460	33·5	10·5	54·5	8883	1	·5		D.	Deg.
43.	16·10·37	46	22000	·08	5·2	·33		·5	24·5	75	13530	61·5	13·5	23	5060	1·5	·5	S. Sl.	D.	Reg.
44.	20·10·37	58	15500	·03	8·3	·52		4	30·5	69·5	6742	43·5	13	42	6570	1·5		Sl.	D.	Reg.
45.	25·10·37	52	19600	·003	7·8	·49		·5	33·5	67	7154	36·5	7·5	52·5	10290	2·5	1	Sl.	D.	Reg.
46	27·10·37	46	24000		3·6	·23			19	81	13680	57	12	30	7200		1	S. Sl.	D.	Deg.
47.	1·11·37	57	13100	·003	2·8	·22		·5	18	81·5	5505	45·5	6	46	5566	2	·5	Sl.	D.	Reg.
48.	10·11·37	51	9800		1·6	·10			9·5	90·5	2450	22	10	67	6566		1			
49	15·11·37	50	17100	·01	13·1	·82		2	42	56	5985	35	9·5	55·5	9490			Sl.	D.	Reg.
50.	24·11·37	45	18200	·006	6·0	·38		1	27	72	11375	62·5	7	29	5278	1·5		Sl.	D.	Reg.

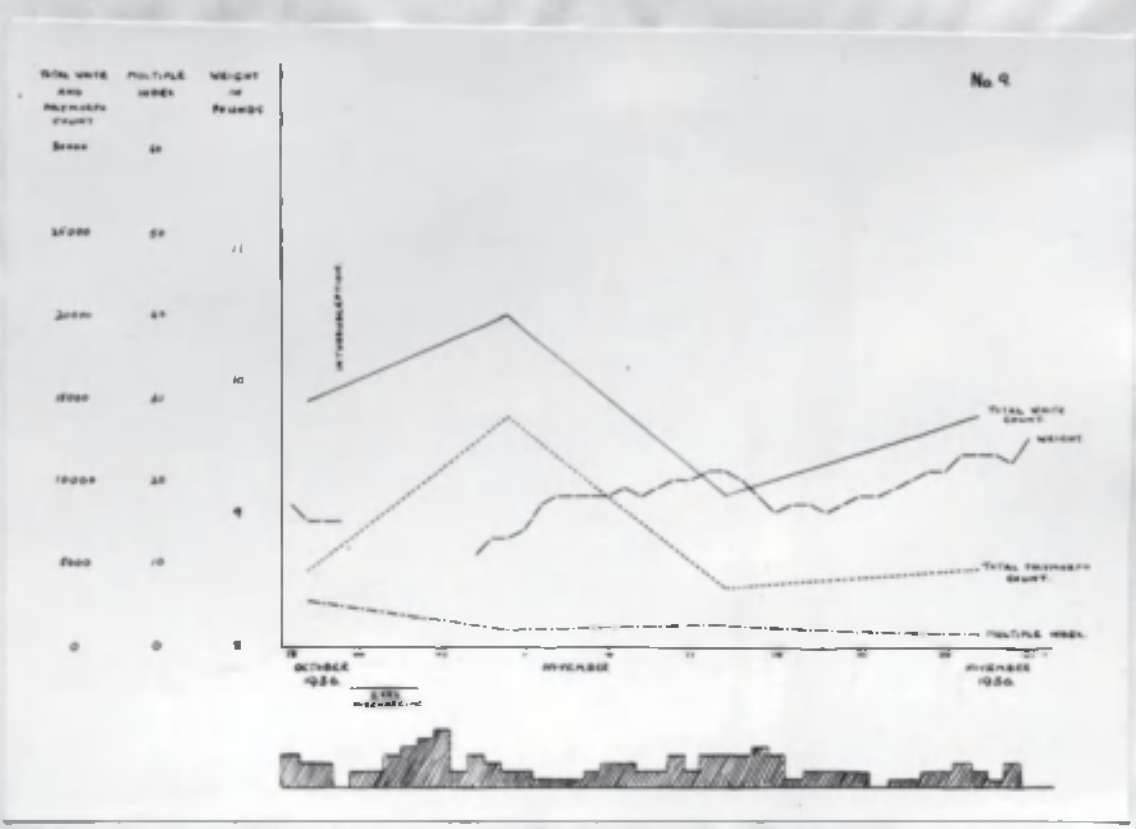
Name:- M.B. No:- 9. Sex:- Female. Age:- 3 months.

Admitted:- 18.10.36. Discharged:- 30.11.36.

History:- This child had been in hospital in August, 1936 with bilateral otorrhoea. On present occasion there was a recurrence of loose green stools and refusal of feeds, fretfulness and restlessness. There was also some vomiting.

Condition on Examination:- The child looked ill and both tympanic membranes were very red and injected. There was some nasal discharge and stools were loose and green. Temperature was 99° F.

Progress:- The general condition improved for two days and then on 21.10.36 blood was passed in quantity per rectum, and a tumour was palpable in the abdomen. A diagnosis of intussusception was made which was confirmed at operation. On the day following the operation there was slight otorrhoea, but on 27.10.36 there was no discharge and the child's general condition was much improved. Both tympanic membranes continued pink until 15.11.36, after which general condition improved until its discharge from hospital on 30.11.36.



Description of Graph:- This child suffered from a mild otitis media and the graph is interesting because it will be seen that the multiple index, although slightly raised, was never high and was completely unchanged by the occurrence of the intussusception and operation. The graph shows that the multiple index gives a response only in presence of infection which in this case is not marked.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	19.10.36	67	14800	.003	5.4	.40		.5	31.5	78	4514	30.5	6.5	61	9028	1	1		D.	Reg.
2.	31.10.36	69	20000		2	.18			12	88	13800	69	6.5	20	4000	3.5	1	S. St.	D.	Reg.
3.	13.11.36	52	9000		2.4	.15			13.5	86.5	3640	40	8.5	46	4186	5	.5		D.	Deg.
4.	28.11.36	63	13800		1.4	.09			9	91	4692	34	13	49.5	6831	1	2.5			

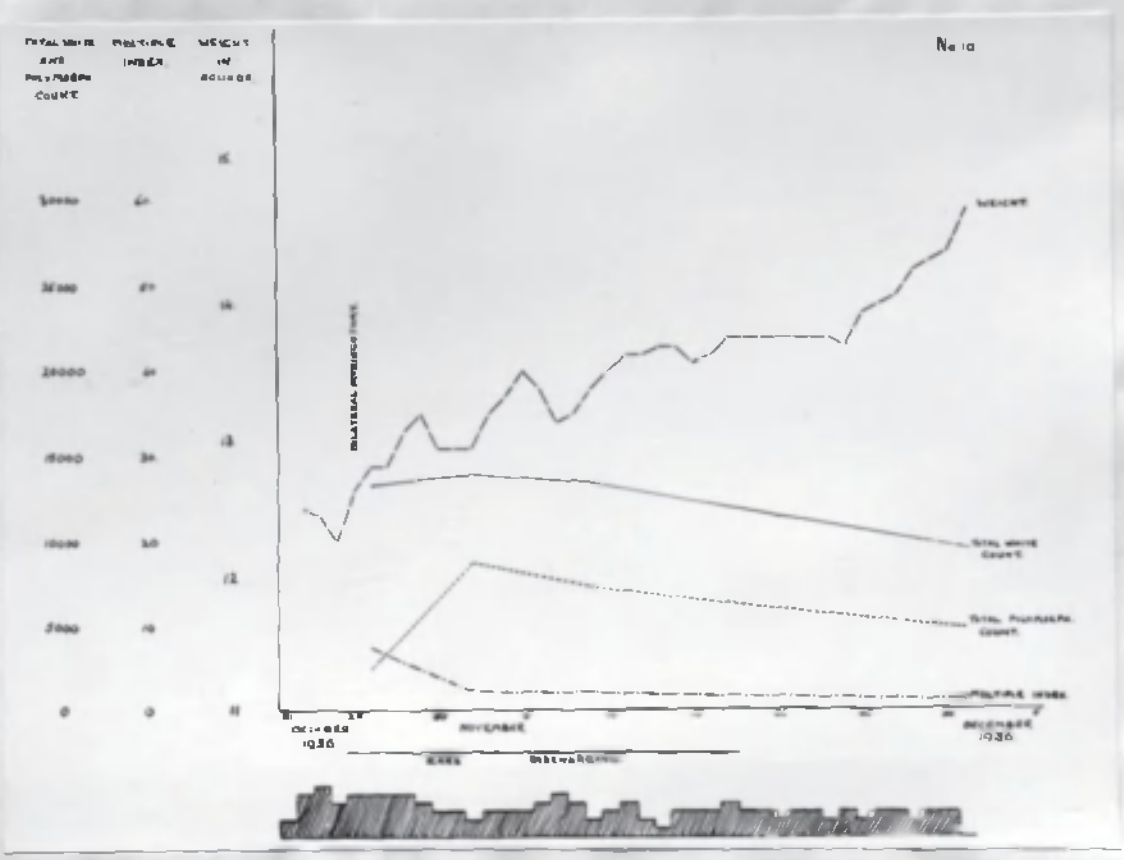
Name:- N.H. No:- 10. Sex:- Male. Age:- 4½ months.

Admitted:- 21.10.36. Discharged:- 30.11.36.

History:- This child was admitted with a history of vomiting, which commenced four days prior to admission, and diarrhoea of two days' duration. Stools were loose, frequent and green.

Condition on Examination:- The child was very toxic but not markedly dehydrated and its fontanelle had normal tension, and the tympanic membranes lacked lustre. The temperature was 101° F. and other examination was negative.

Progress:- On the following day the right tympanic membrane was injected and beginning to bulge and the left tympanic membrane was lustreless. The infant was very toxic and ill. On 25.10.36 bilateral myringotomy was performed and profuse discharge of pus occurred from both ears. On 27.10.36 its general condition had improved and it had gained some weight. The temperature still remained in the vicinity of 101° F. Otorrhoea continued until 17.11.36, during which time slow gain in weight took place and the infant became apyrexial. There was no further otorrhoea after 18.11.36 and the child's general condition gradually improved until its discharge from hospital on 30.11.36.



Description of Graph:- This is a typical recovery graph. The multiple index was elevated at the first estimation and gradually subsided as the illness subsided. There is divergence of weight and multiple index curves indicating a good prognosis. The total white count was never elevated outwith normal limits and therefore was not so accurate an index of the child's condition as the multiple index.

	No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
T.	1.	26·10·36	57	13400	·04	7·6	·48		5	31	64	2546	19	8	67·5	9045	5	·5		D.	Reg.
	2.	2·11·36	70	14000		2·4	·15			13·5	86·5	8820	63	15	18·5	2590	3	·5	St.	D.	Deg.
	3.	9·11·36	61	13500		2·5	·16			14·5	85·5	7492	55·5	15	27	3645	2	·5	St.	D.	Deg.
	4.	1·12·36	68	9700		1·4	·09			8·5	91·5	4996	51·5	15	29	2813	4·5		St.		
T	5.	7·1·37	70	14800		·32	·02			2·5	97·5	8214	55·5	7·5	37	5476			St.		

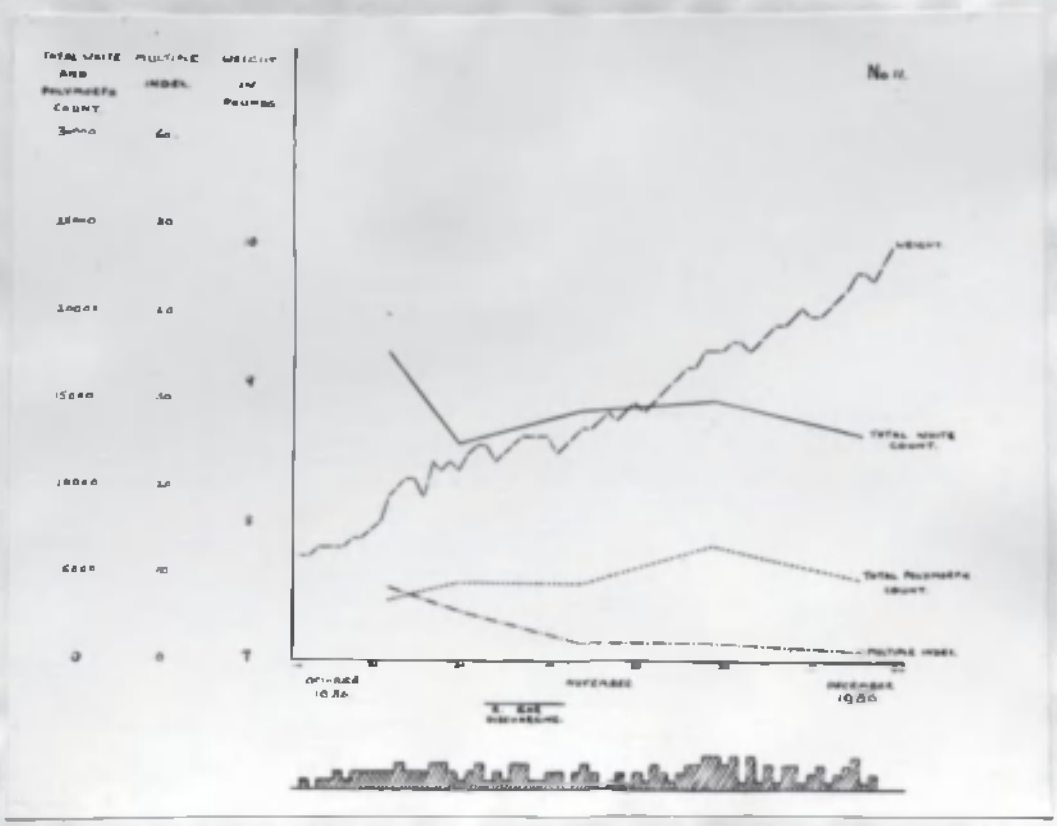
Name:- B.B. No:- 11. Sex:- Female. Age:- 3 months.

Admitted:- 12.10.36. Discharged:- 17.12.36.

History:- This child was admitted with a history of occasional vomiting after feeds. There was no history of diarrhoea or vomiting.

Condition on Examination:- This infant looked fairly well. Its fontanelle was slightly depressed, otherwise it seemed normal and temperature was not elevated.

Progress:- A few days after admission both tympanic membranes were seen to be reddened and gain in weight was not satisfactory. On 30.10.36 the right tympanic membrane was reddened and on 2.11.36 the right ear was discharging profusely and continued to do so until the 11.11.36. Gain in weight during this time was unsatisfactory. Thereafter discharge ceased and the infant began to put on weight. This general improvement continued until discharge on 17.12.36.



Description of Graph:- The multiple index was elevated to begin with and fell after discharge commenced from the right ear. About the same time that multiple index gained an almost normal figure (13.11.36) the infant commenced its final gain in weight. The total white count was never outwith normal figures and neutrophilic response was never marked. The multiple index in this case was a more accurate guide to the infant's condition than either the total white count or total polymorphonuclear count.

No.	Date	Hb.	Total W. B. Cs.	L I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	22·10·36	53	17800	·007	8·5	·52		1	34	65	3560	20	10	68	12104	1			D.	Reg.
2.	30·10·36	52	12700	·006	6·0	·37		1	26·5	72·5	4508	35·5	14	49	6223	1	·5		D.	Reg.
3.	13·11·36	61	14500		2·2	·14			13	87	4567	31·5	13·5	52	7560	3			D.	Deg.
4.	28·11·36	59	15100		2·7	·17			15·5	84·5	6795	46	11·5	41	6191	2	·5	St.	D	Deg.
5.	16·12·36	77	13100		1·4	·09			5·5	94·5	4847	37	16·5	46·5	6091					

Name:- R.H. No:- 12. Sex:- Male. Age:- 3 months.

I. Admitted:- 27.10.36. Discharged:- 6.12.36.

History:- This child was admitted with a history of vomiting since birth and diarrhoea for two weeks. Loss of weight had occurred during the last week and the left ear had been discharging for two weeks.

Condition on Examination:- This infant was in fair general condition, with no toxicity or dehydration. There was considerable purulent discharge from the left ear and tympanic membrane was obscured by debris. Other examination was negative and temperature was not elevated.

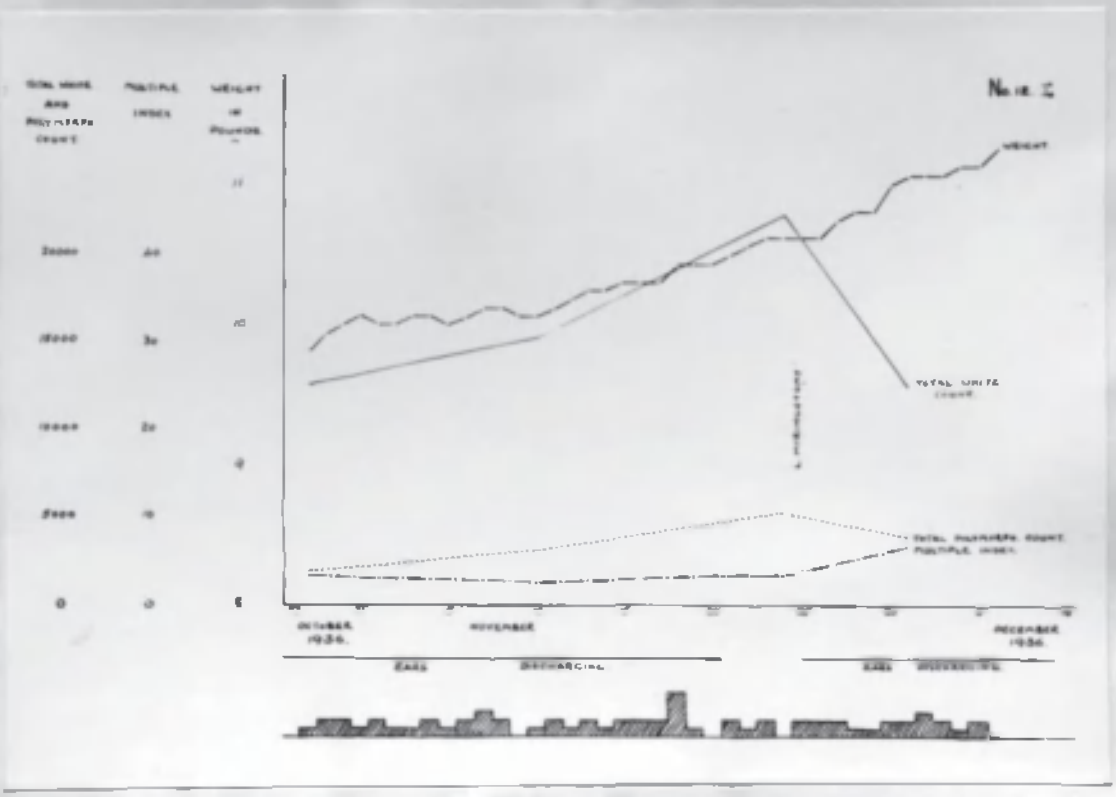
Progress:- On the day following admission the left tympanic memorane was red and bulging with discharge pulsating through. Other examination was negative. This situation continued more or less unaltered for some time and gain in weight was unsatisfactory. Slow weight gain began about 12.11.36 and the right ear commenced to discharge also. On 21.11.36 both ears were dry and both tympanic membranes were reddened and bulging slightly. On 25.11.36 left myringotomy was performed with release of some thick pus. Profuse discharge then continued until infant's dismissal from hospital. This situation continued until 6.12.36, when the infant was removed from hospital on the parents' own responsibility.

II. Re-Admitted:- 19.5.37. Discharged:- 21.8.37.

History:- Child had been in hospital several times since discharge and the ears ultimately became dry. On this occasion the right ear had re-commenced on day before admission. It had been taking its feeds well with no vomiting and its motions had been normal.

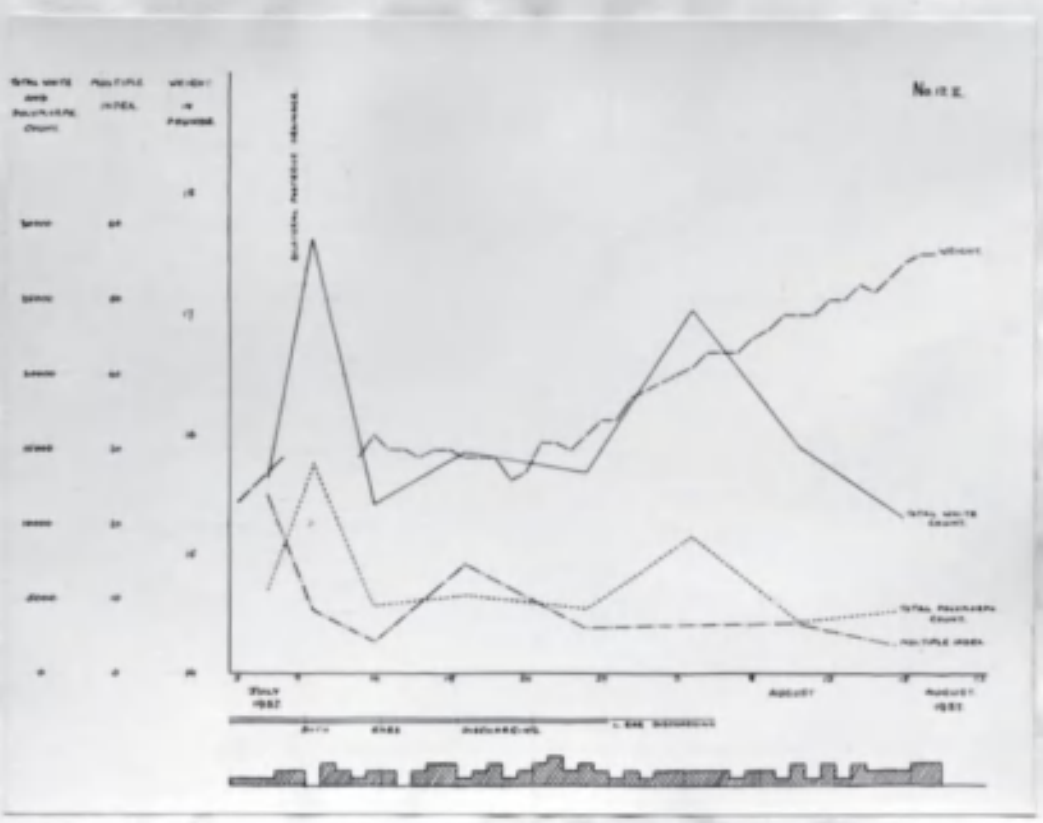
Condition on Examination:- The right ear was discharging profuse, thick pus. The left tympanic membrane showed no abnormality. There were a few moist sounds at both bases, but other examination was negative and temperature was not elevated.

Progress:- On 23.5.37 both ears were discharging profusely but child's general condition was good and gain in weight was satisfactory. This state of affairs continued and ultimately it was decided to operate and on 9.7.37 bilateral posterior drainage was performed. Three weeks after operation the right ear was satisfactory but the left was still discharging. By the end of the fourth week after operation the wounds were healed well but there was still slight meatal discharge. Ultimately the infant was again taken out of hospital on the parents' own responsibility on 21.8.37.



Description of Graph:- (First admission).

In this case where the infant's general condition was always good and discharge from its ear adequate and maintained so, the multiple index, although raised, was never alarmingly high. It was actually rising when the child was taken from hospital. The total white count and total polymorphonuclear count were never outwith normal limits.



Description of Graph:- (Second Admission).

Two days before operation multiple index was high and fell following the operation. There was a good response with a high total white count and total polymorphonuclear count on day following operation. Multiple index rose again for no apparent reason during which time gain in weight was unsatisfactory. It began to fall when gain in weight was re-commenced. There was a second peak in total white count and total polymorphonuclear count for no apparent reason but no corresponding rise in the multiple index. When the infant was taken from hospital multiple index had fallen but had not yet reached a normal figure.

During second admission haemoglobin was consistently low and on 20.7.37 nucleated red cells were observed in the film.

Red counts were as follows:-

28.7.37.	R.B.Cs.	-	4,150,000	Many nucleated red cells.
	Hb.	-	36%	
	C.I.	-	.4	
4.8.37.	R.B.Cs.	-	4,890,000	No nucleated red cells.
	Hb.	-	30%	
	C.I.	-	.3	
11.8.37.	R.B.Cs.	-	4,640,000	No nucleated red cells.
	Hb.	-	50%	
	C.I.	-	.5	
18.8.37	R.B.Cs.	-	3,890,000	No nucleated red cells.
	Hb.	-	40%	
	C.I.	-	.5	

The exhibition of iron had not led to marked improvement when the infant was taken from hospital.

	No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
I	1.	25·10·36	70	12600		3·2	·20			17	83	1853	15·5	4·5	61·5	7749	8·5			D.	Deg.
	2.	10·11·36	54	15200		2·5	·16			14	86	3040	20	9	64	10488	1·5	·5		D.	Deg.
	3.	24·11·36	79	22300		3·3	·21			18	82	5129	23	11	63·5	14160	2	·5	St.	D.	Deg.
	4.	1·12·36	79	12500		6·5	·41			32	78	3937	31·5	11	53·5	6687	3·5	·5		D.	Deg.
II	5.	7·7·37	34	13200		24	1·5			60	40	5676	43	9·5	43	5676	3·5	1	St.	D.	Deg.
	6.	10·7·37	30	29000	·007	8·8	·55	·5	1	34	64·5	14165	48·5	10·5	40·5	11745		·5.	S. St.	D.	Reg.
	7.	14·7·37	30	11400	·006	4·3	·27		1	20·5	78·5	4788	42	11	38·5	4389	7·5	1	St.	D.	Reg.
	8.	20·7·37	30	14800	·01	14·8	·92		1·5	46·5	52	5254	39·5	12	49	7252	3	·5		D.	Reg.
	9.	28·7·37	36	13500	·01	6·2	·39		1·5	27	71·5	4455	33	13	49·5	6682	3	1·5		D.	Reg.
	10.	4·8·37	30	24300	·01	6·5	·41		2·5	27	70·5	9234	38	10	48·5	11785	3	·5	St.	D.	Reg.
	11.	11·8·37	50	15200	·003	7·0	·44		·5	30·5	69	3648	24	15	51·5	7828	9	·5		D	Reg.
	12.	18·8·37	40	10500	·01	4·0	·25		2·5	18	79·5	4252	40·5	11	43·5	4567	4	1	St.	D	Reg.

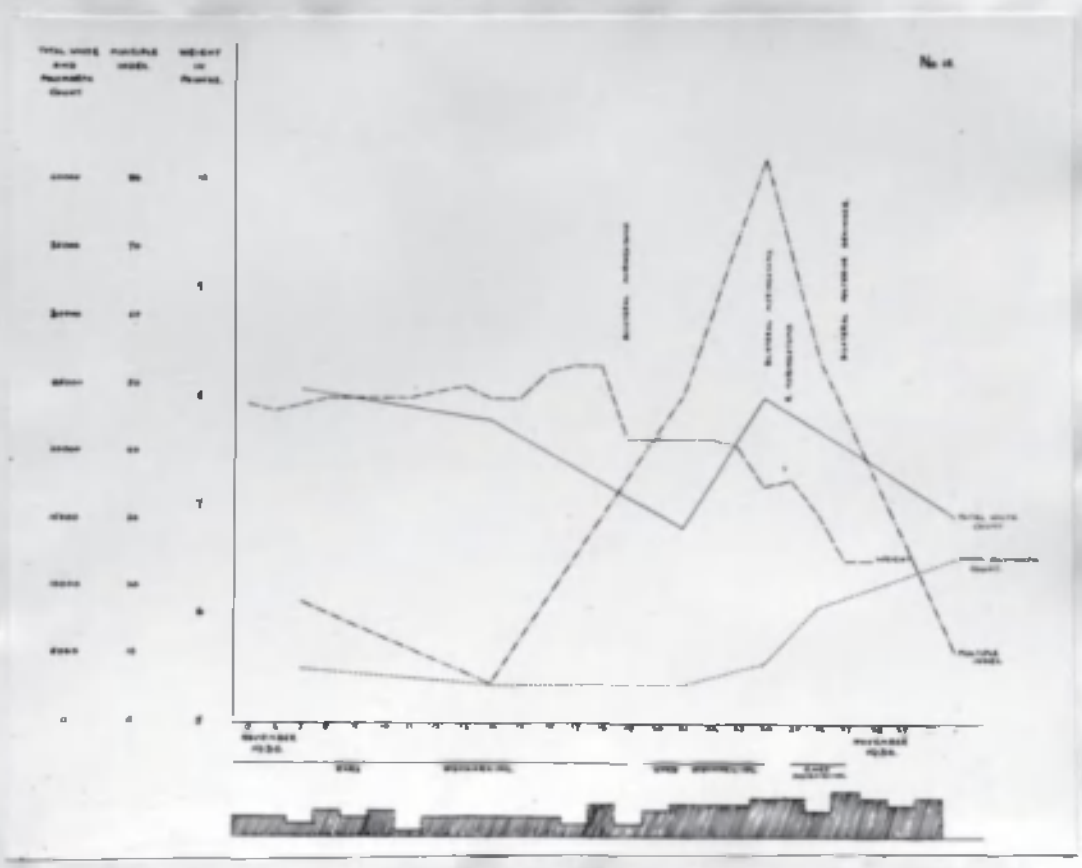
Name:- A.C. No:- 13. Sex:- Male. Age:- 9 weeks.

Admitted:- 5.11.36. Died:- 1.12.36.

History:- This child was admitted with a history of right otorrhoea one week previously and left otorrhoea since day before. Stools were loose and offensive one week, gain in weight unsatisfactory and the infant was not taking its feeds well.

Condition on Examination:- Small, thin baby. The child was not dehydrated and its fontanelle had normal tension. There was purulent discharge from both ears. Other examination was negative and temperature not elevated.

Progress:- For the next fortnight slow gain in weight occurred and both ears continued to discharge profusely. On 19.11.36 there was a rise of temperature to 99.9° F. accompanied by marked loss of weight and the discharge from the ears had ceased. Bilateral myringotomy was performed and thick pus liberated from the left ear. Five days later discharge had again ceased and weight was stationary. Bilateral myringotomy was performed and again pus was obtained from the left ear. There was mild pyrexia - 99.2° - 99° F. On the following day right myringotomy was performed and slight amount of pus obtained. The infant's condition remained unsatisfactory and on 27.11.36 bilateral posterior drainage was performed and pus found in both mastoid cells. The child unfortunately died the following day.



Description of Graph:- After admission total white count was raised with poor neutrophilic response and the multiple index was raised. All three had fallen at the second estimation and the infant had gained in weight slightly. At the third estimation the multiple index had risen considerably while the total white count had fallen, thus giving an earlier and more accurate prognosis. After the myringotomies and the ears were discharging again the multiple index fell somewhat. The last terminal fall of multiple index is probably due to marrow failure. The weight curve and multiple index curves converge - indicating a bad prognosis.

No.	Date	Hb.	Total W. B. Cs.	L I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	7·11·36	60	24600	·04	17·6	1·1		4	49·5	46·5	3999	16·5	21	62	15252		·5	St.	D.	Reg.
2.	13·11·36	55	22300		5·5	·36			27	73	2899	13	12	74·5	16613		·5	St.	D.	Reg.
3.	21·11·36	52	14400	·14	48	3·0		4·5	63·5	32	2808	19·5	17	61·5	8856	2			S. D.	Reg.
4.	24·11·36	57	24000	·34	83·2	5·2		5·5	78·5	16	4480	27	15·5	56	13440	1	·5	St.	S. D.	Reg.
5.	26·11·36	61	21700	·4	54·4	3·4		9	68·5	22·5	8571	39·5	14	44·5	9659	1	1	St.	S. D.	Reg.
6.	1·12·36	70	15300	·11	10·5	·66		7	33	60	12163	79·5	6·5	14	2142			S. St.	D.	Reg.

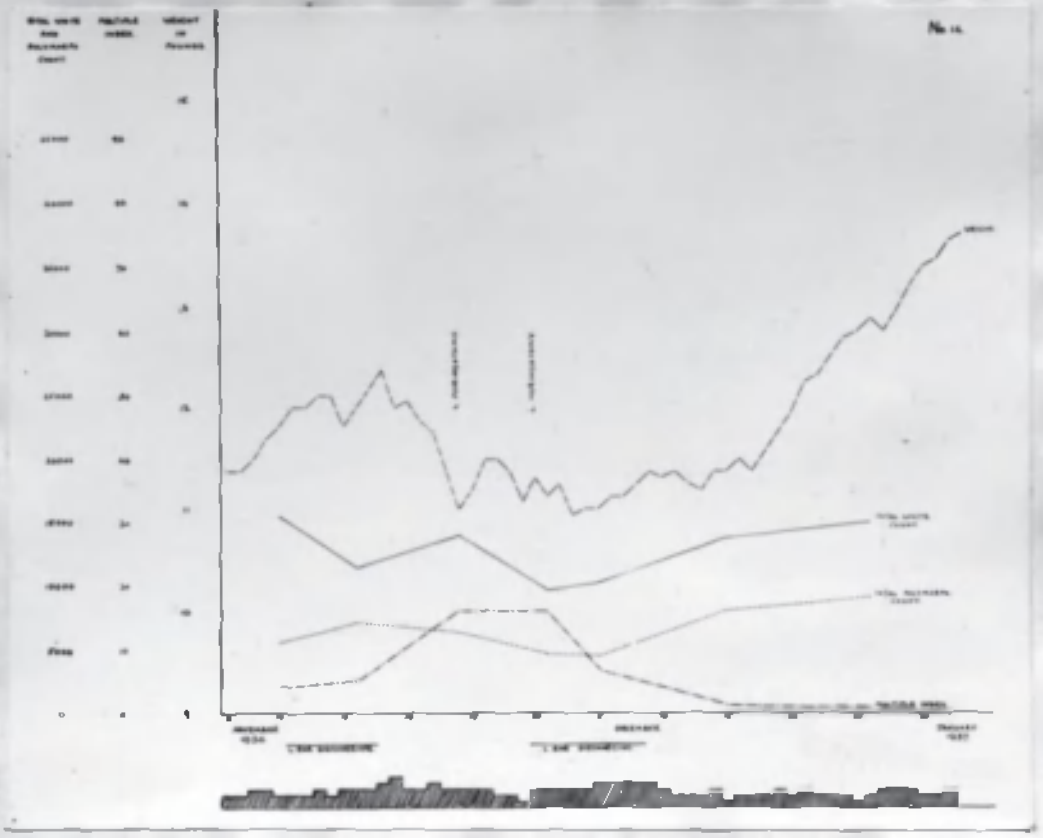
Name:- B.N. No:- 14. Sex:- Male. Age:- 4½ months.

Admitted:- 6.11.36. Discharged:- 1.1.37.

History:- This child was admitted with a history of screaming and putting its hand to its right ear, vomiting, not gaining weight satisfactorily, loose stools and restlessness.

Condition on Examination:- Left and right tympanic membranes were full and red posteriorly. Other examination was negative and the temperature was not elevated.

Progress:- A few days later child was gaining weight and its temperature was still normal. The left tympanic membrane was red and bulging and there was profuse discharge. The right tympanic membrane was red. On 20.11.36 weight loss began and on 24.11.36 temperature rose to 99.8° F. and the child looked ill and toxic and the stools were loose. The left tympanic membrane was reddened posteriorly with slight bulging. Myringotomy was performed but no pus obtained. On 29.11.36 there was slight discharge from the left ear and pyrexia was still present. On 30.11.36 left myringotomy was repeated and a small quantity of thick pus obtained. On 3.12.36 temperature was 100.8° F. and the left ear was discharging and meanwhile weight had been unsatisfactory. By 11.12.36 general condition was much better, the tympanic membranes were just slightly pink and there was no discharge. The child's condition then gradually improved until it was discharged from hospital on 1.1. 37.



Description of Graph:- The multiple index was raised to begin with and rose still further when otorrhoea ceased. This rise coincided with a marked weight loss when the child was very ill. After drainage had been re-established the multiple index fell and at that point weight commenced to go up. The weight curves and multiple index curve converge during the ill period and diverge as the child recovered. The total white count was never outwith normal figures, i.e. the multiple index was a much more accurate guide as to the infant's condition.

No.	Date	Hb.	Total W. B. Co.	L I.	M I.	Sch I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R. P.	T.	Type of Left Shift
1.	10-11-36	73	15400		4	·25			20·5	79·5	55 44	36	16·5	39·5	5983	6·5	1·5		D.	Deg.
2.	16-11-36	75	11300		5·1	·32			24·5	75·5	72 32	64	9·5	43·5	4915	2·5	·5	St.	D.	Deg.
3.	24-11-36	78	13800	·02	16	1		1	49	50	6348	46	23	31	4278			St.	D.	Reg.
4.	1-12-36	71	9600	·04	16	1		2	48·5	49·5	4752	54	11·5	33·5	3216	1		St.	D.	Reg.
5.	5-12-36	75	10200	·01	7·0	·44		1	33	76	4534	44·5	14·5	38	3876	3		St.	D	Reg.
6	15-12-36	52	13700		1·2	·08			7·5	92·5	8083	59	12.	27	3699	2		St.		
7.	28-12-36	60	14900		·96	·06			6	94	9089	61	12·5	25	3725	2·5		St.		

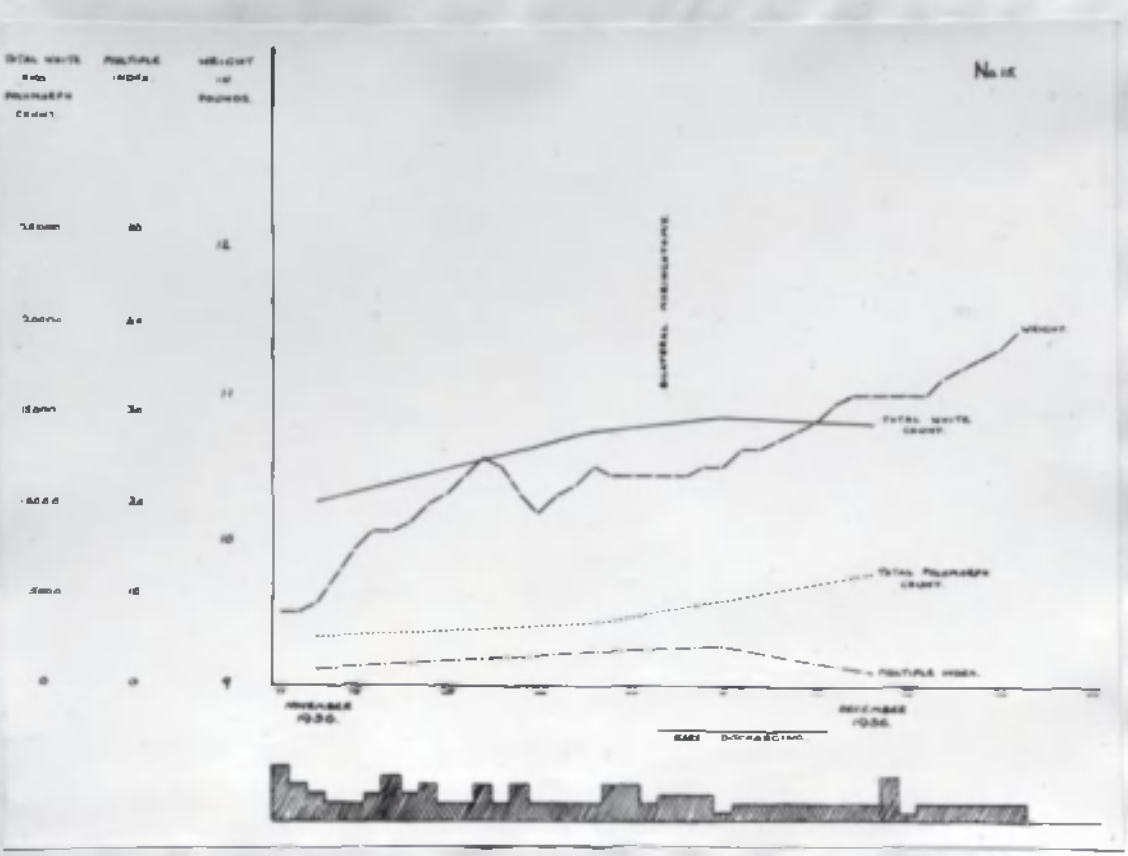
Name:- M.R. No:- 15. Sex:- Male. Age:- 5 months.

Admitted:- 11.11.36. Discharged:- 21.12.36.

History:- This child was admitted with a history of having had enteritis six weeks ago. Diarrhoea re-commenced three days before admission - with frequent watery motions of normal colour but no vomiting.

Condition on Examination:- The infant looked well and was neither toxic nor dehydrated. Both tympanic membranes were dull red and other examination was negative. The temperature was not elevated.

Progress:- Until 22.11.36 infant gained weight and its stools improved. The ears subsided and the tympanic membranes were dull and lustreless. Then some loss of weight occurred and thereafter gain in weight was slower. On 30.11.36 the right tympanic membrane was dull red with slight bulging, and on 2.12.36 bilateral myringotomy was performed and serous fluid obtained from both ears. On 5.12.36 the right ear was discharging profusely but there was no discharge from the left, and on 7.12.36 the left tympanic membrane was red and bulging. By 15.12.36 the infant was again gaining weight and its ears had subsided, there being no otorrhoea. The infant was discharged well on 21.12.36.



Description of Graph:- In this case there was never any marked disturbance. The multiple index rose very slightly and remained elevated during the period of unsatisfactory gain and fell again after drainage was established. The total white count and total polymorphonuclear count were never elevated, but the multiple index indicated the presence of infection.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	13·11·36	66	10100		1·7	·11			10	90	2727	27	17·5	54	5454	1·5				
2.	28·11·36	67	13400		3·6	·23			19	81	3450	25	16·5	56·5	7853	1·5	·5		D.	Deg.
3.	5·12·36	68	14800		4·1	·26			21	79	4736	32	13	52·5	7770	2	·5		D.	Deg.
4.	13·12·36	66	14400		1·4	·09			9	91	6126	42·5	15	40·5	5832	1·5	·5	St.		

Name:- M.H. No:- 16. Sex:- Female. Age:- 5 months.

Admitted:- 13.11.36. Died:- 18.11.36.

History:- This child was admitted with a history of refusing feeds for six days, loose, green stools for seven days and loss of weight.

Condition on Examination:- The child was slightly dehydrated, colour fair. The right tympanic membrane was very red and bled easily. Temperature was not elevated.

Progress:- A few days later the child was very fretful and ill. The right tympanic membrane was still red but not bulging. It took its feeds satisfactorily. On 17.11.36 the infant was toxic but not greatly dehydrated, pyrexial, and the stools were loose and offensive. Both tympanic membranes lacked lustre and the left tympanic membrane was now slightly injected. Bilateral posterior drainage was performed and the bone of both mastoids was soft and necrotic. There was some muco-pus. Death occurred on the following day.

Description of Blood Investigations:- Before operation the total white count was high with considerable neutrophilic response and the multiple index was elevated. Following operation the total white count fell and the multiple index rose slightly - more accurate prognosis.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	17.11.26	72	26900	·03	8·8	·55		2·5	23	64·5	12912	48	7	45	12105			S. St.	D	Reg.
2.	18.11.26	69	13500	·05	11	·69		2·5	27	59·5	7087	52·5	4	43·5	5872			St.	D	Reg.

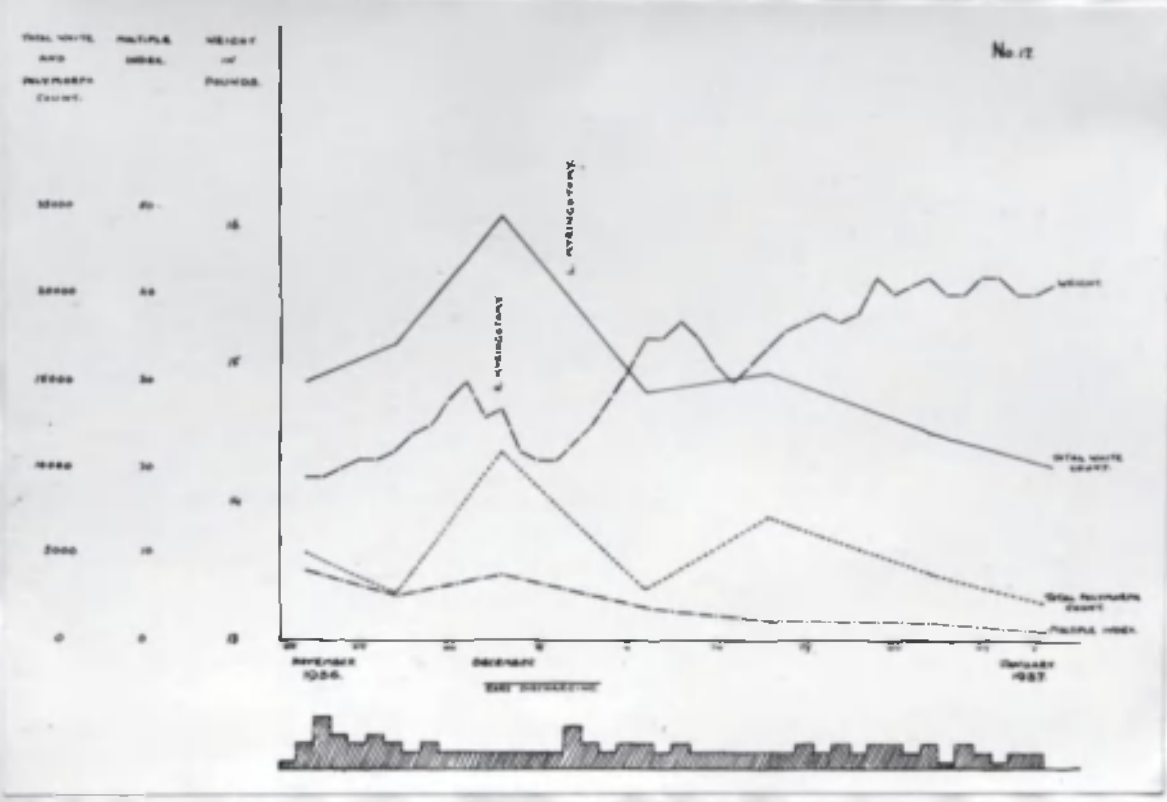
Name:- R.P. No:- 17. Sex:- Male. Age:- 7 months.

Admitted:- 20.11.36. Discharged:- 1.1.37.

History:- This child was admitted with a history of vomiting of four days' duration, stools were loose and foul-smelling.

Condition on Examination:- The infant was fretful, vomiting and stools were loose and frequent. The right tympanic membrane was red and bulging, while the left tympanic membrane was lustreless and not so injected. Other examination was negative and temperature was 99.6° F.

Progress:- Temperature subsided on 22.11.36 and right tympanic membrane was still injected but there was no bulging. Stools were still loose. On 2.12.36 the child had gained weight and its general condition was good. The right tympanic membrane was again very red and bulging. Right myringotomy was performed and a small amount of pus released. On 6.12.36 left myringotomy was performed and thin pus obtained, and by 10.12.36 the child was gaining weight. Both tympanic membranes were slightly pink and the stools were loose. Condition improved thereafter and the infant was discharged from hospital on 1.1.37.



Description of Graph:- The multiple index was raised to begin with while the total white count was not above normal. It fell slightly and then rose before the myringotomies, after which it gradually subsided to normal. The rise coincided with a loss of weight. Here the multiple index and weight curves gradually diverge, indicating a good prognosis.

No.	Date	Hb.	Total W. B. Cs.	L I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	21 11 36	68	15000		8·1	·51			34	66	5025	33·5	9·5	57	8550				D.	Deg.
2.	26 11 36	67	17100		5·6	·35			26	74	2821	16·5	16	67·5	11542				D.	Deg.
3.	2. 12 36	69	24600	·03	7·8	·49		2	31	67	11070	45	14·5	40	9840	·5		S. St	D.	Reg.
4.	10 12 36	60	14500		4·0	·25			20·5	79·5	3190	22	13	61·5	8917	1·5	2		D.	Deg.
5.	17 12 36	68	15500		2·4	·15			15	85	7285	47	6	45·5	7052	·5	1	St.	D.	Deg.
6.	26 12 36	72	12200		2·2	·14			13	87	4026	33	16·5	49·5	6039	·5	·5		D	Deg.
7.	2. 1 37	58	10200		1·2	·08			8	92	2346	23	15	61·5	6273	·5				

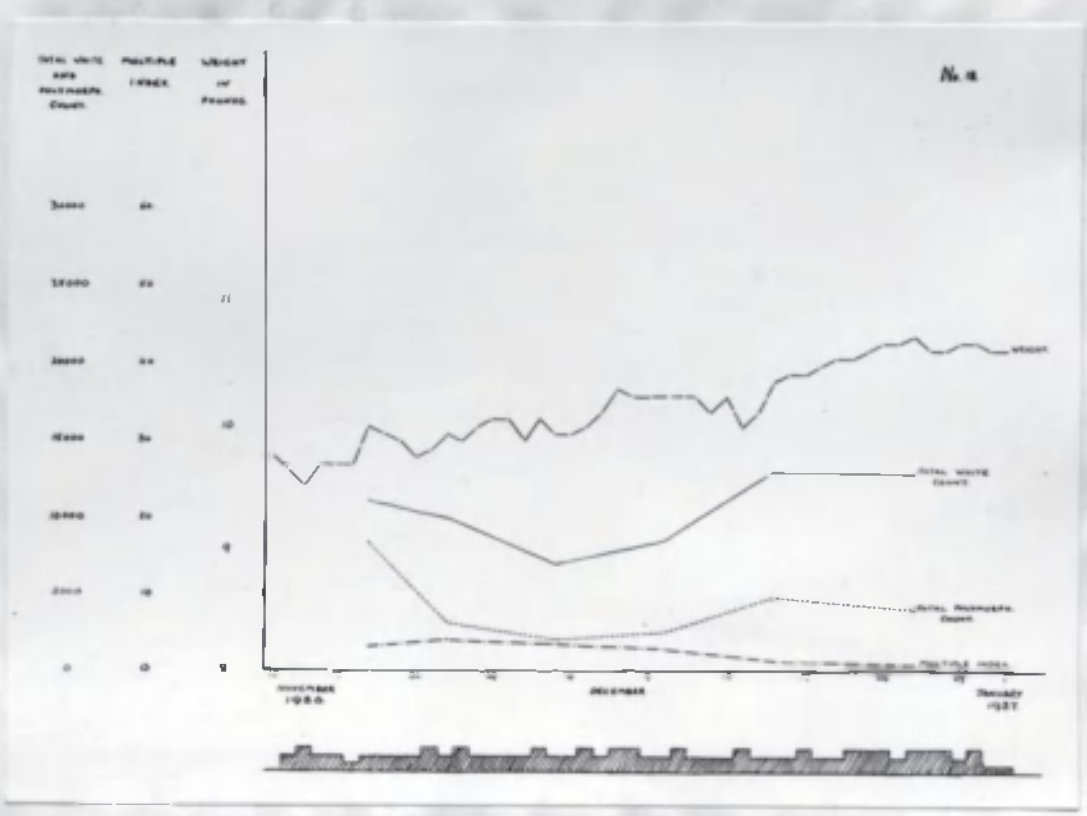
Name:- R.B. No:- 18. Sex:- Male. Age:- 4 months.

Admitted:- 15.11.36. Discharged:- 31.12.36.

History:- This child was admitted with a history of convulsions day before admission, but child had seemed well since.

Condition on Examination:- Child looked well, anterior fontanelle was slightly depressed, both tympanic membranes were injected but other examination was negative. Temperature was not elevated.

Progress:- Child continued well although weight remained stationary, and on 20.11.36 the right tympanic membrane was very injected while the left tympanic membrane lacked lustre, and on the following day temperature rose to 99.4° F. Condition subsided however, and on 10.12.36 the child was gaining weight, stools were normal and both tympanic membranes were pale and lacked lustre. Infant was very well on discharge on 31.12.36.



Description of Graph:- There was never any marked haematological disturbance in this mild case. The multiple index was mildly elevated but gradually settled to normal with the infant's gain in weight and improved general condition. The total white count was never outwith normal figures but the multiple index did reflect the mild pathological process which was present.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	21-11-36	52	11100		3·3	·21			18	82	8547	77	7	26	2886			St.	D.	Deg.
2.	26-11-36	59	10000		4·1	·26			21	79	3350	33·5	15·5	48	4800	2	1		D.	Deg
3.	3-12-36	72	7100		3·6	·23			19	81	2272	32	9·5	56·5	4011	1·5	·5		D.	Deg.
4.	10-12-36	64	8700		3·0	·19			16	84	2610	30	7	51	4437	11·5	·5		D.	Deg.
5.	17-12-36	78	13200		1·6	·10			9·5	90·5	4818	36·5	10	50	6600	3·5				
6.	26-12-36	73	13000		1·2	·08			8	92	4290	33	9·5	50	6500	7	·5			

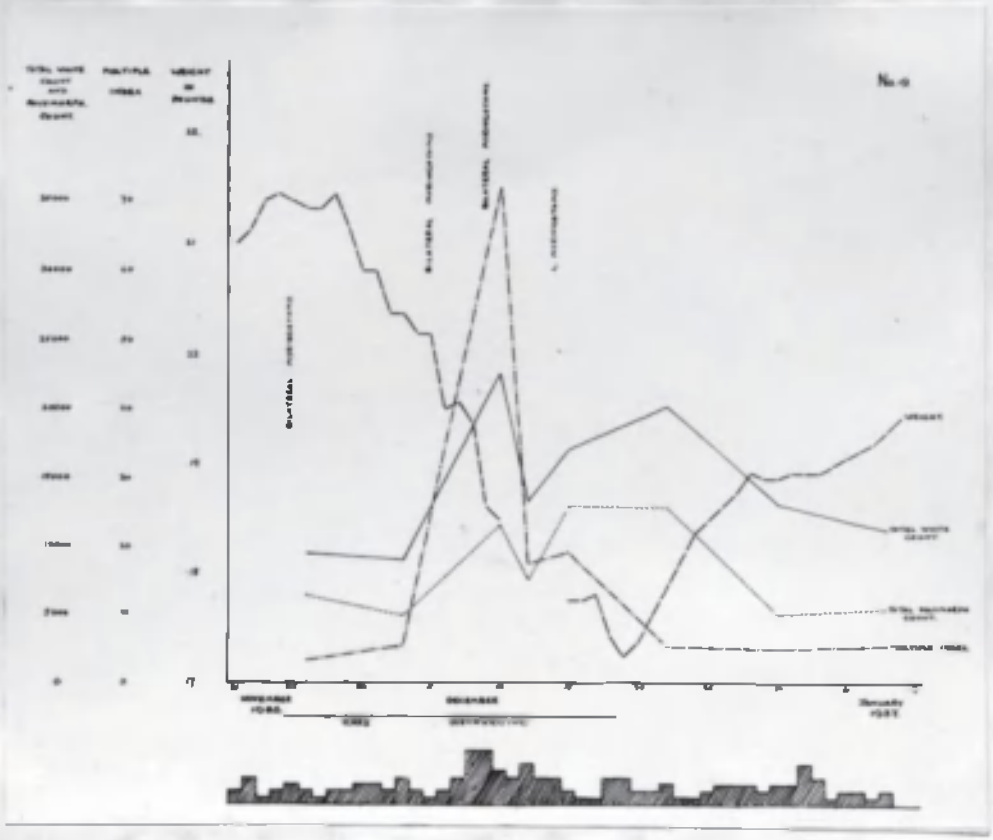
Name:- B.B. No:- 19. Sex:- Male. Age:- 8 months.

Admitted:- 21.11.36. Discharged:- (P.O.R.) 8.1.37.

History:- This child was admitted with a history of a "cold" four days previously. He was drowsy and would not take his feeds. Vomiting occurred but no diarrhoea. Temperature was 103° F.

Condition on Examination:- He was a large, well-nourished boy. Throat was slightly injected and there were a few moist sounds at both bases. The tympanic membranes seemed normal.

Progress:- On the following day there was some nasal discharge, but otherwise his condition was unchanged. On the 22.11.36 the left tympanic membrane was red and bulging and the right tympanic membrane was injected, and on 25.11.36 bilateral myringotomy was performed and pus released from both ears. On 30.11.36 weight loss began and the left ear was discharging profusely and the right tympanic membrane was red and slightly swollen. On 5.12.36 considerable weight had been lost and the child looked toxic and restless. Bilateral myringotomy was again performed, drainage being unsatisfactory from the left ear and pus released. On 8.12.36 further loss of weight occurred and temperature rose to 103° F. On 9.12.36 left myringotomy wound was re-opened and pus obtained and right myringotomy repeated, but no pus was found. On 10.12.36 temperature was normal but stools were loose, the child was very toxic and further weight loss occurred. There was slight discharge from the right ear. Until 14.12.36 the child remained very ill and left myringotomy was repeated, but no pus obtained. On 21.12.36 the child was gaining weight steadily, taking feeds well and its tympanic membranes were only slightly injected. This satisfactory state of affairs continued until 8.1.37 when the parents took the child home on their own responsibility although it was not quite ready for discharge from hospital.



Description of Graph:- This graph shows slight rise of multiple index at second estimation. Then it rises very rapidly with the corresponding marked loss of weight. At this point the weight and multiple index curves converge - indicating bad prognosis. Only after the third myringotomy when infection was overcome, does the multiple index curve fall. Simultaneously with its fall the weight curve commences to rise - giving divergence of the two curves - indicating a good prognosis. The multiple index was not normal when the child was taken out by its parents. The multiple index throughout gave a much more accurate estimation of the child's condition than the total white count or total polymorphonuclear count.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	26·11·36	45	9500		3·3	·21			18	82	6365	67	4	28·5	2707	·5		St.	D.	Deg.
2.	3·12·36	67	9000		5·6	·35			26	74	4995	55·5	11	33	2970	·5		St.	D.	Deg.
3.	10·12·36	68	22600	·25	72	4·5		4·5	77·5	18	11639	51·5	20·5	28	6328			S. St.	S. D.	Reg.
4.	12·12·36	69	13400	·08	17·6	1·1		4	50·5	45·5	7772	58	13·5	28·5	3819			St.	D.	Reg.
5.	15·12·36	65	17000		19·2	1·2			51	49	13005	76·5	5·5	17·5	2975	·5		S. St.	D.	Deg.
6.	22·12·36	72	20200		5·6	·35			26	74	12928	64	13	20·5	4141	1·5	1	S. St.	D.	Deg.
7.	30·12·36	65	13200		5·1	·32			24·5	75·5	5016	38	16·5	45·5	6006	·5	·5		D.	Deg.
8.	7·1·37	57	11300		5·7	·36			26·5	73·5	5367	47·5	19	32·5	3672	1		St.	D.	Deg.

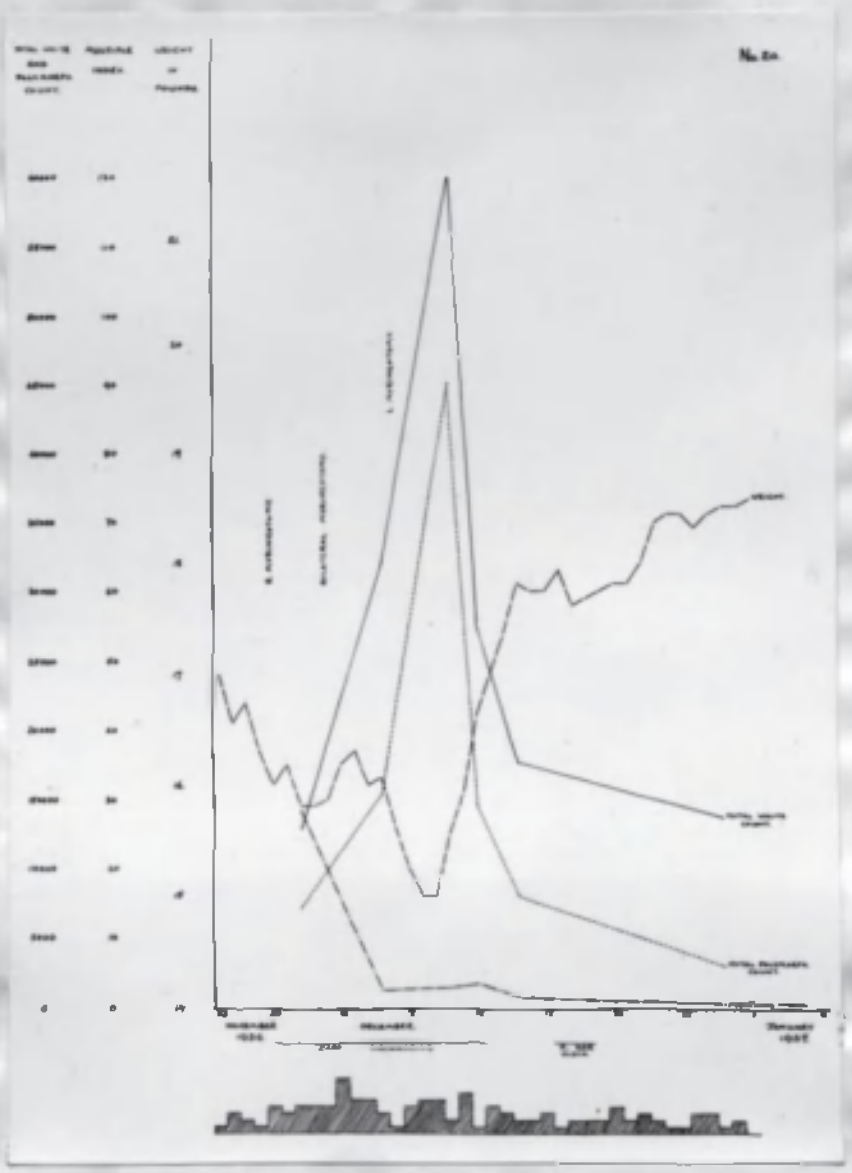
Name:- S.D. No:- 20. Sex:- Female. Age:- 6½ months.

Admitted:- 23.11.36. Discharged:- 31.12.36.

History:- This child was admitted with a history of "pain in the stomach" for two weeks, and loose, green stools. There was no vomiting and it took its feeds well, but had lost weight.

Condition on Examination:- This was a fairly well-nourished child, with no obvious physical signs. The temperature was 99.8° F.

Progress:- The following day its throat was noted to be red and the tympanic membranes pale, otherwise the child seemed well, but its stools were loose. On 27.11.36 the right tympanic membrane was observed to be dull red with slight posterior bulging, while the left tympanic membrane was still pale. Right myringotomy was performed and some thin serous fluid released. On 1.12.36 temperature rose to 101.8° F. and meanwhile considerable weight had been lost and the stools were loose and frequent. The infant was toxic and both tympanic membranes were very injected with bulging of the left tympanic membrane. Bilateral myringotomy was performed and copious discharge of pus obtained from the right side, but blood only from the left. Left myringotomy was repeated on 6.12.36 and pus released. Until 10.12.36 loss of weight and copious otorrhoea continued and then although still having temperatures of 101.2° - 101.8° the child began to gain weight. Otorrhoea ceased on 12.12.36. There was a rise of temperature to 102° F on 18.12.36, which subsided when the right ear discharged again for two days. Otorrhoea then ceased and did not recur. The child was discharged from hospital on 31.12.36 gaining weight satisfactorily and taking its feeds well.



Description of Graph:- This graph is interesting as it shows how misleading the total white count can be. The multiple index was high to begin with and fell abruptly although the infant was also losing weight. At this time the total white count rose very high and there was a marked neutrophilic response, which, no doubt, assisted the infant to overcome its infection, but was quite misleading from the point of view of prognosis. The multiple index was at the same time low, giving an accurate prognosis as very shortly the infant began to regain weight, producing divergence of weight and multiple index curves.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	29. 11. 36	76	12800	·12	18·5	1·5		4·5	60	35·5	7296	57	13	28·5	3648		1·5	St.	D.	Reg.
2.	5. 12. 36	71	31800		2·7	·17			15	85	15423	48·5	10	41	13038	·5		S. St.	D	Deg.
3.	8. 12. 36	74	60600	·01	3·0	·19		1	15	84	45147	74·5	6	19·5	11817			S. St.	D	Reg.
4.	12. 12. 36	57	27600		3·5	·22			18·5	81·5	14628	53	11·5	35	9660	·5		S. St.	D.	Deg.
5.	15. 12. 36	63	17600		1·6	·10			9·5	90·5	8008	45·5	11·5	42·5	7480	·5		St.		
6.	30. 12. 36	53	13700		·96	·06			6	94	3114	22	11·5	65	8905	1·5				

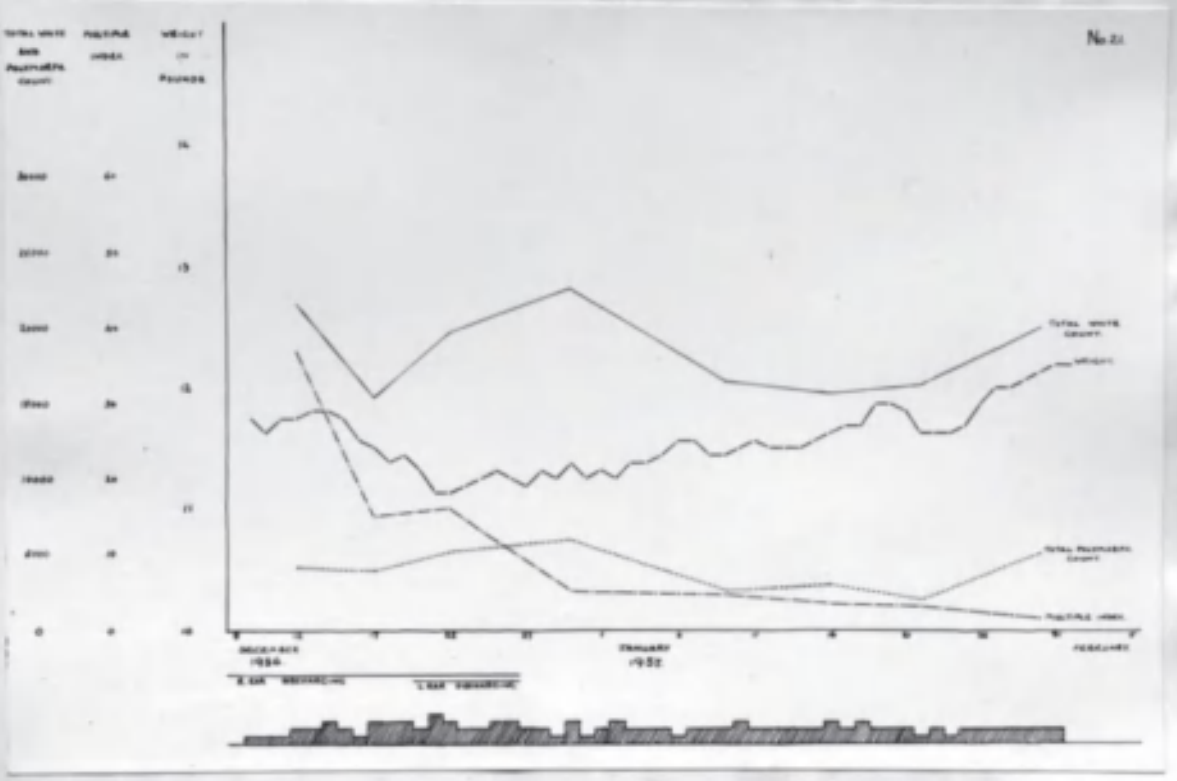
Name:- J.D. No:- 21. Sex:- Male. Age:- 4 months.

Admitted:- 8.12.36. Discharged:- 20.1.37.

History:- This child was admitted with a history of vomiting every feed for six days prior to admission, loss of weight and right otorrhoea of three days' duration.

Condition on Examination:- This was a small child with slight cough, right tympanic membrane was very injected and there was profuse right otorrhoea. Left tympanic membrane was normal. Stools were normal, no vomiting had occurred, weight was stationary. Temperature was as high as 100.6° F. but with exception of a small umbilical hernia other examination was negative.

Progress:- Temperature continued with elevations to 99.6° F. and right otorrhoea persisted. On 20.12.36 the left ear, tympanic membrane of which had not hitherto seemed pathological, commenced to discharge. On 22.12.36 condition was improved and both ears were discharging profusely and by 30.12.36 the child was apyrexial and both tympanic membranes had subsided, right pale and left slightly pink, but no discharge was present. Improvement continued until 31.1.37 when the child was discharged home.



Description of Graph:- Multiple index was high to begin with and then fell. A second fall in multiple index then occurred when the left ear began to discharge. The multiple index curve then gradually fell to normal and the weight curve gradually rose, indicating a good prognosis. The total white count was more markedly elevated. The multiple index was a very accurate guide to the progress of the case.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	12.12.36	59	21500	·06	36·8	2·3		2	68	30	4212	19·5	10·5	68·5	14727	1·5			S.D.	Reg.
2.	17.12.36	56	15,300	·05	15·0	·94		3	45·5	51·5	4054	26·5	12	61·5	9409				D.	Reg.
3.	22.12.36	60	19600	·02	16	1·0		1	49	50	5292	27	8	64	12544	·5	·5		D.	Reg.
4.	30.12.36	65	22600	·006	5·1	·32		·5	24	75·5	5876	26	12	61·5	13786	·5			D.	Reg.
5.	9.1.37	63	16400		4·7	·26			21	79	2706	16·5	16·5	65	10660	1·5	·5		D.	Reg.
6.	16.1.37	50	15700	·003	3·6	·23		·5	18·5	81	3061	19·5	13	66	10362	1·5			D.	Reg.
7.	22.1.37	66	16200		2·3	·21			18	82	2025	12·5	10·5	75·5	12231	1·5			D.	Reg.
8.	30.1.37	73	20000		1·4	·09			8·5	91·5	5000	25	9·5	63	12600	2	·5			

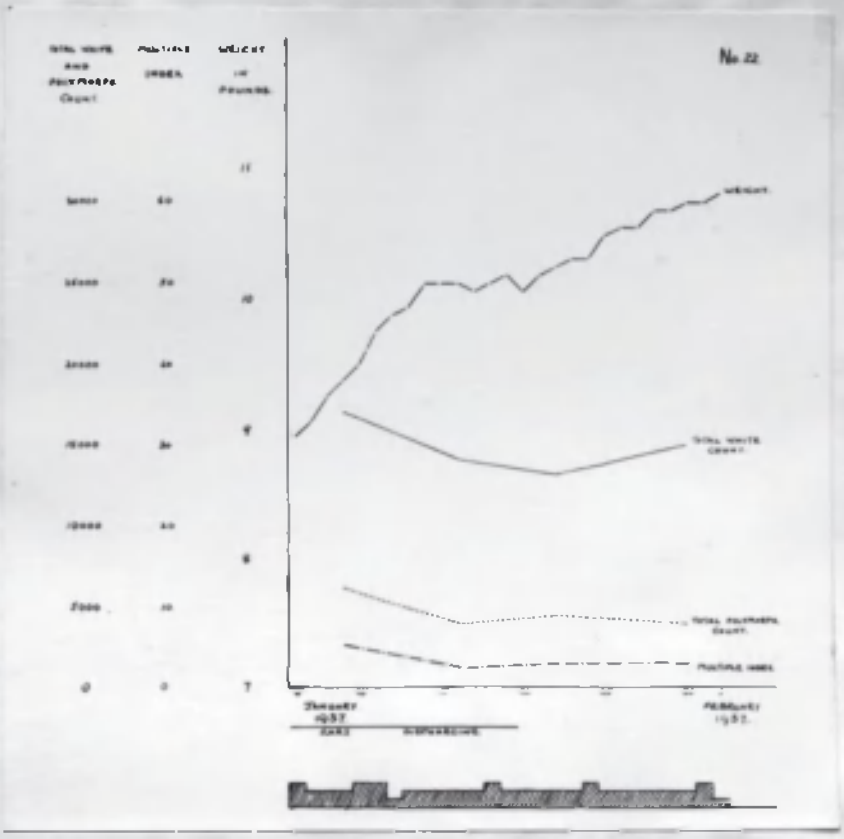
Name:- G.B. No:- 22. Sex:- Male. Age:- 4 months.

Admitted:- 6.1.37. Discharged:- 1.2.37.

History:- This child was admitted with a history of screaming, sweating and breathlessness of three days' duration. Vomiting and diarrhoea had also occurred, but it had seemed to take its feeds well.

Condition on Examination:- This was a small child. Right tympanic membrane showed a perforation with some discharge, left tympanic membrane was normal. Stools were slightly loose and vomiting occurred. Temperature was 99° F. but other examination was negative.

Progress:- On 9.1.37 temperature had subsided and the child looked well. There was copious nasal discharge, the right tympanic membrane was acutely inflamed and there was profuse discharge. The left tympanic membrane was paler and there was slight discharge. On 12.1.37 there was profuse discharge from both ears but the infant was gaining weight. Discharge ceased on 20.1.37 and the child continued to gain weight until its discharge from hospital on 1.2.37.



Description of Graph:- In this case where drainage was satisfactory from the beginning disturbance of blood picture was not marked and multiple index subsided to almost a normal figure while weight curve rose. The total white count was never outwith normal limits and multiple index reflected the child's condition accurately.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	9-1-37	69	17000		5·2	·33			25	75	6205	36·5	14	49·5	8245	1		St.	D.	Deg.
2.	16-1-37	60	14100		2·5	·16			14	86	4089	29	13	55	7755	3			D.	Deg.
3.	22-1-37	68	13300		3·0	·19			16	84	4522	34	16	49	6517	1			D.	Deg.
4.	30-1-37	68	15000		3·2	·20			17	83	4050	27	12	59	8850	2			D.	Deg.

Name:- M.M. No:- 23. Sex:- Male. Age:- 6½ months.

Admitted:- 5.1.37. Discharged:- 23.1.37.

History:- This child was admitted with a history of looking flushed the day before admission. It had seemed to have a "heavy cold". Vomiting and rolling of head had occurred. Stools were normal.

Condition on Examination:- This was a fretful child. Both tympanic membranes were red but other examination was negative. Temperature was 101.2° F.

Progress:- On 9.1.37 temperature had subsided but the child was still very fretful and both tympanic membranes were red and bulging slightly, and on 10.1.37 there was slight discharge from the left ear which continued until 12.1.37. Thereafter condition of ears gradually improved. Weight was more or less stationary throughout illness and stools were normal. It was discharged well on 23.1.37.

Description of Blood Investigations:- This was a very mild case and multiple index was never raised outwith normal limits. The total white count was also within normal limits. Unfortunately investigations were commenced after discharge had commenced, and it is probable that there was an elevation previously.

No.	Date	Hb.	Total W. B. Cs.	L I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	12·1·37	56	14 800		·96	·06			6	94	6734	45·5	5·5	48	7104	·5	·5	St.		
2.	19·1·37	56	16 000		·48	·03			3·5	96·5	4320	27	12·5	58	9280	1	1·5			

Name:- J.M. No:- 24. Sex:- Female. Age:- 5 months.

I. Admitted:- 11.2.37. Discharged:- 27.4.37.

History:- This child was admitted with a history of right discharging ear for a fortnight.

Condition on Examination:- This was a healthy looking child. the right pinna was displaced forwards and there was slight swelling and redness over the mastoid process and profuse discharge from the meatus. The left tympanic membrane seemed normal. Other examination was negative and temperature was 99.8° F.

Progress:- The next day right posterior drainage was performed and pus found in the soft tissues. The mastoid bone was very soft and necrotic and the condition was considered probably tuberculous in origin. The Mantoux Reaction 1/1,000 was positive. Temperature subsided from 99° F., where it had remained since admission, to normal on 16.2.37. On 21.2.37 general condition was excellent, stools were normal and the child was apyrexial but not gaining weight satisfactorily. The upper part of the wound was discharging pus. Then on 27.2.37 stools became loose and frequent. Temperature rose to 101° F. and 6 ozs. in weight were lost. The wound was discharging copiously but there was no meatal discharge and the left tympanic membrane was normal. By 4.3.37 temperature had settled and weight went up again, stools were still loose, but general condition was excellent. Another pyrexial bout, with loss of weight, occurred on 13.3.37 and lasted for several days. On 18.3.37 the left tympanic membrane looked very red and bulging and myringotomy was performed but no pus obtained, and on 19.3.37 left otorrhoea began and continued until 16.4.37. Thereafter condition gradually improved but discharge persisted from right wound and it was still discharging on 27.4.37 when the infant was discharged from hospital. X-ray of chest did not show any evidence of tuberculosis, but there was 13th rib on right side and spina bifida.

II. Re-Admitted:- 15.6.37. Discharged:- 7.7.37.

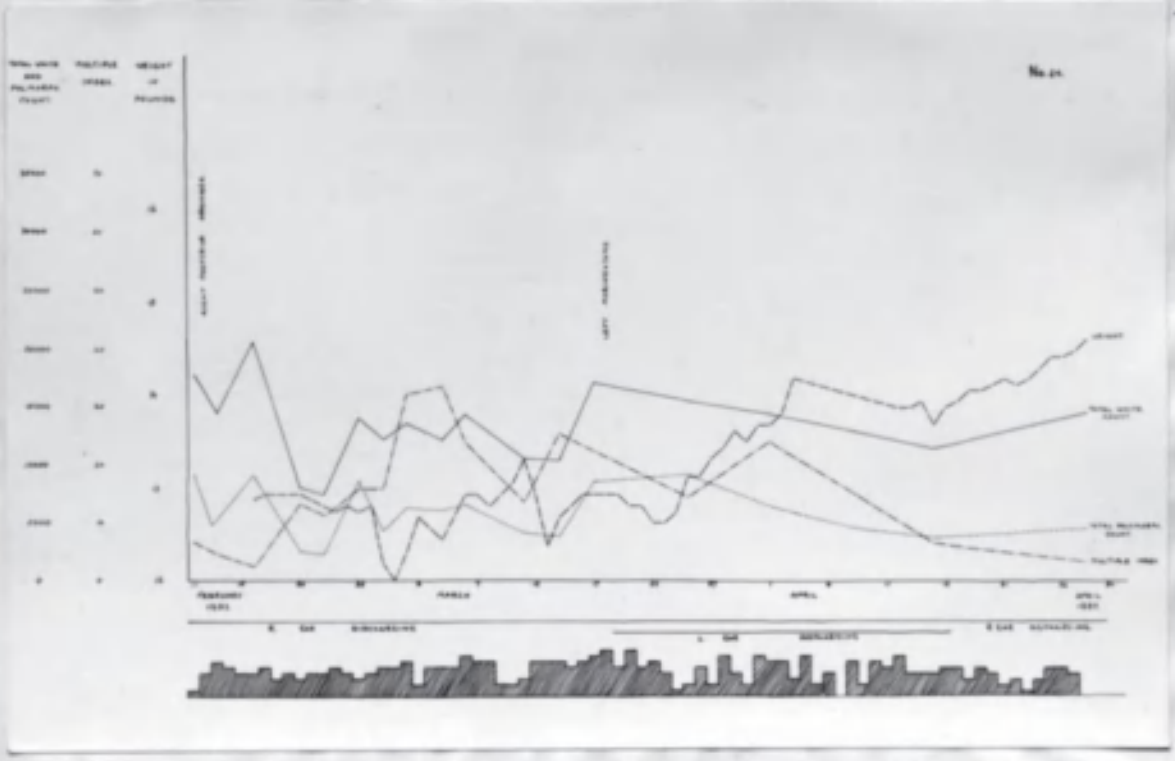
Re-admitted with history of vomiting and foul discharge from right mastoid wound and ear, otherwise general condition was excellent. Temperature was 99° F. on admission and normal the next day, and then remained so. There was also a gradual gain in weight. Both wound and ear were still discharging when infant was dismissed.
X-ray of chest:- showed mottling - rather suspicious.

III. Re-Admitted:- 13.7.37. Discharged:- 20.7.37.

Re-admitted with history of rubbing the other ear (left), and appearance of having pain but no discharge from left ear occurred. The right ear was in the same condition as when discharged on last occasion. There was slight peripheral injection of the left tympanic membrane. Other examination was negative. The infant was discharged I.S.Q. on 20.7.37.
Gastric lavage was performed and a specimen sent for guinea pig inoculation with negative result. Washings from the right ear were inoculated on Löwenstein's medium also with negative result.

IV. Re-Admitted:- 16.9.37. Discharged:- 30.10.37.

Re-admitted - having had operation on right mastoid six months previously. The right ear was still discharging. On 17.9.37 right conversion to radical operation was performed. Mantoux 1/1,000 was performed again and was strongly positive. Condition improved and she was discharged well on 30.10.37 - cavity and ear clean and dry.



Description of Graph:- (First Admission).

To begin with the multiple index was not markedly elevated and fell after the operation. It then rose, this rise preceding the rise of temperature, etc. on 27.2.37. There was also another rise with the second pyrexial bout on 14.3.37 and then it fell when left otorrhoea began. The third peak on 1.4.37 was not satisfactorily explained except that the condition of the right ear was highly unsatisfactory and the left ear was still discharging. The multiple index graph follows the weight graph, rising when weight falls and vice versa. Total white count rose to 20,000 per one cu. mm. shortly after operation, but was never subsequently outwith normal limits. Throughout the multiple index reflected the clinical condition more accurately than either total white count or total polymorphonuclear count.

Blood Investigations:-

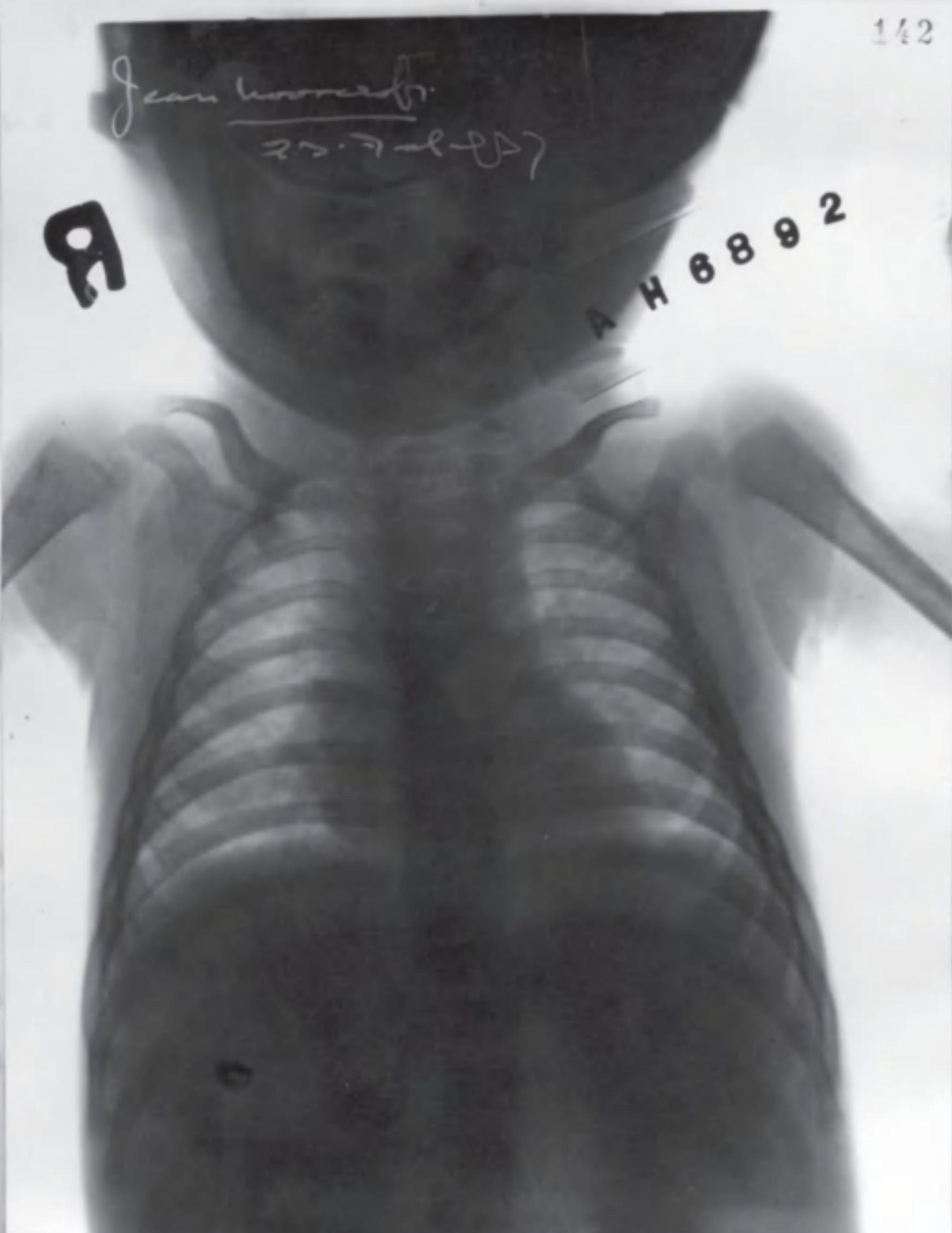
Second Admission. Showed total white counts within normal limits, but multiple indices were still raised, indicating presence of infection.

Third Admission. Showed condition unchanged with persistently raised multiple indices.

Fourth Admission. During which radical operation was performed. Total white count was raised post-operatively while the multiple index fell following operation. This fall in multiple index continued until a normal figure was reached, indicating that the infection had been eradicated.

	No.	Date	Hb.	Total W. B. Cs.	L I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
I	1.	11.2.37	56	17800		6.7	.42			30	70	9286	52	16	32	8696	.5	.5	St.	D.	Deg.
	2.	18.2.37	56	16500	.003	4.6	.29		.5	22	77.5	4857	33.5	14	51	7393	.5	1		D.	Reg.
	3.	16.2.37	56	20600		2.5	.16			16.5	83.5	9270	45	18.5	34.5	7107	2		St.	D.	Deg.
	4.	20.2.37	58	5100	.004	13.2	.83		.5	45	54.5	2794	34.5	18.5	46.5	3766	.5			D.	Reg.
	5.	22.2.37	64	7500	.008	11.2	.7	.5	2.5	39	58	2362	31.5	15.5	52.5	3937	.5			D.	Reg.
	6.	25.2.37	60	14100	.02	16	1.0		2	49.5	48.5	8601	61	8.5	30.5	4300			S. St.	D.	Reg.
	7.	27.2.37	53	12200	.01	16	1.0	.5	2	48.5	49	4392	36	15.5	47.5	5795	.5	.5		D.	Reg.
	8.	1.3.37	54	13600	.03	32	2.0	1	2.5	64	32.5	6314	46.5	16.5	36	4896	1		St.	S.D.	Reg.
	9.	4.3.37	52	12200	.03	33.6	2.1		2	66.5	31.5	6100	50	10.5	39	4758		.5	St.	S.D.	Reg.
	10.	6.3.37	54	14400	.02	24	1.5	1	3.5	56.5	39	6768	47	11	41	5904	.5	.5	St.	D.	Reg.
	11.	11.3.37	59	10500	.009	13.9	.81		1	44	55	4200	40	17	41.5	4357	1	.5	St.	D.	Reg.
	12.	4.3.37	48	10400	.01	25.6	1.6	.5	5	56.5	38	3952	38	14	47	4886	.5	.5		D.	Reg.
	13.	17.3.37	46	17200	.01	22.4	1.4	.5	3	55	41.5	8772	51	13.5	35	6020		.5	St.	D.	Reg.
	14.	25.3.37	55	15500	.004	14.7	.92		.5	47.5	52	9122	59.5	9	29	4495	2.5		St.	D.	Reg.
	15.	1.4.37	52	14400	.02	24.0	1.5		2	58.5	39.5	6552	45.5	11.5	42.5	6120	.5		St.	D.	Reg.
	16.	8.4.37	40	13000		15.6	.98			49.5	50.5	4660	36	11	50	6500	2.5	.5		D.	Reg.

	No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
	17.	15·4·37	58	11500		6·8	·43			30·5	69·5	8852	33·5	11·5	52	5950	2·5	·5		D.	Deg.
	18.	29·4·37	62	14600		3·5	·22			18·5	81·5	4672	32	6·5	58	8468	2	1·5		D.	Deg.
II	19.	24·6·37	62	14900	·003	7·5	·47		·5	31·5	68	3799	25·5	10·5	62·5	9312	1	·5		D.	Reg.
	20.	7·7·37	62	14200	·02	16	1·0		2	49	49	7810	55	8	34	4828	1	2	St.	D.	Reg.
III	21.	13·7·37	45	9200	·01	19·2	1·2	·5	3	52	44·5	4554	49·5	9	40	3680	1	·5	St.	D.	Reg.
	22.	20·7·37	45	10800		4·6	·25			20·5	79·5	4374	40·5	9·5	49·5	5346	·5		St.	D.	Deg.
IV	23.	16·9·37	50	13500	·03	8·3	·52		4·5	30	65·5	6412	47·5	13	38·5	5197	·5	·5	St.	D.	Reg.
	24.	18·9·37	52	24400	·02	4·9	·31		4	20	76	8453	39·5	17	43·5	9304			S. St.	D.	Reg.
	25.	25·9·37	60	25000		5·7	·36			27	73	12125	48·5	14·5	35	8750	1·5	·5	S. St.	D.	Deg.
	26.	2·10·37	55	9600	·006	4·6	·29	·5	1	21	77·5	2832	29·5	14·5	53·5	5136	1·5			D.	Reg.
	27.	9·10·37	46	18800		2·5	·16			14	86	7520	40	14	44·5	8366	1·5		St.	D.	Deg.
	28.	16·10·37	48	12600		3·5	·22			18·5	81·5	4977	39·5	12·5	47	5922		1		D.	Deg.
	29.	25·10·37	61	12000		2·4	·15			13·5	86·5	2700	22·5	10·5	62	7440	4	1		D.	Deg.
	30.	30·10·37	55	11800		·92	·07			7	93	3127	26·5	8·5	61	7198	2·5	1·5			


A H 6892

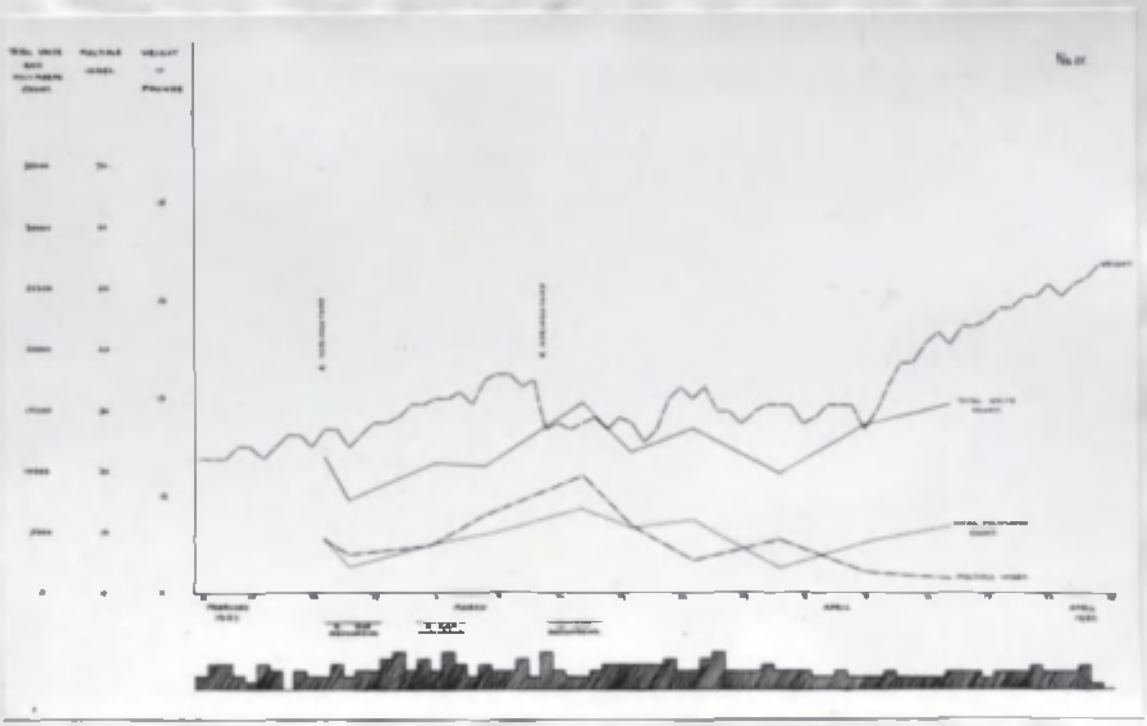
Name:- T.T. No:- 25. Sex:- Male. Age:- 5 months.

Admitted:- 16.1.37. Discharged:- 26.4.37.

History:- This child was admitted with a history of vomiting. Stools had been loose and green for one week and the infant had been crying frequently.

Condition on Examination:- Well-nourished child but very fretful. Stools were loose and green. Left tympanic membrane lacked normal lustre but other examination was negative. Temperature was not elevated.

Progress:- Condition remained unchanged and on 1.2.37 stools were still loose and left tympanic membrane was slightly injected. The child did not gain weight satisfactorily and had occasional rises of temperature up to 100° F. On 23.2.37 the right tympanic membrane was red and bulging, and right myringotomy was performed with release of pus, but discharge did not continue. The infant, however, began to gain weight and its stools were somewhat improved. On 4.3.37 the right tympanic membrane was very injected but there was no bulging and no discharge. On 22.2.37 slight weight loss occurred and temperature rose to 99.6° F. Both tympanic membranes were acutely injected. Condition subsided and general condition gradually improved again, but gain in weight was unsatisfactory and stools were much improved. On 13.3.37 this unsatisfactory state was still present and the right tympanic membrane was injected with slight posterior bulge. Right myringotomy was repeated with release of a small amount of pus, but discharge did not continue and on 18.3.37 the left tympanic membrane was also red and unhealthy. On 21.3.37 stools were loose and both tympanic membranes were inflamed but no bulging was present. This situation continued until 10.4.37 when gain in weight commenced and the ears had subsided. The infant then progressed satisfactorily until its discharge on 26.4.37.



Description of Graph:- Investigations on this case were commenced after the infant had been in hospital for some weeks. The multiple index was raised throughout the entire period of unsatisfactory weight gain. Discharge was never very satisfactory but multiple index did commence to fall after the second right myringotomy and only fell to normal when the child commenced its final gain in weight. Total white count was never outwith normal limits so that multiple index gave a more accurate indication of the child's condition.

No.	Date	Hb.	Total W. B. Cs.	L I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	23.2.37	66	11200	·02	8·9	·56		3	33	64	4592	41	12·5	45	5040	1	·5	St.	D.	Reg.
2.	25.2.37	48	7700		6·2	·39			28	72	2117	27·5	16	53	4081	2·5	1		D.	Reg.
3.	4.3.37	61	10600		7·8	·49			33	67	4081	38·5	9·5	50	5300	2			D.	Reg.
4.	8.3.37	55	10400	·01	12·9	·81		1·5	43·5	55	4848	37	15	47	4888	1		St.	D.	Reg.
5.	16.3.37	73	15700	·01	19·2	1·2		1	54	46	6908	44	12	43·5	6829		·5	St.	D.	Reg.
6.	20.3.37	60	11700		11·2	·70			41·5	58·5	5440	46·5	8·5	43·5	8089	1·5		St.	D.	Reg.
7.	25.3.37	58	13600		5·4	·34			25·5	74·5	6052	44·5	8	46·5	6324	1		St.	D.	Reg.
8.	1.4.37	57	9900	·007	8·9	·56		1	35	64	2029	20·5	14·5	62·5	6187	2·5			D.	Reg.
9.	8.4.37	58	13800		3·5	·22			18·5	81·5	4140	30	10	58	8004	1	1		D.	Reg.
10.	15.4.37	57	16700		2·5	·16			14	86	5573	35·5	8	55	8635	1·5			D.	Reg.

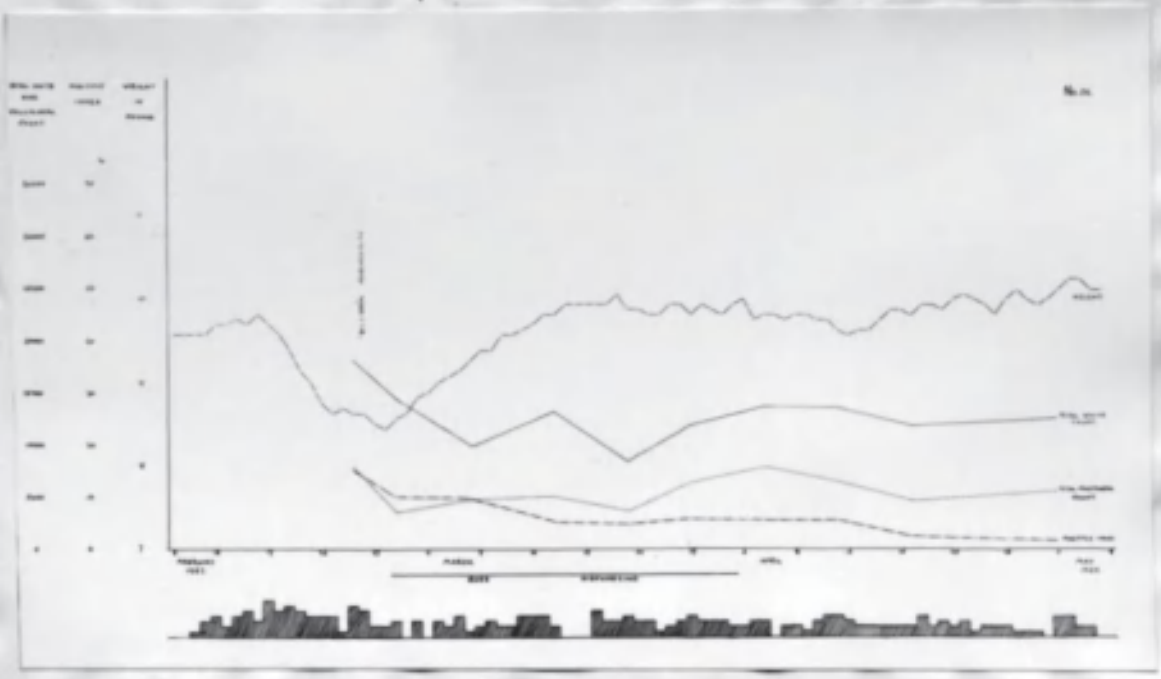
Name:- L.B. No:- 26. Sex:- Male. Age:- 4 months.

Admitted:- 8.2.37. Discharged:- 6.3.37.

History:- This child was admitted with a history of "bronchitis". Loss of weight had occurred but stools were not loose.

Condition on Examination:- Crepitations were audible in the chest but other examination was negative. Temperature was 99° F.

Progress:- On the day following admission temperature rose to 103.2° F. but the signs in the chest were not at all definite, and two days later temperature was down and the infant seemed well. Weight gain was unsatisfactory and occasional elevations of temperature from 99° - 99.8° F. occurred. On 22.2.37 temperature rose to 101.2° F. and right tympanic membrane was found to be pink. Condition remained unsatisfactory until 20.2.37 when left tympanic membrane was very red. Myringotomy was performed but no pus obtained. A similar condition and similar results occurred on the right side. On 1.3.37 right otorrhoea commenced and on 3.3.37 both ears were discharging. From this point satisfactory gain in weight commenced. The left ear settled gradually but the right continued to discharge but much less profusely. The ears ceased to discharge and condition gradually improved. The child was dismissed well on 6.3.37.



Description of Graph:- Multiple index curve falls after myringotomy, and from that point gain in weight commences with divergence of multiple index and weight curves. The total white count was only once outwith normal limits.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	25·2·37	76	18000	·03	15·0	·94		2·5	46	51·5	7830	43·5	24	32·5	5670	1		St.	D.	Reg.
2.	1·3·37	51	14800	·01	10·0	·63		2	37	61	3578	25	18·5	53·5	7918	2·5	·5		D.	Deg.
3.	8·3·37	65	10000	·01	9·6	·6		2	35·5	62·5	4750	47·5	13	38·5	3850	1		St.	D.	Reg.
4.	16·3·37	63	13100		5·1	·32			24·5	75·5	5043	38·5	14	43·5	5698	4		St.	D.	Deg.
5.	23·3·37	64	8400		4·9	·31			24	76	3612	43	14·5	40	3360	1	1·5		D.	Deg.
6.	29·3·37	61	11800		5·7	·36			27	73	6490	55	13	31	3658	1		St.	D.	Deg.
7.	5·4·37	53	13700		5·6	·35			26	74	7946	58	11	30	4110	1		St.	D.	Deg.
8.	12·4·37	59	13600		5·6	·35			26	74	6528	44	14·5	36·5	4964		1	St.	D.	Deg.
9.	19·4·37	56	11900		2·4	·15			13·5	86·5	4760	40	15·5	43	5117	1	·5	St.	D.	Deg.
10.	3·5·37	48	12600		1·7	·11			10	90	5733	45·5	13	40	5040	1	·5	St.		

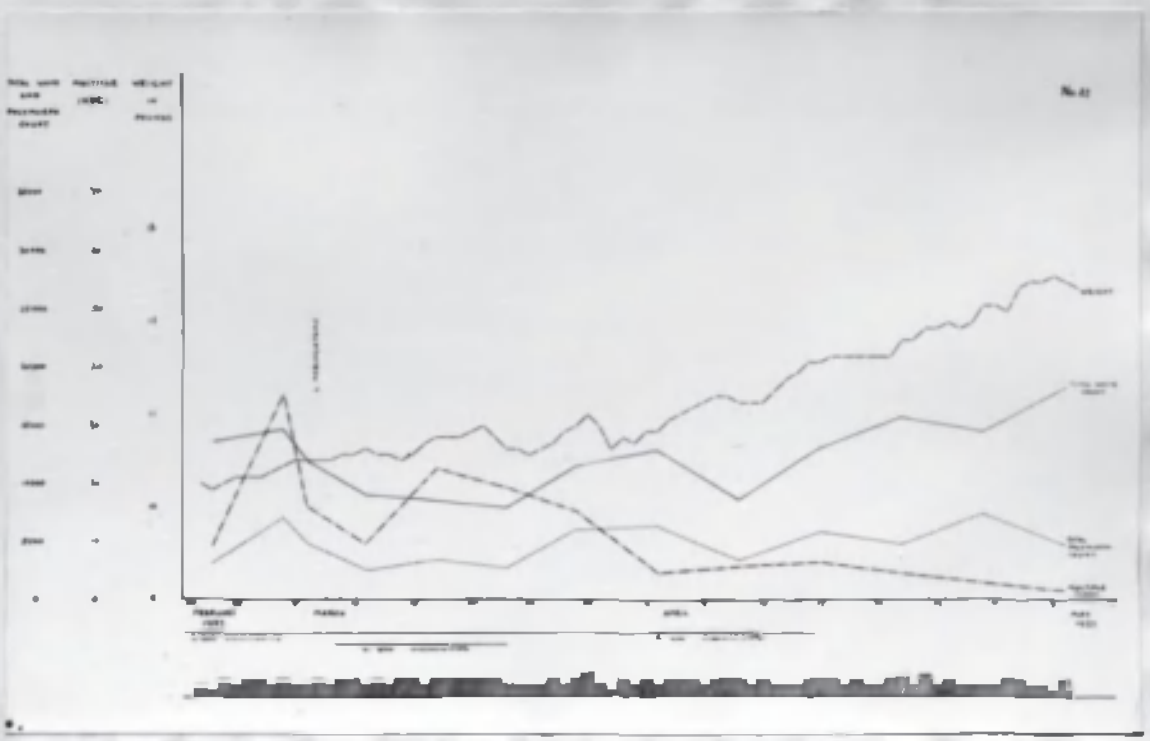
Name:- W.K. No:- 27. Sex:- Male. Age:- 7 months.

Admitted:- 24.2.37. Discharged:- 11. 5.37.

History:- This child was admitted with a history of right otorrhoea of one week's duration and failure to take food for one day. There was no history of diarrhoea or vomiting.

Condition on Examination:- This child's general condition was good, stools were normal and it was taking its feeds well. The right tympanic membrane was red and unhealthy and there was profuse discharge; the left tympanic membrane was normal. Other examination was negative and temperature was not elevated.

Progress:- On 5.3.37 the right ear was unchanged but the left tympanic membrane was very red and bulging postero-superiorly and on 7.3.37 left myringotomy was performed but no pus obtained. On 9.3.37 both ears were discharging. This discharge continued until 23.3.37 when the left ear ceased to discharge and the right ear continued until 18.4.37. The infant gained slowly during this time and was discharged from hospital well on 11.5.37. The infant was apyrexial throughout.



Description of Graph:- The multiple index was high to begin with and fell after the left myringotomy. It rose again while both ears were discharging and then gradually fell to normal. The low figure on 6.4.37 coincides with commencement of final gain in weight. The total white count was never outwith normal limits so that the multiple index gave a more accurate indication of the progress of the case.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	26·2·37	41	13700	·01	9·1	·57		2	34·5	63·5	32·88	24	14	58	72·64	3·5	·5		D.	Reg.
2.	4·3·37	46	14600	·05	35·2	2·2		3·5	62	29·5	70·91	48·5	12	35·5	51·83	3·5	·5	St.	S. D.	Reg.
3.	6·3·37	42	12000		16	1·0			51·5	48·5	49·80	41·5	10	46	55·20	2·5		St.	D.	Reg.
4.	11·3·37	55	9000	·004	9·6	·6		·5	37	62·5	25·20	28	14	56	50·40	1·5	·5		D.	Reg.
5.	17·3·37	52	8500	·01	22·4	1·4		1·5	57	41·5	34·00	40	17·5	42	35·70	·5			D.	Reg.
6.	23·3·37	55	7900	·02	19·2	1·2		2	54·5	43·5	27·65	35	10	51	40·29	3·5	·5		D.	Reg.
7.	29·3·37	56	11500	·009	15·0	·94		1	47·5	51·5	60·37	52·5	7	37·5	43·12	2·5	·5	St.	D.	Reg.
8.	5·4·37	55	12900		4·4	·28			22	78	63·85	49·5	10	57	73·53	3·5		St.	D.	Deg.
9.	12·4·37	50	8700		5·6	·35			26	74	34·36	39·5	12	47	40·09	1·5			D.	Deg.
10.	19·4·37	55	13100		6·2	·39			28·5	71·5	58·95	45	16	38	49·78	1		St.	D.	Deg.
11.	26·4·37	70	15800		4·6	·29			23	77	45·98	31	8	58	91·64	1·5	1·5		D.	Deg.
12.	3·5·37	62	14600		3·0	·19			16	84	75·19	51·5	7·5	39·5	57·67	1·5		St.	D.	Deg.
13.	10·5·37	66	19300		1·7	·11			10·5	89·5	49·41	27	4	67	12·61	2				

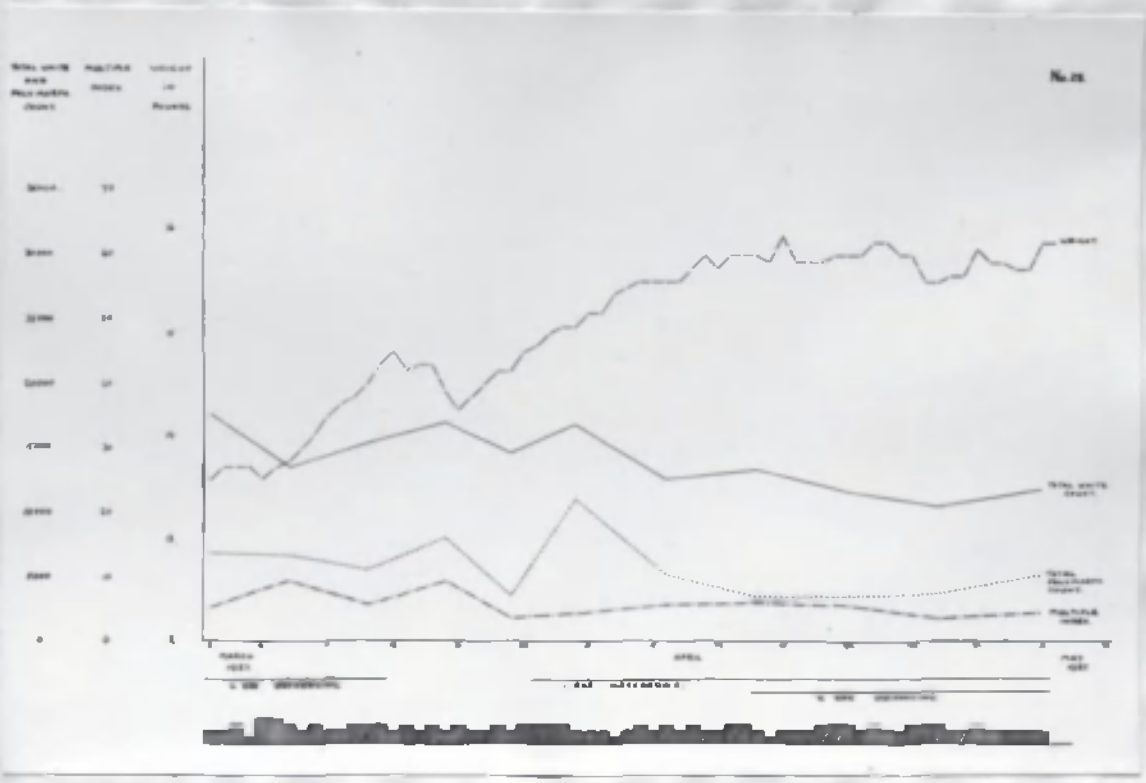
Name:- C.E. No:- 28. Sex:- Female. Age:- 4 months.

Admitted:- 1.3.37. Discharged:- 6.5.37.

History:- This child was admitted with a history of screaming attacks of five days' duration and it had been observed to put its hand to its left ear, which had been discharging. There was no history of diarrhoea and vomiting.

Condition on Examination:- This was a plump, healthy-looking child, taking its feeds well without vomiting, and stools were normal. The left tympanic membrane was unhealthy and there was profuse discharge while the right tympanic membrane was slightly injected. Other examination was negative and temperature was not elevated.

Progress:- On 5.3.37 general condition was very good but weight was stationary. The left tympanic membrane was pale and there was still some discharge; the right tumpanic membrane was still slightly injected. Discharge ceased on 15.3.37 and on 19.3.37 temperature rose to 99.4° F. and the infant lost weight. On 23.3.37 the child was improving again and gained weight, and on 6.4.37 the left ear was discharging again. On 12.4.37 the left tympanic membrane was red without discharge and the right ear was discharging, and on 13.4.37 both ears were discharging profusely. Weight at this time was stationary. Bilateral otorrhoea persisted until discharge from hospital on 6.5.37. The parents would not give consent for operation, for which this was a very suitable case, but they consented to bring the child as an out-patient. This they did for some time and then they ceased to attend and the case was unfortunately lost sight of.



Description of Graph:- The multiple index in this case was never very high. It fell with first gain in weight and rose again with fall in weight, and although it settled to some extent with the final gain in weight, it never reached a normal figure. The total white count was never outwith normal figures but the multiple index showed the existence of some infection. The child's general condition was excellent at time of discharge and it would have been an eminently suitable case for operation.

No.	Date	Hb.	Total W. B. Cs.	L I.	M.I.	Seh.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	1·3·37	61	17600	·01	5·1	·32		1·5	25·5	73	6864	39	14	46·5	8184	·5		St.	D.	Reg.
2.	8·3·37	57	13500	·003	9·1	·57		·5	36	63·5	6615	49	17·5	33·5	4252	2		St.	D.	Reg.
3.	14·3·37	52	15300		5·7	·36			26·5	73·5	5672	24	12	61·5	9409	2	·5		D.	Deg.
4.	20·3·37	66	17000	·003	9·2	·58		·5	26·5	63	8160	48	6·5	45·5	7735			St.	D.	Reg.
5.	25·3·37	70	14700		3·8	·25			20	80	3601	24·5	10	65	9585	·5			D.	Deg.
6.	30·3·37	67	16600		4·4	·28			22	78	11004	65·5	10·5	23·5	3948	·5		S. St.	D.	Deg.
7.	6·4·37	48	12600		5·6	·35			26	74	5229	41·5	8·5	49	6174	·5	·5	St.	D.	Deg.
8.	13·4·37	65	13400		5·9	·37			27·5	72·5	3551	26·5	13·5	59	7906	·5	·5		D.	Deg.
9.	20·4·37	58	11600		5·6	·35			26	74	3596	31	8·5	59·5	6902	1			D.	Deg.
10.	27·4·37	68	10500		3·8	·24			19·5	80·5	3780	36	8·5	54	5670	1	·5		D.	Deg.
11.	5·5·37	47	11900		4·4	·28			22	78	5117	43	7·5	48·5	5771	·5	·5	St.	D.	Deg.
O.P. 12.	11·5·37	56	9200		4·1	·26			21	79	4975	58·5	11	34	3962	1·5			D.	Deg.
13.	18·5·37	52	13600		4·9	·31			24	76	4352	32	9	58·5	7956	·5			D	Deg.
14.	25·5·37	46	8200		3·3	·21			17·5	82·5	2009	24·5	8	66	5412	1	·5		D.	Deg.
15.	1·6·37	56	13200		2·2	·14			12·5	87·5	3630	27·5	10	62	8184	·5			D.	Deg.
16.	8·6·37	47	14900		2·4	·15			13·5	86·5	5364	36	8	64	8046	·5	1·5		D.	Deg.
17.	15·6·37	70	17300		3·0	·19			16	84	7093	41	5·5	52	8996	1	·5	St.	D	Deg.

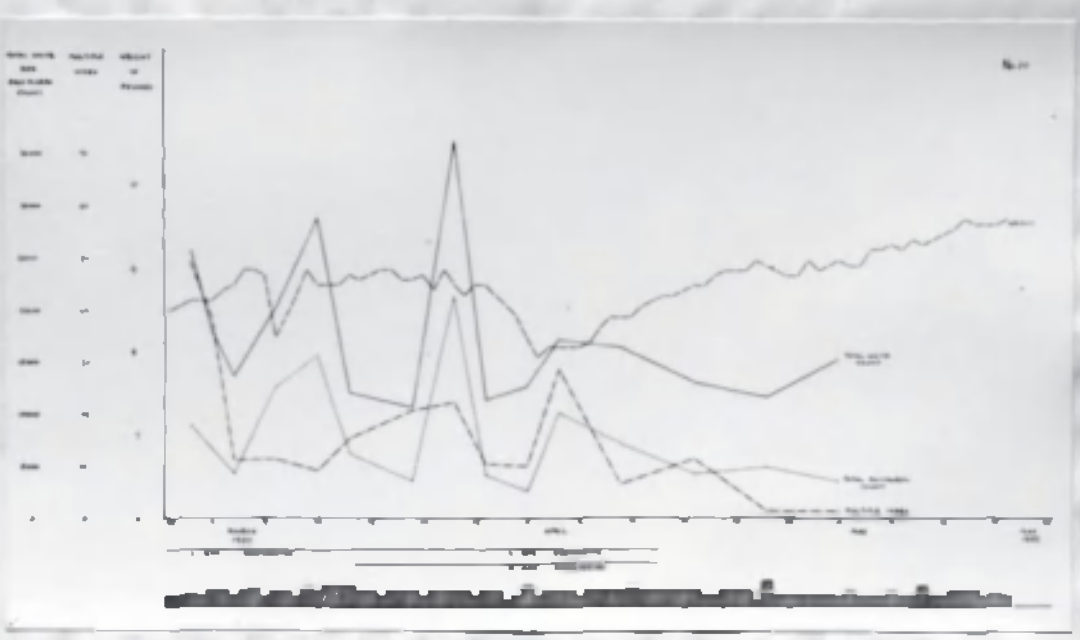
Name:- C.D. No:- 29. Sex:- Male. Age:- 10 weeks.

Admitted:- 27.2.37. Discharged:- 18.5.37.

History:- This child was admitted with history of cough for two days and left otorrhoea of indefinite duration.

Condition on Examination:- The child was small and pale, the stools were loose and it was not taking its feeds well. There was profuse nasal discharge and a few râles at both bases. The right tympanic membrane was pale and lacked lustre, while the left tympanic membrane had a small posterior perforation and thin, blood-stained discharge. Pyrexia from 99° to 99.9° F. was present.

Progress:- A few days later the child was still pyrexial, but there was no diarrhoea or vomiting and it was gaining weight slowly. The right tympanic membrane was pale and there was profuse, purulent discharge from the left ear. The blood Wassermann reaction was negative, and considerable nasal discharge was present. On 10.3.37 the infant lost 13 ozs. in weight and was slightly toxic but did not seem much worse, and its left ear was still discharging profusely. Temperature was normal. On 18.3.37 both ears were discharging freely, the child was apyrexial and had regained slowly. On 31.3.37 commenced to lose weight again and on 2.4.37 temperature rose to 102° F. The child did not look so well and the left ear was not discharging so much. Temperature subsided again on 5.4.37 and on 20.4.37 it was gaining weight and there was no otorrhoea. There was slight right otorrhoea observed on 5.5.37, but otherwise it progressed satisfactorily until its discharge from hospital on 18.5.37.



Description of Graph:- The multiple index was very high at first estimation and fell rapidly but remained well above normal. On 17.3.37 the total white count fell while the multiple index rose, reflecting more accurately the clinical condition of the child. The multiple index rose sharply on 6.4.37 corresponding with weight loss and then fell as the weight curve commenced on its final rise. The graph shows general convergence of weight and multiple index curves during the acute stages of the illness when the prognosis was doubtful and divergence as the infant gradually recovered.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	2·3·37	62	25800	·04	49·6	3·1	1	7·5	67·5	24	9030	35	15	50	12900			St.	S. D.	Reg.
2.	4·3·37	66	18200	·07	38·4	2·4		4·5	66·5	29	7371	40·5	19	40·5	7371			St.	S. D.	Reg.
3.	6·3·37	53	13800	·01	11·5	·72		2	40	58	4347	31·5	14·5	53·5	7393	·5			D.	Reg.
4.	10·3·37	63	20300	·008	10·0	·63	·5	3·5	35	61	12687	62·5	12·5	23·5	4770	1	·5	S. St.	D.	Reg.
5.	14·3·37	51	28900	·01	9·2	·58		2	35	63	15750	84·5	9	36	10404		·5	S. St.	D.	Reg.
6.	17·3·37	62	12100	·04	15·6	·98		4·5	45	50·5	6352	52·5	9·5	37·5	4537		·5	St.	D.	Reg.
7.	23·3·37	67	10700	·01	20·5	1·3		2·5	55·5	42	3691	34·5	14·5	50·5	5403	·5			D.	Reg.
8.	27·3·37	57	36300	·06	22·4	1·4		2·5	57	40·5	21417	59	17·5	23·5	8530			S. St.	D.	Reg.
9.	30·3·37	60	11400	·01	10·5	·66		1·5	38·5	60	4161	36·5	10	53·5	5985	1			D.	Reg.
10.	3·4·37	52	12700		10·0	·63			39	61	2730	21·5	16	60·5	7693	1·5	·5		D.	Deg.
11.	6·4·37	61	17200	·01	28·8	1·8		1·5	63	35·5	10234	59·5	13	27	4644	·5		St.	D.	Reg.
12.	12·4·37	68	16500	·003	6·8	·43		·5	30	69·5	7342	46·5	12	41·5	6647	1·5	·5	St.	D.	Reg.
13.	19·4·37	60	13200		11·6	·73			42·5	57·5	4422	33·5	15	50	6600	·5	1		D.	Deg.
14.	26·4·37	73	11800		1·7	·11			10·5	89·5	5074	43	11·5	39	4602	6·5		St.		
15.	3·5·37	58	15400		1·4	·09			8·5	91·5	3773	24·5	8·5	58	8932	8·5	·5			

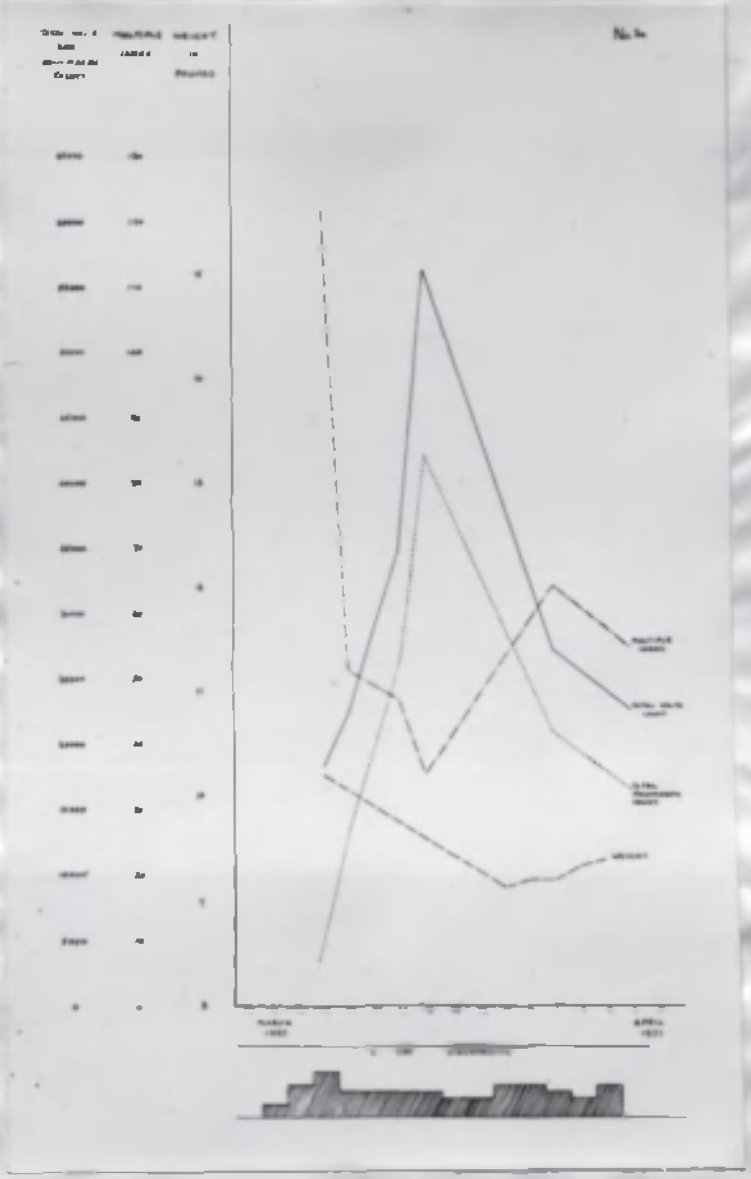
Name:- G.E. No:- 30. Sex:- Female. Age:- 6 months.

Admitted:- 20.3.37. Died:- 4.4.37.

History:- This child was admitted with a history of cough of three weeks' duration. The stools were loose for two days, but there was no vomiting. There had been left otorrhoea for one week.

Condition on Examination:- Pale, ill-looking child, right tympanic membrane was lack-lustre and the left tympanic membrane reddened and bulging posteriorly with some otorrhoea. The child was sunken-eyed, its stools were loose and the temperature 99.2° F.

Progress:- The following day the temperature rose to 103.8° F. The right tympanic membrane was dull-purplish in colour while the left tympanic membrane was red with thin, purulent discharge. On 25.3.37 temperature was still swinging up to 103° F. and there was profuse left otorrhoea and a large perforation in the left tympanic membrane. The right tympanic membrane was still reddened. On 25.3.37 temperature became normal and remained so until 30.3.37 when it again rose to 101° F. Left otorrhoea continued. On 4.4.37 a slight convulsion occurred and lumbar puncture was performed, but examination of cerebro-spinal fluid was negative. There were coarse, moist sounds all over the chest and purpuric rash on left side of abdomen. The temperature rose at one point to 104.6° F. and the child ultimately died.



Description of Graph:- The multiple index was very high at first and fell to some extent with the improvement which took place in the child's general condition and fall in temperature. It remained high and meanwhile the total white count rose very considerably with very satisfactory neutrophilic response. The multiple index then rose as the infant developed the broncho-pneumonia and the total white count fell, i.e. the multiple index gave a more accurate prognosis, and although it fell slightly on the day of death it remained very high, while the total white count had fallen to an almost normal figure.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	23·3·37	74.	18200	·48	121·6	7·6	5·5	13·5	69·5	11·5	34 5·8	19	26	54	9828	1			S. D.	Reg.
2.	24·3·37	62.	22100	·1	51·2	3·2	2·5	10	64	23·5	13320	60	10·5	29·5	6549			S. St.	S. D.	Reg.
3.	26·3·37	78	34700	·01	46·4	2·9	·5	7	67	25·5	26025	75	4	20·5	7113	·5		S. St.	S. D.	Reg.
4.	27·3·37	84	56100	·01	35·2	2·2	·5	4·5	64·5	30·5	42150	75	5·5	19	10678	·5		S. St.	S. D.	Reg.
5.	1·4·37	75.	27100	·02	64	4·0	·5	4·5	75	20	20867	77	4·5	18·5	5013			S. St.	S. D.	Reg.
6.	4·4·37	50	22500	·06	54·4	3·4	1·5	12·5	63·5	22·5	16425	73	4·5	22·5	5062			S. St	S. D.	Reg.

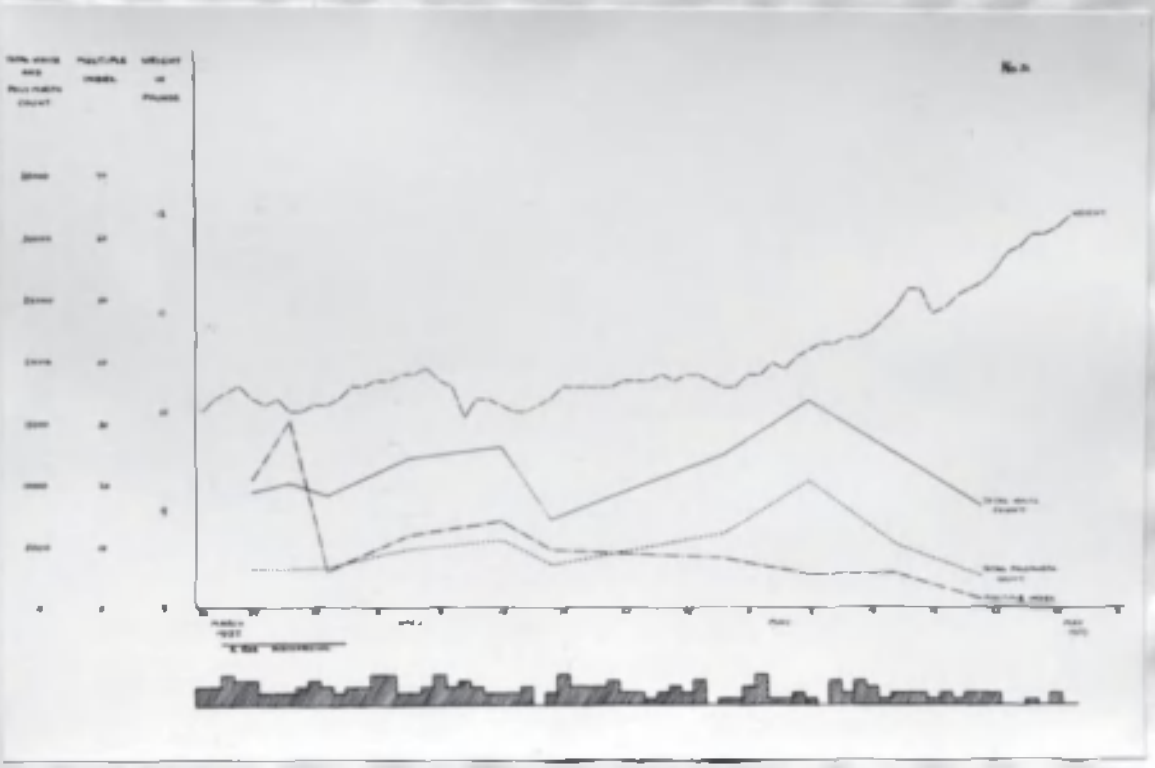
Name:- R.K. No:- 31. Sex:- Male. Age:- 3 months.

Admitted:- 20.3.37. Discharged:- 29.5.37.

History:- This child had been in hospital earlier in the year with diarrhoea and vomiting, which did not occur. Mother stated that it had started vomiting again.

Condition on Examination:- The child was in fair condition. Both tympanic membranes were dull red but there was no bulging. Stools were loose, and other examination was negative. Temperature was not elevated.

Progress:- Two days after admission stools were still loose and right ear was discharging while the left tympanic membrane was still red and now bulging posteriorly. By 31.3.37 right otorrhoea had ceased and both tympanic membranes were red and on 5.4.37 both tympanic membranes lacked normal lustre, but were no longer inflamed. Until 21.4.37 weight gain was not satisfactory but stools were much improved. The infant commenced to gain about 1.5.37 and continued to do so until discharge from hospital on 29.5.37.



Description of Graph:- The multiple index was high to begin with and fell when discharge became satisfactory. It remained somewhat elevated through the entire period when the child's weight was unsatisfactory and began to fall to normal about 1.5.37, when the child commenced its final gain in weight. The total white count and total polymorphonuclear count were never outwith normal limits and therefore the multiple index reflected the progress of the case much more accurately.

No.	Date	Hb.	Total W. B. Cs.	L I.	M I.	Sch. I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R P.	T.	Type of Left Shift
1.	24·3·37	79	9400	·01	20·8	1·3		1	55	44	3243	34·5	13	51	4794	1·5			D.	Reg.
2.	27·3·37	69	10100	·01	30·4	1·9		1	65	34	3232	32	10	56·5	5706	1	·5		S. D.	Reg.
3.	30·3·37	66	9200		6·0	·38			28	72	3450	37·5	11	48	4416	3	·5		D.	Deg.
4.	6·4·37	74	12200		11·8	·74			42·5	57·5	4758	39	10	49·5	6039	1	·5	St.	D.	Deg.
5.	13·4·37	60	13100		14·0	·85			47	53	5567	42·5	17	46·5	6091			St.	D.	Deg.
6.	17·4·37	68	7200		9·6	·60			37·5	62·5	3528	49	18·5	31·5	2268	·5	·5		D.	Deg.
7.	1·5·37	60	12500		8·1	·51			34	66	6150	50	10·5	38·5	4812	1		St.	D.	Deg.
8.	8·5·37	80	16900		5·7	·36			27	73	10309	61	13	25	4225	1		St.	D.	Deg.
9	15·5·37	57	12700		5·9	·37			27·5	72·5	5334	42	15	43	5461			St.	D.	Deg.
10.	22·5·37	63	8800		1·6	·10			9·5	90·5	2697	32·5	13·5	53	4299	1				

Name:- J.G. No:- 32. Sex:- Female. Age:- 6 months.

Admitted:- 22.3.37. Died:- 1.4.37.

History:- This child was admitted with a history of persistent vomiting of two days' duration, green, loose motions and colocky pain - otherwise nil.

Condition on Examination:- There were a few rhonchi audible in the chest but other examination was negative. Temperature was not elevated.

Progress:- A few days later the child looked very ill and had lost weight. The right tympanic membrane showed some redness round handle of malleus, absent light reflex, pallor elsewhere. The left tympanic membrane was very red at the edges. On 27.3.37 loss of weight was marked and the left tympanic membrane was very red. Myringotomy was performed but no pus obtained. On 31.3.37, by which time considerable weight had been regained, (the accuracy of this weighing is doubted), the child was very ill and toxic and there was slight left otorrhoea. The right tympanic membrane was lustreless. The child died on 1.4.37.

Description of Blood Investigations:- The multiple index was high and rose consistently until death - giving an accurate prognosis. To begin with the total white count was not unduly high and rose slightly with a belated neutrophilic response.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	27·3·37	51	22900	·02	12·0	·75		3	40	57	8816	38·5	9	50·5	11564	2		St.	D.	Reg.
2.	29·3·37	58	10600	·01	19·2	1·2		2·5	53	44·5	6901	33·5	6·5	59·5	12257	·5			D.	Reg.
3.	1·4·37	69	26200	·03	32	1·0		2·5	64·5	33	15851	60·5	5·5	34	8908			S. St.	S. D.	Reg.

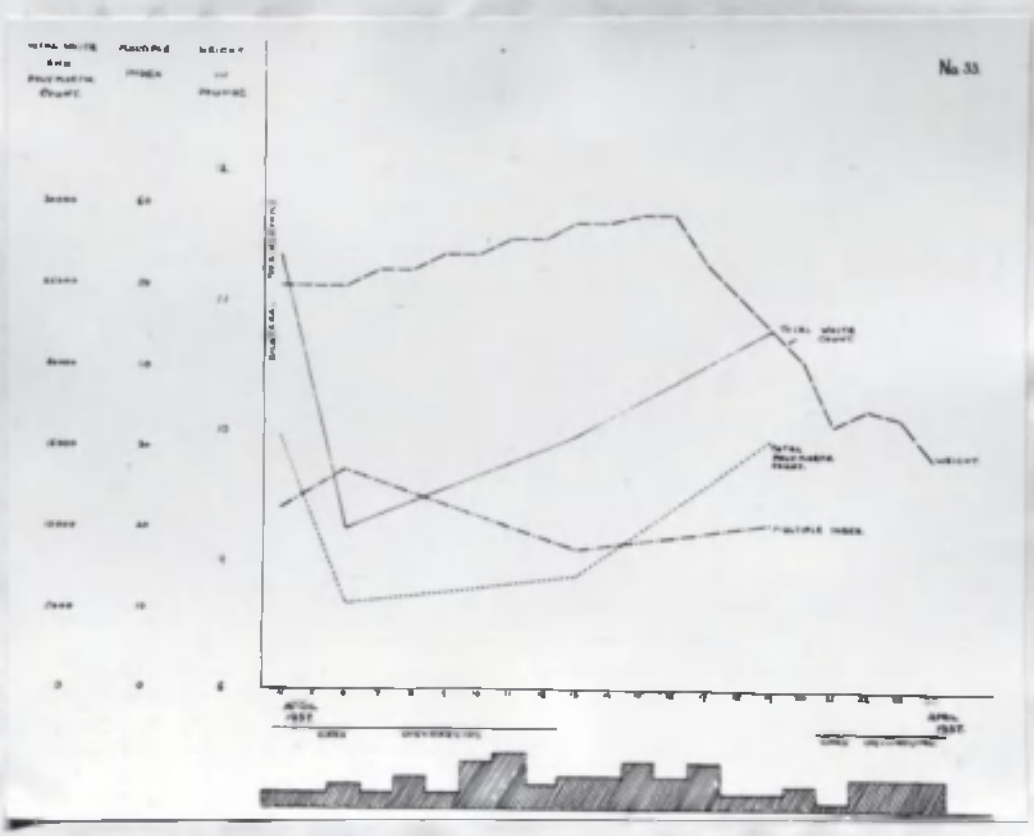
Name:- M.M. No:- 33. Sex:- Female. Age:- 4½ months.

Admitted:- 4.4.37. Died:- 24.4.37.

History:- This child took ill four days prior to admission, with drowsiness, rolling of head, restlessness and vomiting. The father suffered from open pulmonary tuberculosis.

Condition on Examination:- The child was very ill and toxic and there were a few crepitations at both bases. Both tympanic membranes were very red and bulging. Temperature on admission was 102° F.

Progress:- On admission bilateral myringotomy was performed and pus released on both sides. On the following day the child's general condition was much improved and the temperature was subsiding. Two days later improvement was maintained, both ears were discharging profusely, temperature falling and weight rising. On 10.4.37 Mantoux reaction 1/1,000 was strongly positive, as was the patch tuberculin test. Temperature came down to normal and remained so until 16.4.37 when it rose to 102.2° F. and the following day the child was again very ill and there were moist sounds at both bases. Pyrexia continued and the child ultimately died on 24.4.37 with marked loss of weight.



Description of Graph:- This graph is interesting because the multiple index rose after myringotomy while the total white count fell, i.e. the multiple index gave more accurate prognosis. It fell during the temporary improvement and rose again before death, but it remained high throughout, thus being more accurate than the total white count, which fell and remained within normal limits.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	4.4.37	66	16900	.02	22.4	1.4		2	57	41	15736	58.5	11.5	30	8070			S. St.	D.	Reg.
2.	6.4.37	50	10000	.01	27.2	1.7	.5	3	61	35.5	5550	55.5	8.5	36	3600			St.	D.	Reg.
3.	13.4.37	47	15700	.005	17.6	1.1		.5	53.5	46	7065	45	14.5	40	6160		.5	St.	D.	Reg.
4.	19.4.37	38	21600		20.8	1.3			57.5	42.5	15594	69	10.5	20	4320		.5	S. St.	D.	Reg.

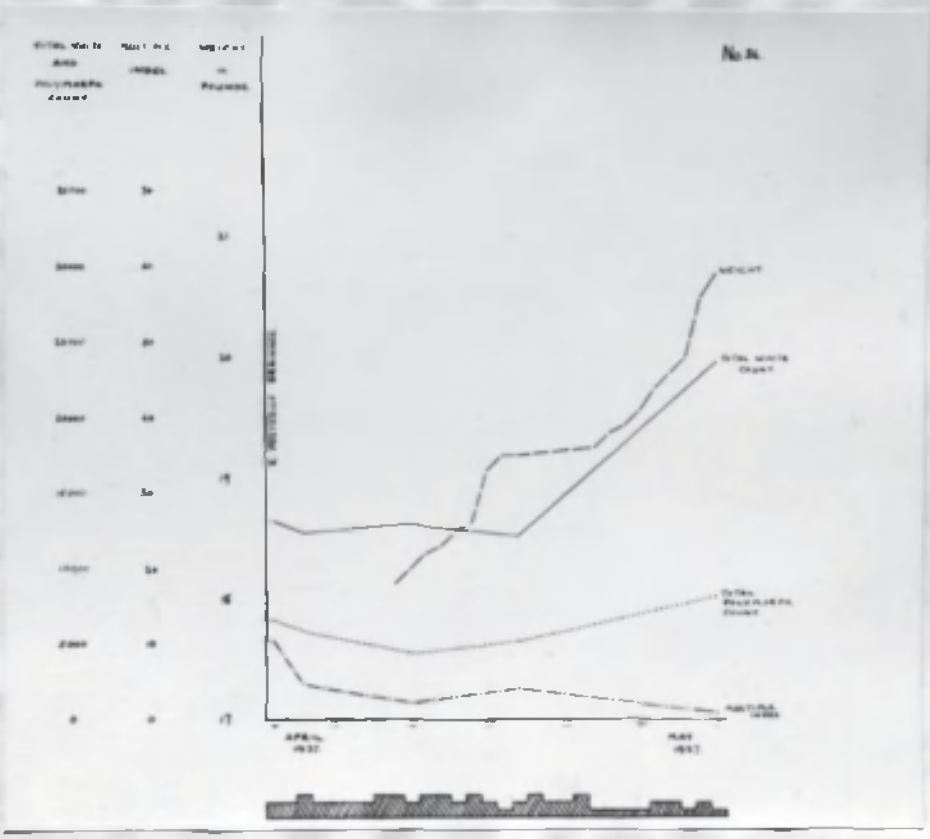
Name:- B.S. No:- 34. Sex:- Male. Age:- 8 months.

Admitted:- 6.4.37. Discharged:- 5.5.37.

History:- This child was admitted with a history of swelling behind the right ear of one week's duration. The swelling was tender and the infant would not allow mother to touch it.

Condition on Examination:- This was a well-nourished infant. There was swelling, redness and tenderness over the right mastoid process. The right tympanic membrane was injected and bulging posteriorly. The left tympanic membrane was slightly injected. Other examination was negative and temperature was 99° F.

Progress:- On the evening of admission right posterior drainage was performed and pus found sub-periosteally. The bone was necrotic. Four days later condition was satisfactory. Gain in weight commenced and discharge lessened. On 23.4.37, when the child was almost fit for discharge, temperature rose to 100.2° F. and several small abscesses occurred on scalp. These recovered satisfactorily and the infant was discharged well on 5.5.37.



Description of Graph:- This child's general condition was very good and the multiple index was not markedly elevated and fell after the operation. The multiple index rose slightly on 22.4.37 with the abscesses on the scalp and fell gradually to normal. Gain in weight was progressive. The total white count was not raised at first but had actually risen at the end. The child was nevertheless discharged and there were no untoward developments. The multiple index here was a very accurate guide to the clinical state and the curve illustrated the comparatively mild disturbance which occurs in cases of classical mastoiditis which is in accord with the clinical state of this infant.

No.	Date	Hb.	Total W. B. Cs.	L I.	M I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R P.	T.	Type of Left Shift
1.	6.4.37	45	13100	·008	10.4	·68		1	38·5	60·5	66 84	51	8	40.5	5305		·5	St.	D.	Deg.
2.	8.4.37	83	12400		4·9	·31			24	76	5952	48	11·5	38 5	4774	2·5	·5	St.	D.	Deg.
3.	15.4.37	55	12900		2·2	·14			12·5	87·5	4450	34·5	10·5	53	7837	1·5	·5		D.	Deg.
4.	22.4.37	51	12100		4·0	·25			20	80	5263	43·5	8 5	48	5808			St.	D.	Deg.
5.	5.5.37	56	13700		·8	·05			5	95	8295	35	9	54	12798	2				

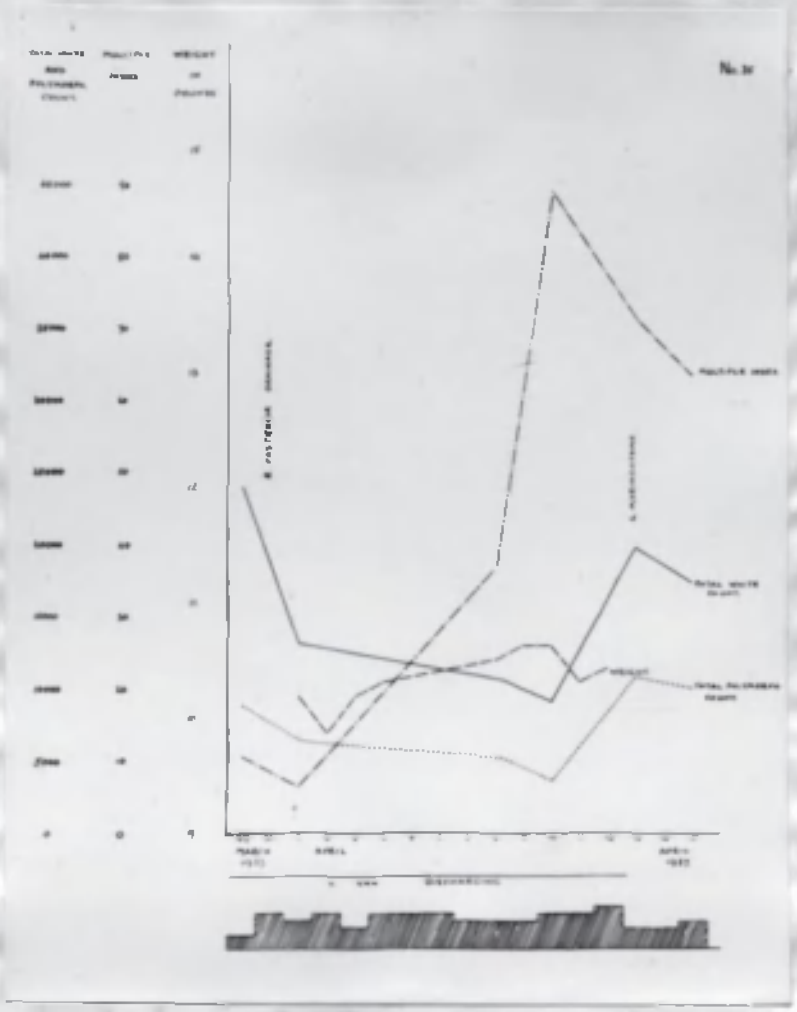
Name:- A.L. No:- 35. Sex:- Female. Age:- 9 weeks.

Admitted:- 29.4.37. Died:- 16.5.37.

History:- This child was admitted with a history of two weeks right otorrhoea. Three days before admission a swelling developed behind the right ear and then the left ear commenced to discharge. Some vomiting had occurred but no diarrhoea and gain in weight had been satisfactory.

Condition on Examination:- This was a fretful child in fair condition. There was redness, tenderness and swelling over the right mastoid process. The right tympanic membrane was acutely inflamed and there was profuse thick discharge. The left tympanic membrane was also reddened posteriorly and there was profuse discharge. Temperature was not elevated.

Progress:- Right posterior drainage was performed and pus was found subperiosteally. Operation on the left ear was contemplated but unfortunately not performed. Temperature rose after operation to 99.6° F. but rapidly subsided. On 8.5.37 child's condition was very satisfactory but the left ear was discharging profusely. On 12.5.37 the child looked ill, temperature rose to 101.2° F. and stools became loose. Left otorrhoea ceased on 13.5.37 and left myringotomy was without result. This pyrexia continued until the end and the child became very ill and toxic. The infant ultimately died on 16.5.37.



Description of Graph:- The multiple index was elevated but not markedly so on admission and fell after the operation. On 8.5.37 the multiple index had risen sharply and continued to do so until 10.5.37, during which time the child's condition appeared satisfactory. On 12.5.37 the infant became very ill, i.e. the rise in the multiple index preceded the onset of the acute illness by at least a week. The total white count gave no indication of this occurrence. It is also probable that it was the infant's left mastoid which caused its death, and that if it had also been operated on the fatal issue might have been averted. The fall in the multiple index towards the end was probably due to marrow failure. The multiple index throughout this case gave a clear index of prognosis and progress of this infant's illness.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	29.4.37	37	24500		10.5	.60			40	60	8880	37	14	41.5	10167	7.5		St.	D.	Deg.
2.	1.5.37	43	13200		6.4	.40			29	71	6534	49.5	13	37.5	4950			St.	D.	Deg.
3.	8.5.37	42	10600	.03	36.8	2.3	1	3	66.5	29.5	5247	49.5	14.5	34	3604	2		St.	S.D.	Reg.
4	10.5.37	44	9100	.1	89.6	5.6		3	82	15	3776	41.5	7.5	46.5	4231	4.5			S.D.	Reg.
5.	13.5.37	60	19900	.07	72.0	4.5		2.5	79.5	18	11144	56	12	31.5	6268	.5		St.	S.D.	Reg.
6.	15.5.37	57	17500	.18	64.0	4.0		7.5	72.5	20	10237	38.5	9	32.5	5687			St.	S.D.	Reg.

Name:- G.W. No:- 36. Sex:- Female. Age:- 12 weeks.

Admitted:- 5.5.37. Died:- 9.5.37.

History:- This child was admitted having been ill three days. Diarrhoea and vomiting had occurred during last five days, but she had been taking food well until day before admission. Loss of weight had occurred.

Condition on Examination:- This infant was toxic and its colour was poor. It was slightly dehydrated and the stools were loose. The temperature was 98° F. Left tympanic membrane was pale and lacked lustre while right tympanic membrane was very red and unhealthy with profuse purulent discharge and eczema of right pinna. Other examination was negative.

Progress:- On 7.5.37 the infant was extremely ill and toxic, temperature having risen to 101.4° F. This state of affairs continued until death on 9.5.37.

Blood Investigations:- Only two estimations were made on this case. Total white count was raised in both instances and neutrophilic response was good in second estimation. Although multiple index remained elevated it fell considerably at second reading.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	6·5·37	45	19100	·13	80 0	8·0		4·5	79	16·5	8308	43·5	15	40 5	7735	1		Sl.	S. D	Reg.
2.	8·5·37	56	24400	·01	11·6	·73		2	40·5	37 5	16226	66 5	6	25·5	6322			S. Sl.	D	Reg.

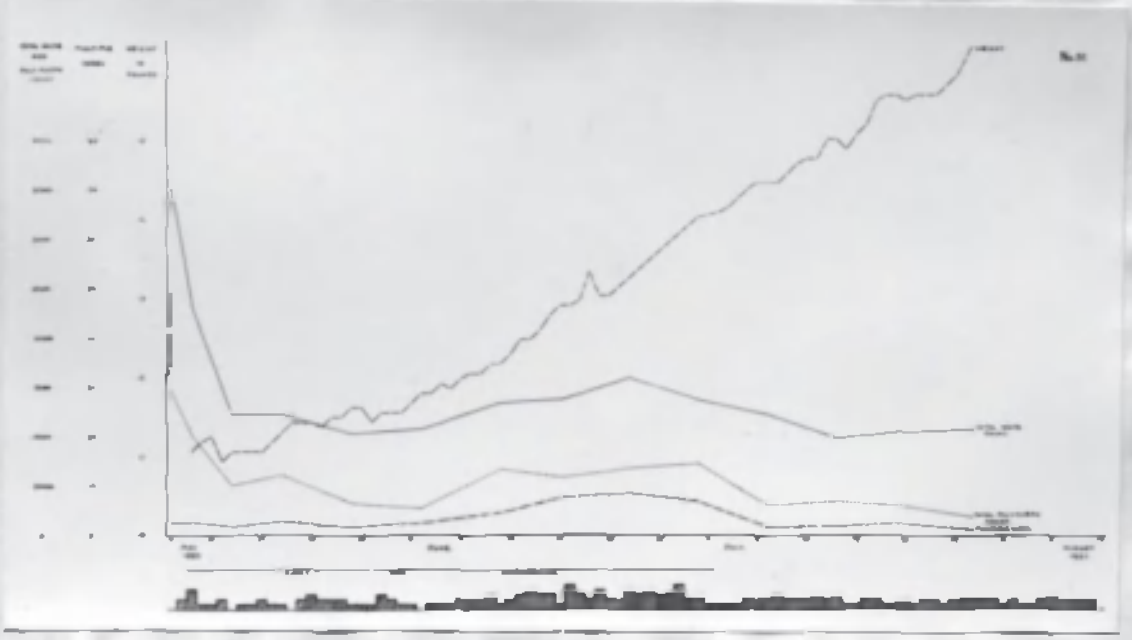
Name:- J.M. No:- 37. Sex:- Male. Age:- 6 months.

Admitted:- 11.5.37. Discharged:- 12.8.37.

History:- On the day before admission this child was observed to scream when the right ear was touched. Mother also noticed redness behind the ear and nasal discharge.

Condition on Examination:- The right pinna was displaced forwards and there was redness and oedema over the mastoid process. The right tympanic membrane was very red and bulging. The left tympanic membrane was normal. There was profuse nasal discharge. Other examination was negative and temperature was 100.2° F.

Progress:- The infant was operated upon on the day of admission, right posterior drainage being performed. Pus was found under the periosteum and in the mastoid antrum. Temperature remained elevated during the next six days, varying from 100.2° to 101.2° F. It then settled and gain in weight began. Right meatal discharge began on 13.5.37 and continued until 4.7.37. On 29.5.37 infant was apyrexial but weight gain was not very satisfactory. The wound was satisfactory and there was profuse discharge from the right meatus. The left tympanic membrane was normal and nasal discharge less. The blood Wassermann reaction was negative. On 7.6.37 nasal discharge still persisted, the wound was healing, but there was still discharge from the right meatus. On 24.6.37 morphological K.L.B. were found in nasal discharge. On 27.6.37 slight weight loss had occurred but general condition was good. Mastoid wound was healed and the meatal discharge was much less. The virulence test of nasal swab was "mitis and virulent". K.L.B. recurred in throat and nose frequently until 6.8.37, when all swabs became negative. The Schick test, performed on 26.7.37, was negative. Meanwhile the infant had been gaining weight satisfactorily and aural discharge had ceased. It was discharged from hospital well on 12.8.37.



Description of Graph:- The total white count was very high to begin with as was the total polymorphonuclear count, but the multiple index was very slightly elevated and more consistent with the infant's general condition, which was excellent. The total white count and total polymorphonuclear count both subsided quickly to within normal limits and the multiple index also became normal. The multiple index then suffered a gradual rise to a not very high level, which persisted through the month of June - the only explanation of which was the nasal diphtheria. It then gradually subsided again to normal. This graph illustrates the mild disturbance which occurs in classical mastoiditis.

No.	Date	Hb.	Total W. B. Ca.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	11.5.37	36	35100		2.5	.16			14	86	14714	42	14	43	15093	.5	.5	St.	D.	Deg.
2.	13.5.37	34	23100		2.7	.17			15	85	10279	44.5	15	40.5	9355			St.	D.	Deg.
3.	17.5.37	33	12300		1.9	.12			11.5	88.5	5104	41.5	16.5	41	5043	.5	.5	St.		
4.	22.5.37	42	12300		2.8	.18			15.5	84.5	6173	51	15	33.5	4120	.5		St.	D.	Deg.
5.	29.5.37	37	10300		1.9	.12			11	89	3399	33	15	51	5153	1				
6.	5.6.37	63	10800		2.4	.15			13.5	86.5	2862	26.5	16.5	52.5	3670	4	.5		D.	Deg.
7.	13.6.37	71	13500		4.6	.29			23	77	6985	51	7.5	41	5585	.5		St.	D.	Deg.
8.	19.6.37	50	13800		7.8	.49			33	67	6003	43.5	10.5	43	5934	2	1	St.	D.	Deg.
9.	26.6.37	56	16100		8.9	.56			36	64	6842	42.5	17	37	8937	3.5		St.	D.	Deg.
10.	3.7.37	46	13900	.009	5.1	.32		1.5	23	75.5	7367	53	12	34	4726	1		St.	D.	Reg.
11.	10.7.37	56	12400		1.9	.12			11.5	88.5	3100	25	10.5	59.5	7378	5				
12.	17.7.37	43	10000	.002	2.0	.13		.5	11.5	88	3500	35	8.5	53	5300	1.5	2.		D.	Reg.
13.	24.7.37	44	10600		2.5	.16			13	87	3074	29	17.5	51.5	5459	2			D.	Deg.
14.	31.7.37	48	10900		1.2	.08			8	92	1907	17.5	20.5	58	6312	4				

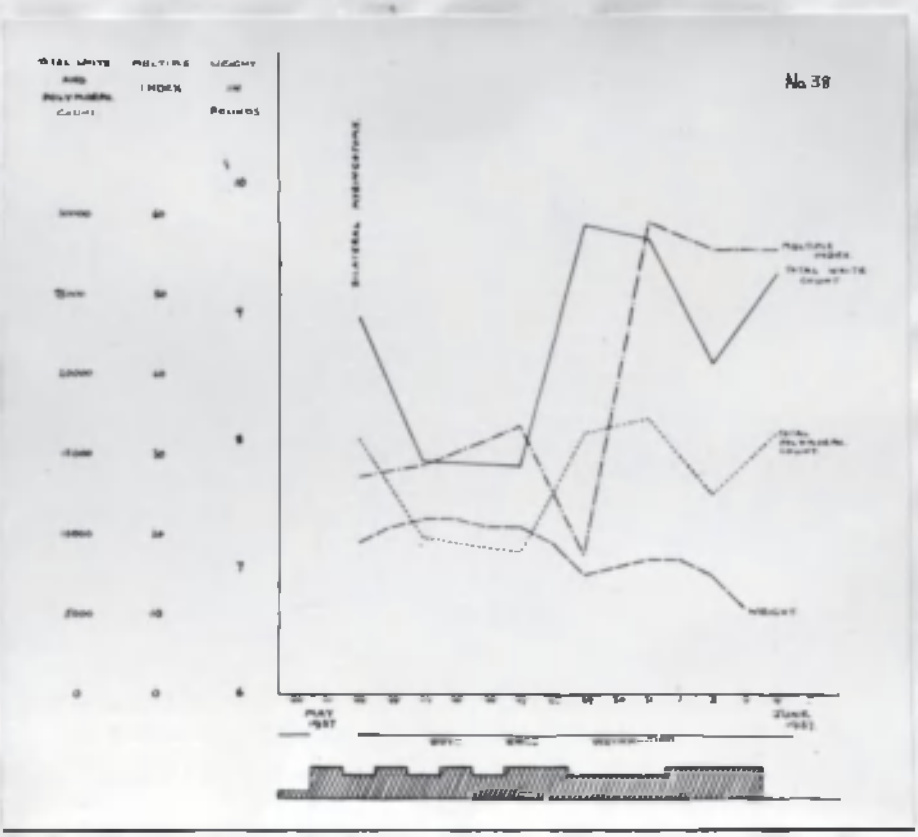
Name:- N.W. No:- 38. Sex:- Female. Age:- 3 months.

Admitted:- 20.5.37. Died:- 4.6.37.

History:- This child was admitted with a history of right otorrhoea of one week's duration. The stools were loose and green and loss of weight had occurred.

Condition on Examination:- This was a very toxic and dehydrated child, with bilateral otorrhoea. Both tympanic membranes were very unhealthy and there was some discharge from both eyes. Temperature was 99.2° F.

Progress:- Two days later the child was still very ill and its temperature had been as high as 101.6° F. Otorrhoea had ceased and both druma were pink and bulging. Bilateral myringotomy was performed and thin pus released from both ears. On 24.5.37 temperature was 103° F., both ears were discharging profusely and the child was very ill. This unsatisfactory state of affairs continued until death occurred on 4.6.37.



Description of Graph:- The multiple index was high and remained so throughout. This graph is interesting because on 29.5.37 the multiple index fell and the total white count and the total polymorphonuclear count both rose. The multiple index rose very high at the next estimation, i.e. on this occasion the rise of the multiple index lagged behind instead of preceding the rise in the total white count as is usual. It remained very high until death.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	22.5.37	52	23600	.02	27.2	1.7		1.5	62.5	36	16048	68	11.5	20.5	4838			S. St.	D.	Reg.
2.	24.5.37	57	14700	.02	28.2	1.8	.5	3.5	61.5	34.5	9922	67.5	9.5	23	3381			St.	D.	Reg.
3.	27.5.37	54	14300	.01	33.6	2.1	.5	2.5	65.5	31.5	8937	62.5	12.5	24.5	3503	.5		St.	S. D.	Reg.
4.	29.5.37	63	29400	.02	17.6	1.1		2.5	80	47.5	16464	56	12	32	9408			S. St.	D.	Reg.
5.	31.5.37	58	28600	.16	59.2	3.7		7	72	21	17303	60.5	12	27.5	7865			S. St.	S. D.	Reg.
6.	2.6.37	63	20800	.06	56.0	3.5		3	75	22	12792	61.5	14.5	24	4992			S. St.	S. D.	Reg.
7.	4.6.37	63	26800	.06	56.0	3.5	1.5	6.5	70	22	16430	62	8.6	29.5	7817			S. St.	S. D.	Reg.

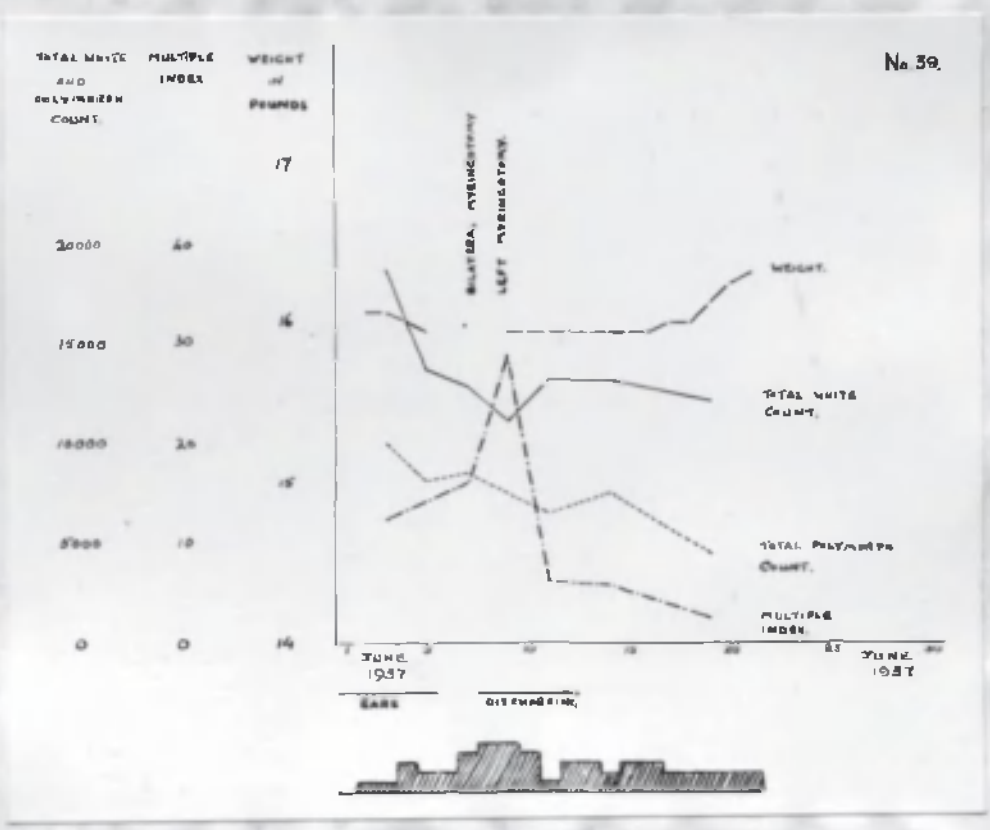
Name:- A.M. No:- 39. Sex:- Male. Age:- 4 months.

Admitted:- 1.6.37. Discharged:- 21.6.37.

History:- This child was admitted with a history of vomiting of five days' duration, worse during last two days. Convulsions occurred on day before admission.

Condition on Examination:- This child's neck was a little stiff, but fontanelle was of normal tension and respirations seemed rather rapid. Both ears were discharging, the right more than the left. Other examination was negative and temperature was 99.2° F.

Progress:- The child's condition remained unaltered until 7.6.37, when temperature, which had subsided, rose again to 99.4° F. It was toxic rather than dehydrated. Left tympanic membrane was very red and bulging with no discharge, while right tympanic membrane was similar with much less discharge than formerly. Bilateral myringotomy was performed and thick pus released from right ear, but only blood was obtained on left side. Left myringotomy was again performed on 8.6.37. On 9.6.37 temperature was 100.6° F. and there was very little discharge from either ear. On 11.6.37 temperature subsided to normal. On 19.6.37 the general condition was very good, weight was going up, ears were dry and both tympanic membranes pale. The infant was discharged from hospital well on 21.6.37.



Description of Graph:- Multiple index was moderately elevated to begin with and rose when drainage became unsatisfactory. It fell abruptly after the myringotomies and gradually subsided. The total white count was never outwith normal proportions so that the multiple index was a more accurate indication of the child's condition.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	3·6·37	68	18,700	·008	12·16	·76		1	42·5	56·5	10.004	53·5	12	34·5	6451			St.	D.	Reg.
2.	5·6·37	49	13,600	·004	14·08	·88		·5	46·5	53	8,228	60·5	14	25	3400	·5		St.	D.	Reg.
3.	7·6·37	61	12,900	·01	16	1·0	·5	2	49	48·5	8,514	66	14	20	2580			St.	D.	Reg.
4.	9·6·37	87	11,200	·02	28·8	1·8	1	2	61·5	35·5	7,560	67·5	4	28	3136		·5	St.	D.	Reg.
5.	11·6·37	73	13200	·006	6·08	·38		1	27	72	6534	49·5	9·5	40	5280	·5	·5	St.	D.	Reg.
6.	14·6·37	59	13200		5·76	·36			26·5	73·5	7670	57·5	7·5	35	4620			St.	D.	Deg.
7.	19·6·37	60	12,200		2·40	·15			13·5	86·5	4814	37	15·5	46·5	5673	·5	·5		D.	Deg.

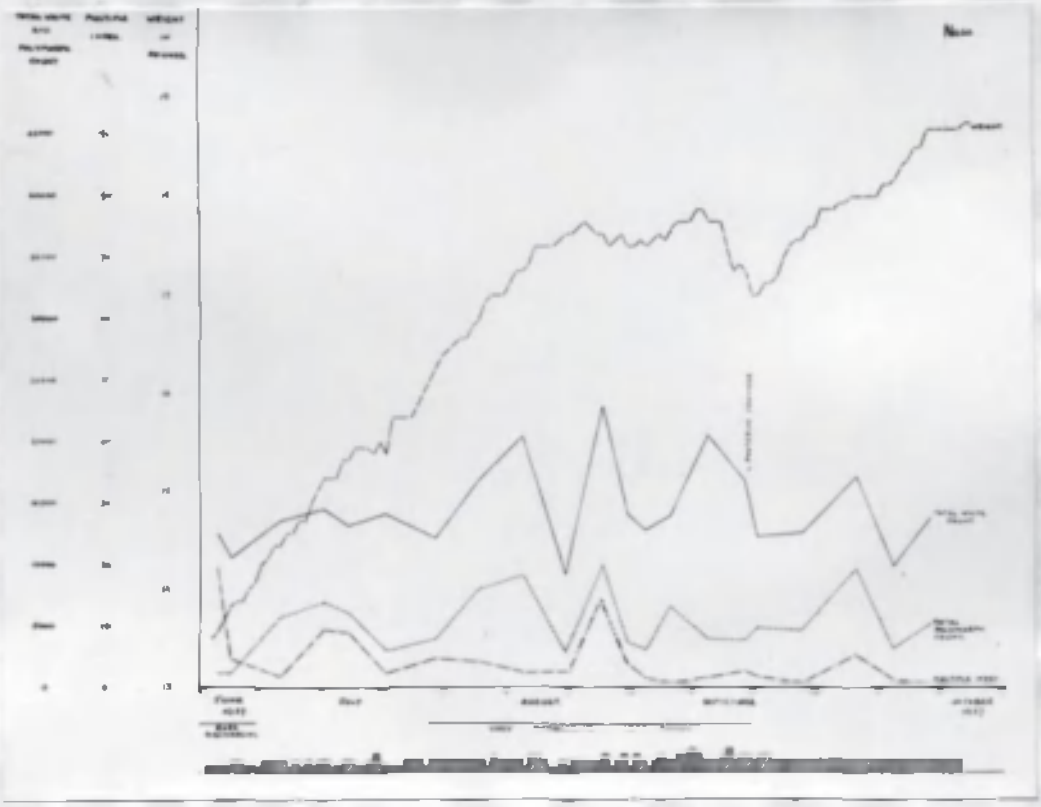
Name:- R.R. No:- 40. Sex:- Male. Age:- 6 months.

Admitted:- 22.6.37. Discharged:- 20.10.37.

History:- This child was admitted with a history of discharge from the left ear of one week's duration. Vomiting commenced on day before admission and stools were loose and frequent.

Condition on Examination:- This child was in fair condition, stools were normal and there was no vomiting. Both tympanic membranes were pale and lacked lustre and both ears were discharging profusely. There was some eczema of the left pinna and a few septic spots on the scalp, and some nasal discharge. Temperature - 102° F.

Progress:- By 25.6.37 temperature was normal and both ears were discharging profusely. Discharge ceased on 30.6.37 and the child was gaining weight, septic spots on scalp and eczema of pinna were healing. Swabs of nose and ears showed morphological K.L.B. but these were found to be non-virulent diphtheroids. On 11.7.37 gain in weight had been satisfactory. Both tympanic membranes were pale and there was no discharge. On 28.7.37 there was slight discharge from the left ear and on 4.8.37 the left ear was again discharging profusely and there was slight discharge from the right. On 22.8.37 and 24.8.37 temperature rose sharply to 102.8° F. and 103.8° F. respectively, but general condition was good, the left ear was discharging and on 25.8.37 tonsillitis was observed. This had subsided by 28.8.37. On 17.9.37 left posterior drainage was performed. This gradually healed without event and the infant was discharged well on 20.10.37.



Description of Graph:- The multiple index was somewhat raised to begin with and then subsided. It rose again during the spell when aural discharge had ceased and then settled somewhat when discharge had re-commenced. The occurrence of the tonsillitis is signified by a sharp peak in the multiple index curve. There was no rise at operation and it gradually subsided to normal with infant's very satisfactory gain in weight. The highest peak of total white count was reached with the tonsillitis, at which point the three curves are parallel. At other times the total white count was never outwith normal limits.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	24.6.37	67	12500	.01	19.2	1.2		1	55	44	11 87	9.5	17.5	72.5	9062		.5		D	Reg.
2.	26.6.37	59	10700		4.1	.26			21	79	11 77	11	13.5	75.5	80 78				D	Deg.
3.	3.7.37	65	13500		1.7	.11			10	90	5602	41.5	11.5	47.5	6142	1.5		St.		
4.	10.7.37	53	14500	.01	9.1	.57		1.5	35	63.5	68 15	47	13.5	38.5	55 82	.5	.5	St.	D	Reg.
5.	14.7.37	40	13200		8.8	.55			35.5	64.5	00 72	46	11.5	40.5	5346	2.		Sc	D.	Deg.
6.	20.7.37	47	14200		2.2	.14			12.5	87.5	30 53	21.5	10	68	9230	3.5			D.	Deg.
7.	28.7.37	42	12200		4.8	.30			23.5	76.5	3843	31.5	16	52	6222	1.5			D.	Deg.
8.	4.8.37	52	16900		4.1	.26			21	79	80 13	41.5	17.5	36	6084	4.5	.5	St.	D.	Deg.
9.	11.8.37	69	20500		2.5	.16			14.5	85.5	9122	44.5	10.5	42	8610	3		St.	D.	Deg.
10.	18.8.37	60	9100		2.4	.15			13.5	86.5	2806	30.5	9.5	55.5	5106	4.5			D.	Deg.
11.	24.8.37	61	22800	.009	14.7	.92	.5	8	39.5	52	9804	43	17.5	39.5	9006			St.	D.	Reg.
12.	28.8.37	48	14100	.009	4.0	.25		1.5	18.5	80	3736	26.5	11	57.5	8107	5			D.	Reg.
13.	30.8.37	57	12800		1.6	.10			9.5	90.5	3200	25	13.5	59	7552	2.5				
14.	4.9.37	60	14000		.86	.05			5	95	66 50	47.5	6	45	6300	1.5		St.		
15.	10.9.37	73	20600		1.6	.10			9.5	90.5	40 77	29.5	13	56.5	11639	1				
16.	16.9.37	65	16800		2.7	.17			15	85	3864	23	13.5	63.5	10668				D	Deg.

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No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
17.	8.9.37	64	12300		1·9	·12			11·5	88·5	4920	40	17	42	5166	1		St.		
18.	25.9.37	58	12600		·96	·06			6·5	93·5	4725	37·5	13·5	46·5	5859	2·5				
19.	4.10.37	54	17200	·01	5·2	·33		2	23	75	9718	56·5	12	30	5160	·5	1	St.	D.	Reg.
20.	10.10.37	52	9800		1·2	·08			8	92	3234	33	10·5	55·6	5439	1				
21.	16.10.37	61	13800		·64	·04			4·5	95·5	5244	38	7·5	52	7176	2·5				

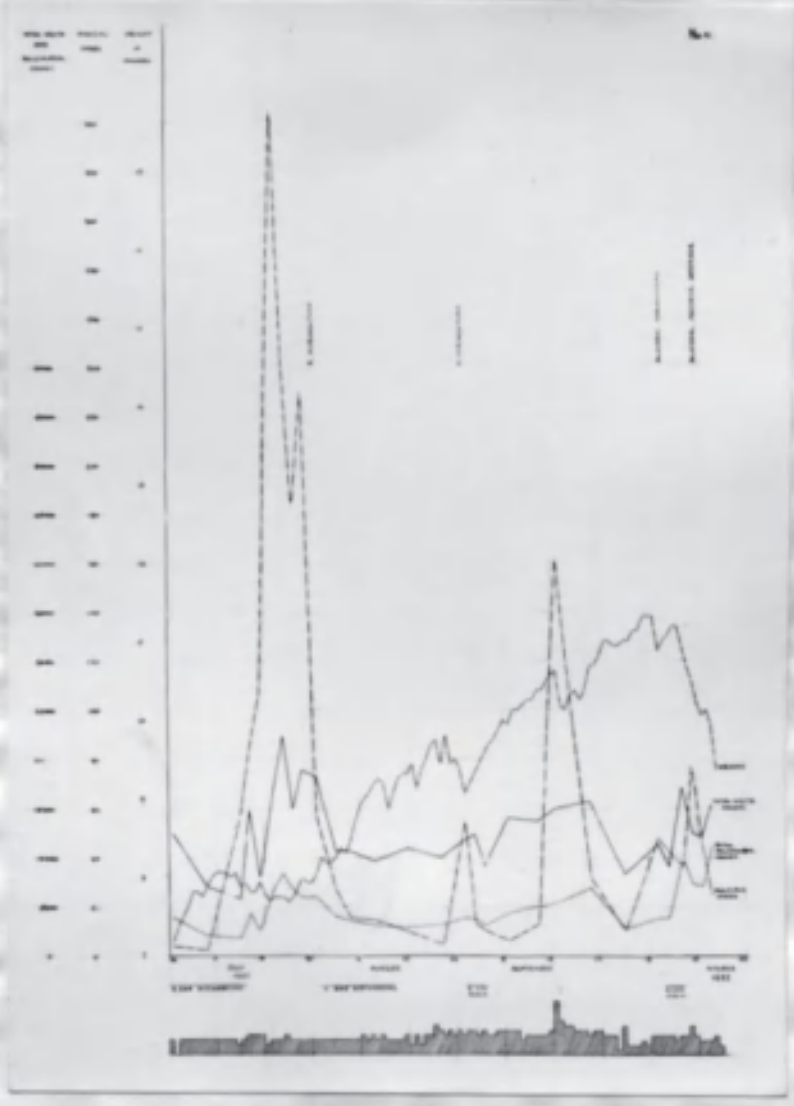
Name:- A.E. No:- 41. Sex:- Female. Age:- 2 months.

Admitted:- 26.6.37. Died:- 18.10.37.

History:- This child was admitted with a history of right otorrhoea of two days' duration, loss of weight. There was constipation and no diarrhoea and vomiting.

Condition on Examination:- The child was small, but there was no dehydration or toxicity. The right tympanic membrane was red and there was profuse purulent discharge, while the left tympanic membrane appeared normal. Its temperature was not elevated.

Progress:- For the first fortnight the child gained weight satisfactorily and right otorrhoea continued. It then ceased to gain satisfactorily and the stools were loose occasionally. Right tympanic membrane - pink and no discharge. On 26.7.37 general condition was fairly good, but the right tympanic membrane had slight posterior bulge and was injected. Right myringotomy was performed and profuse purulent discharge obtained. Gain in weight then became much more satisfactory. Right otorrhoea continued until 11.8.37. On 22.8.37 weight loss began with slight pyrexia and on 26.8.37 right myringotomy was again performed and pus liberated. This was followed by marked gain in weight and the infant was so much improved that its discharge from hospital was contemplated. Then on 14.9.37 temperature rose to 102° F. and sharp weight loss occurred. This rapidly settled and the infant continued to gain. On 6.10.37 the infant became pyrexial and again lost weight. Bilateral myringotomy was performed with slight discharge from the right ear, and on10.10.37 the child was very ill and toxic. On 13.10.37 bilateral posterior drainage was performed and pus was found in the left mastoid antrum. The child did not improve, and on 16.10.37 a transfusion of blood was administered but the infant died on 18.10.37.



Description of Graph:- After admission, while the right ear was discharging satisfactorily, there was no marked haematological disturbance. The multiple index then rose and a few days later otorrhoea ceased. The rise in the multiple index became very marked and later the total white count rose but the neutrophilic response was never satisfactory. While the multiple index was high the infant's weight was practically stationary. After drainage had been re-established the multiple index fell and gain in weight commenced with devarication of the two curves indicating an improvement which was also clinically evident. On 18.8.37 otorrhoea ceased and on 26.8.37 the weight and multiple index curves approached indicating an

unsatisfactory state of affairs, and once again right myringotomy produced pus for two to three days, after which things seemed satisfactory and the Child's discharge from hospital was considered. The high rise of the multiple index on 14.9.37 corresponds with elevation of temperature to 102° F. and a weight loss. From 31.8.37 the ears never again discharged satisfactorily and the multiple index never subsided to normal. Bilateral myringotomy on 5.10.37 was unsatisfactory and the terminal fall in weight commenced. The total white count never rose satisfactorily. The terminal fall in the multiple index is probably indicative of marrow failure. It is possible that involvement of the left mastoid took place about 11.9.37. The satisfactory response to myringotomy in the earlier stages suggests that to begin with the condition was merely a right otitis media without mastoid involvement. During the last month or so the unsatisfactory general condition, failure of myringotomy, culminating in the development of marked toxicity are possibly explained by involvement of the left mastoid.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	26.6.37	48	12300	.003	4.0	.25		.5	19.6	80	3997	31.5	9.5	56.5	6949	1	.5		D.	Reg.
2.	3.7.37	38	7000		2.4	.15			13.5	86.5	2170	31	17	50	3500	2			D.	Reg.
3.	10.7.37	62	5800	.02	36.0	3.5		4	74	22	1885	32.5	17	50.5	2929				S. D.	Reg.
4.	12.7.37	50	14900	.2	83.2	5.1		6.5	77.5	16	4895	29.5	16.5	51	7599	3			S. D.	Reg.
5.	14.7.37	43	8100	.07	105.6	6.6	1	10.5	76.5	13	2754	34	15.5	46	3726	3.5	1		S. D.	Reg.
6.	17.7.37	57	17000	.55	344.0	21.5	2.5	20.5	72.5	4.5	6970	41	13.5	42.5	7225	3		St.	S. D.	Reg.
7.	19.7.37	43	22300	.24	244.8	15.3	1.5	25.5	67.5	5.5	8362	37.5	12	44	9812	6.5		St.	S. D.	Reg.
8.	21.7.37	45	15000	.05	184.0	11.5	.5	26	65.5	8	6900	46	9	34.5	5925	5	.5	St.	S. D.	Reg.
9.	23.7.37	55	18600	.07	228.8	14.3	.5	18	75	6.5	6016	32	19.5	43.5	8178	4.5	.5	St.	S. D	Reg.
10.	26.7.37	61	18200	.2	87.6	3.6		10	68.5	21.5	6006	33	12.5	43.5	7917	11		St.	S. D.	Reg.
11.	29.7.37	47	10700	.06	27.2	1.7		5	59	36	4012	37.5	13	46.5	4975	1.5	1.5		D.	Reg.
12.	2.8.37	40	10700	.01	16	1.0	.5	4	48	47.5	3691	34.5	12	49	5043	4.5			D.	Reg.
13.	7.8.37	56	9700	.03	14.7	.92		4	44	52	3152	32.5	16	45	4365	4	2.5		D.	Reg.
14.	14.8.37	58	10900	.008	10.0	.63	.5	2	36.5	61	2834	26	15.5	47	5123	11.5			D.	Reg.
15.	21.8.37	40	10000	.01	4.8	.30		2	21.5	76.5	3250	32.5	11.2	54.5	5450	1	.5		D.	Reg.
16.	26.8.37	56	11800	.08	54.4	3.4	2	10	65.5	22.5	3894	32	18	47	5546	1.5	.5		S. D.	Reg.
17.	28.8.37	48	12300	.04	13.6	.85		5	41	54	3751	30.5	14	52.5	6457	3			D.	Reg.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
18.	30.8.37	40	9200	·04	10·5	·66		5	35	60	3174	34·5	8·5	54·5	5084	1·5	1		D.	Reg.
19.	4.9.37	62	14000	·02	6·5	·41		3·5	26	70·5	4410	31·5	10	57·5	8050	1			D.	Reg.
20.	10.9.37	64	13700	·05	12·9	·81		6·5	38·5	55	5000	36·5	11	51·5	7055	1			D.	Reg.
21.	14.9.37	70	15000	·1	161·6	10·1	1	7	83	9	5400	36	17	45·5	6825	1·5			S. D.	Reg.
22.	21.9.37	57	15700	·22	32·0	2·0		14·5	53·5	32	6976	44·5	11	43·5	6829	1		St.	S. D.	Reg.
23.	28.9.37	48	8300	·008	10·4	·65	·5	2·5	36·5	60·5	2822	34	19	45	3735	1·5	·5		D.	Reg.
24.	5.10.37	60	11400	·02	48	3·0	·5	7	67.5	25	3819	33·5	20·5	45·5	8157		·5		S. D.	Reg.
25.	7.10.37	51	9100	·01	43·2	2·7	·5	14	58·5	27	3958	43·5	17	37	3367	2	·5		S. D.	Reg.
26.	10.10.37	95	17100	·1	36·8	2·3	·5	11	64·5	29·5	10089	59	9	32	5471			St.	S. D.	Reg.
27.	12.10.37	46	12500	·1	76·8	4·8	3	17·5	62·5	17	7437	59·5	14	26·5	3312			St.	S. D.	Reg.
28.	14.10.37	46	12200	·03	46·4	2·9	1	10·5	63	25·5	7259	59·5	11	29·5	3599			St.	S. D.	Reg.
29.	16.10.37	57	15400	·01	25·6	1·6	·5	10	52	37·5	11165	72·5	6·5	21	3234			S. St.	D.	Reg.

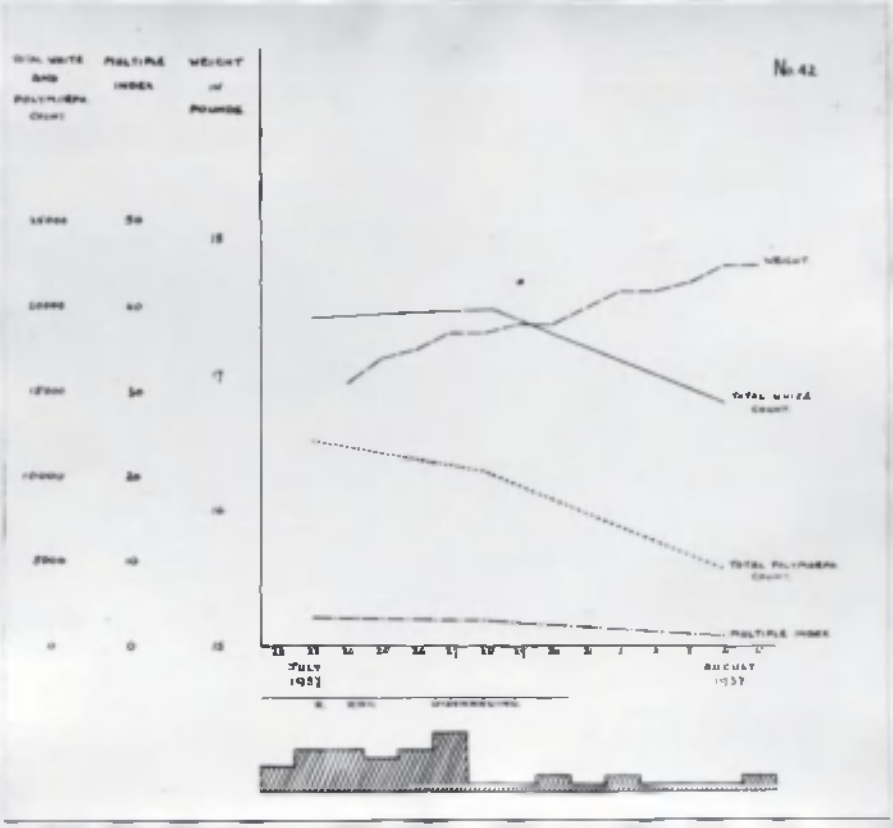
Name:- L.T. No:- 42. Sex:- Female. Age:- 8 months.

Admitted:- 22.7.37. Discharged:- 7.8.37.

History:- This child was admitted with a history of right otorrhoea of three weeks' duration, and the infant had not been taking its feeds well.

Condition on Examination:- This was a healthy, well-nourished child, with no dehydration or toxicity. The left tympanic membrane was normal but the right tympanic membrane was very unhealthy with marginal injection and there was profuse discharge. Other examination was negative and the temperature was not elevated.

Progress:- This child made an uneventful recovery. It gained weight from the day of admission and otorrhoea ceased on 31.7.37. It was discharged home well on 7.8.37.



Description of Graph:- In this case where drainage was satisfactory there was no marked disturbance. The total white count and the total polymorphonuclear count were never outwith normal limits, but the multiple index was slightly elevated to begin with, indicating the presence of infection, and subsided as the ear dried and infant gained weight.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	23.7.37	56	19300	.003	3.3	.21		.5	17.5	82	12159	63	11	24.5	4728	1	.5	St.	D.	Reg.
2.	28.7.37	52	19900		3.2	.20			17	83	10447	52.5	8.5	35.5	7064	3	.5	St.	D.	Reg.
3.	4.8.37	42	14400		1.2	.08			8	92	4608	32	12.5	51.	7488	3.5				

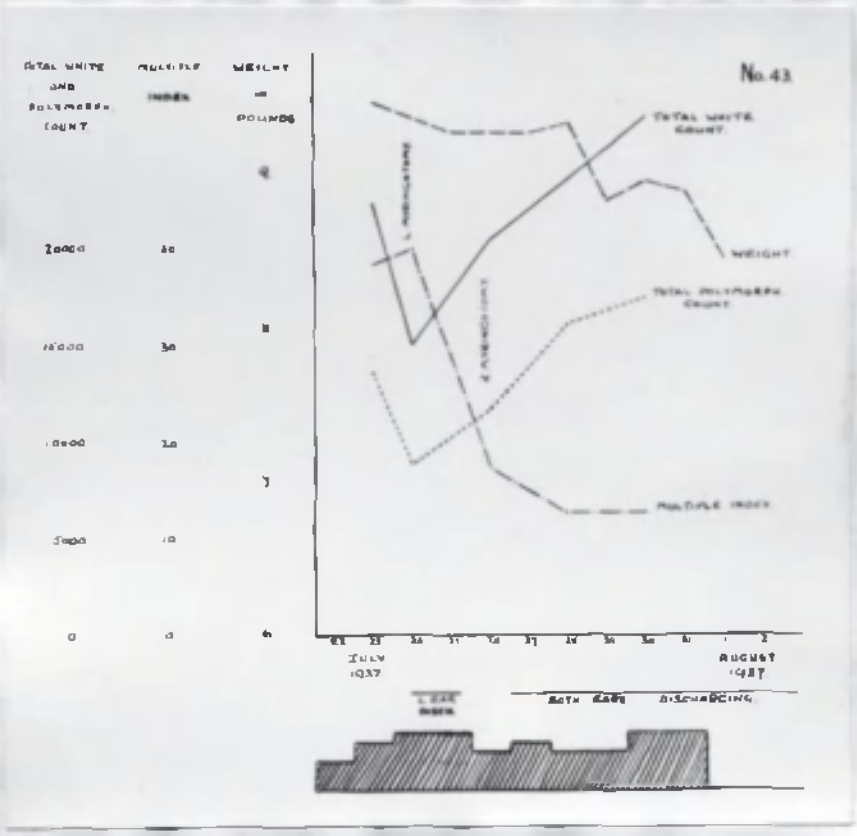
Name:- F.A. No:- 43. Sex:- Female. Age:- 4 months.

Admitted:- 22.7.37. Died:- 2.8.37.

History:- This child was admitted with a history of diarrhoea and vomiting of four days' duration.

Condition on Examination:- This child was very ill and toxic. There was slight dehydration and very loose stools. The right tympanic membrane seemed normal, while the left tympanic membrane showed marginal injection and a slight bulge posteriorly. There was slight purulent discharge from the eyes and the temperature was 100.8° F.

Progress:- On 24.7.37 left myringotomy was performed and pus obtained. On 25.7.37 general condition seemed slightly improved, although the child was still very ill. The right tympanic membrane was very injected and bulging, while the left tympanic membrane showed myringotomy wound open but no discharge. On 26.7.37 right myringotomy was performed and slight amount of pus released. On the following day both ears were discharging. Meanwhile pyrexia had continued between 100° and 101° F. Marked weight loss then commenced and on 30.7.37 the child was very ill, both ears discharging profusely and temperature 103° F. The infant ultimately died on 2.8.37.



Description of Graph:- The multiple index fell after the first myringotomy and slightly after the second, but remained high throughout. The total white count consistently rose throughout with a satisfactory neutrophilic response.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	23.7.37	62	22400	·03	38·4	2·4	1	4·5	65·5	29	13664	61	7·5	31·5	7056			S. St.	S. D.	Reg.
2.	24.7.37	49	15100	·03	40·0	2·5	1	10·5	60·5	28	8689	59	11·5	29·5	4454			St.	S. D.	Reg.
3.	26.7.37	52	20500	·06	17·6	1·1		6	48·5	45·5	11787	57·5	10	32·5	6662			S. St.	D.	Reg.
4.	28.7.37	47	23700	·06	12·9	·81		7·5	37·5	55	16234	68·5	9	22	5214		·5	S. St.	D.	Reg.
5.	30.7.37	53	26800	·03	12·9	·81		3·5	41·5	55	17554	65·5	12·5	22	5896			S. St.	D.	Reg.

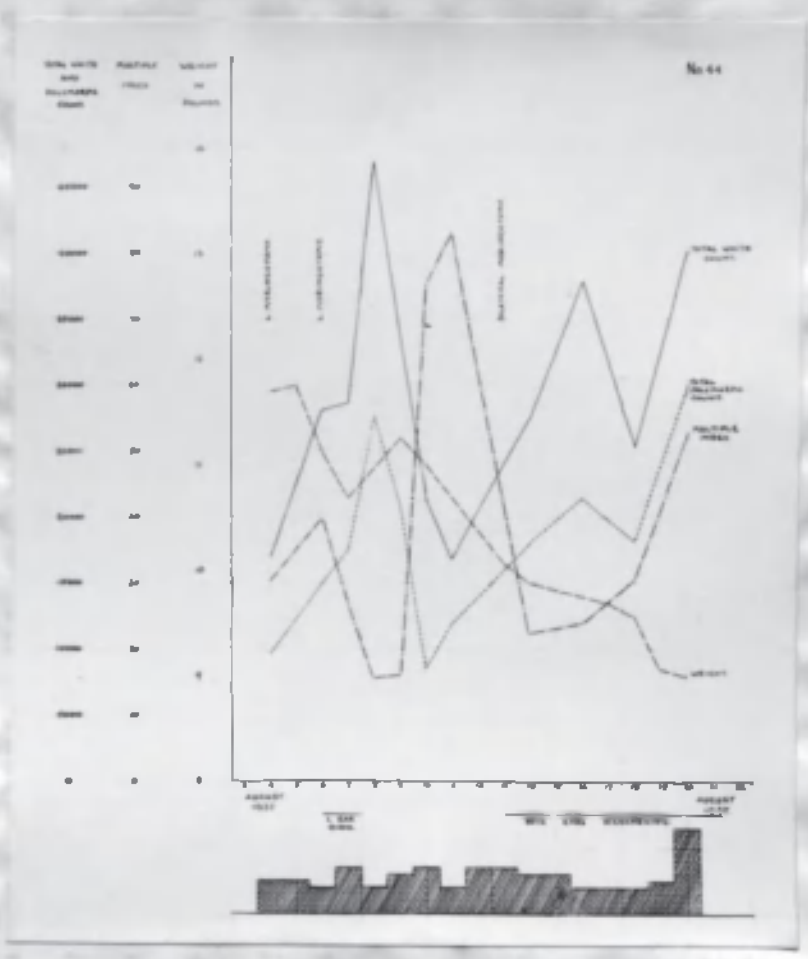
Name:- M.S. No:- 44. Sex:- Female. Age:- 6 months.

Admitted:- 3.8.37. Died:- 21.8.37.

History:- This child was admitted with a history of an ulcerated mouth of four days' duration and diarrhoea of one day's duration. The infant was very fretful but there had been no vomiting.

Condition on Examination:- This child was somewhat toxic and slightly dehydrated. The throat was congested and the tongue dry and ulcerated. Both tympanic membranes were acutely inflamed and bulging, the left more than the right. Temperature was 101.6° F. and other examination was negative.

Progress:- On the following day the stools were loose and offensive and temperature had been as high as 103.4° F. Both tympanic membranes were inflamed. Left myringotomy was performed but there was no discharge. On 6.8.37 marked weight loss occurred; the child was very toxic and dehydrated; the throat and mouth were cleaner. Left myringotomy was repeated with release of moderate amount of thin pus. The right tympanic membrane appeared to be subsiding. On 7.8.37 there was slight discharge from the left ear and post meatal wall was slightly oedematous. Condition continued unaltered except that discharge ceased from left ear. On 13.8.37 the child was extremely ill with temperature of 102.2° F. and the right tympanic membrane was again acutely inflamed and bulging, while the left tympanic membrane seemed only slightly injected. Bilateral myringotomy was performed and a small amount of pus obtained from the left ear, and a large amount from the right. The following day the right ear was discharging profusely, but there was no discharge from the left. On 16.8.37 the infant was still very ill with temperature of 102.8° F. and both ears were discharging profusely. This condition continued until death on 21.8.37.



Description of Graph:- The multiple index was high practically throughout. It fell somewhat with a slight gain in weight and a release of pus at the second left myringotomy. There was a satisfactory total white count and neutrophilic response. At this point there was a slight improvement in the child's condition. Then the multiple index rose very high and did not fall until the bilateral myringotomy established drainage. The rise previous to it was accompanied by a fall in the total white count, i.e. the multiple index was a more accurate guide to the state of the child. The multiple index, however, remained high and gradually rose again with the total white count when the child died. On the whole the multiple index and weight curves converge indicating a bad prognosis.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	4·8·37	58	17000	·08	30·4	1·9		5·5	61	33·5	9605	56·5	14	29·5	5018			St.	S. D.	Reg.
2.	6·8·37	80	25100	·1	40·0	2·5		8·5	63	28·5	15033	53·5	14·5	32	8942			S. St.	S. D.	Reg.
3.	7·8·37	78	28700	·08	30·4	1·9		5·5	61	33·5	17507	61	4·5	34·5	9901			S. St.	S. D.	Reg.
4.	8·8·37	64	47000	·05	15·6	·98		6	43·5	50·5	27730	59	11	30	14100			S. St.	D.	Reg.
5.	9·8·37	67	33700	·05	16	1·0		3·5	47	49·5	21062	62·5	10·5	27	9099			S. St.	D.	Reg.
6.	10·8·37	71	21300	·4	75·2	4·7		16·5	66	17·5	8626	40·5	16·5	43	9158			St.	S. D.	Reg.
7.	11·8·37	66	16800	·09	83·2	5·2	1·5	11·5	71	16	11928	71	14·5	14·5	2356			S. St.	S. D.	Reg.
8.	14·8·37	54	27500	·03	22·4	1·4	1·5	6	51·5	41	18012	65·5	16	18·5	5087			S. St.	D.	Reg.
9.	16·8·37	53	37900	·01	24·0	1·5	·5	8·5	52	39	21413	56·5	14·5	29	10991			S. St.	D.	Reg.
10.	18·8·37	62	25300	·04	30·4	1·9	1·5	14	50·5	34	18216	72	7	21	5313			S. St.	S. D.	Reg.
11.	20·8·37	71	40100	·17	52·8	3·3	4	16	57	23	29874	74·5	8·0	17	6817			S. St.	S. D.	Reg.

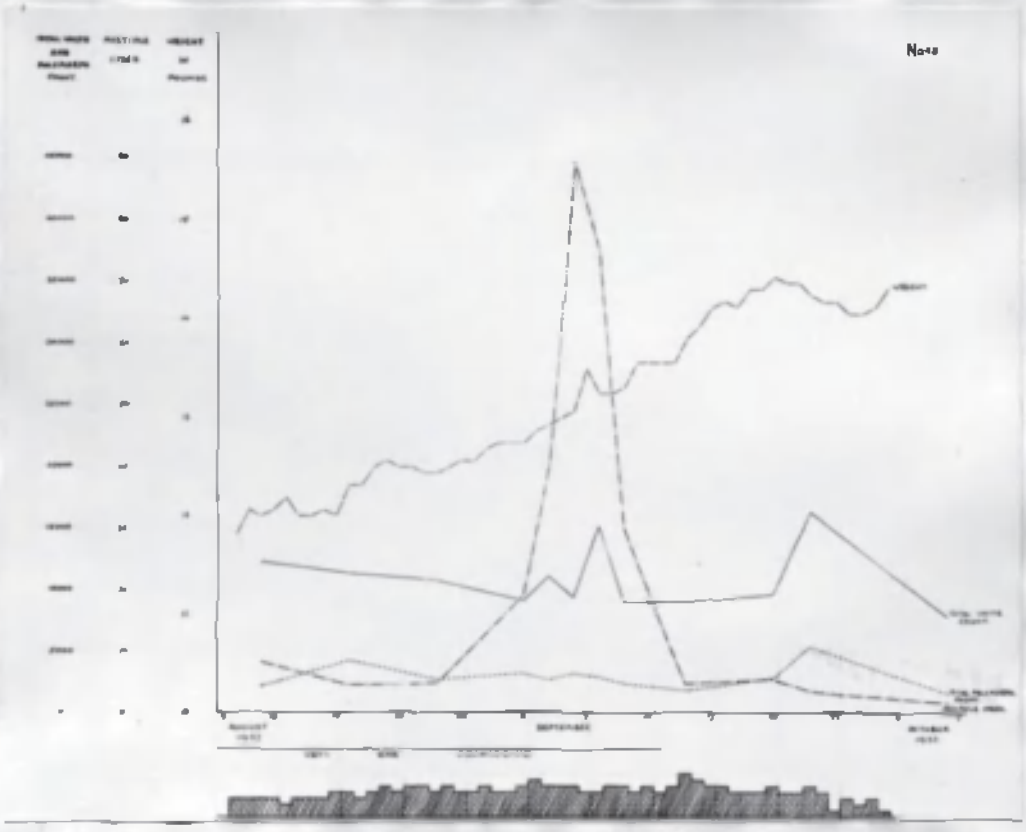
Name:- M.R. No:- 45. Sex:- Female. Age:- 4 months.

Admitted:- 9.8.37. Discharged:- 1.10.37.

History:- This child was admitted with a history of eczema around ears of five weeks' duration. The left ear had commenced to discharge on the morning of admission. The infant appeared to have pain in ears - rolling of head and it was very fretful. vomiting had occurred but no diarrhoea.

Condition on Examination:- This was a very fretful infant with profuse left otorrhoea. There was an eczematous condition behind both pinnae, but other examination was negative and temperature was not elevated.

Progress:- On 12.8.37 the child was very well. There was profuse left otorrhoea and the right tympanic membrane was pale and lack-lustre, and by 19.8.37 discharge had decreased and the infant was gaining weight satisfactorily. The eczema was practically clear. On 8.9.37 both tympanic membranes looked unhealthy and there was still some discharge from the left ear, and on 10.9.37 the infant developed bilateral styes, which were quite severe and continued for some nine days. Condition then improved until discharge from hospital on 1.10.37.



Description of Graph:- This graph is interesting as it demonstrates how much response varies in infants. The multiple index was somewhat elevated to begin with and while discharge from ear was satisfactory, and then suddenly rose sharply on 2.10.37 and continued to do so until a very high figure was reached on 6.10.37. There was no detectable change in the child's general condition or in the condition of its ears. The only explanation for this rise in the multiple index was the occurrence of styes in both eyes, and this rise preceded their appearance by some days. The total white count gave a slight rise also at this point, but not outwith normal figures. The multiple index subsided as the styes discharged and cleared up. The graph illustrates the marked disturbance apparently trifling retained infection can produce in some infants.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	12.8.37	49	12200	.03	8.1	.5%		4	30	66	2196	18	12	62.5	7625	7.5			D.	Reg.
2.	19.8.37	42	11200	.006	4.6	.24		1	22	77	4256	38	11	44.5	4984	6.5			D.	Reg.
3.	26.8.37	65	10700	.01	4.8	.30		2	21.5	76.5	2795	26.5	14	55.5	5938	2	2		D.	Reg.
4.	1.9.37	60	9100	.01	19.2	1.2	.5	6	50	43.5	3230	35.5	15	40.5	3685	7	2		D.	Reg.
5.	4.9.37	52	11100	.1	40.0	2.5		10	62	28	2719	24.5	13.5	50.5	5605	10.5	1		S. D.	Reg.
6.	6.9.37	53	7400	.03	89.6	5.6	.5	10	74.5	15	3190	35	21.5	37	3478	6	.5		S. D.	Reg.
7.	8.9.37	70	15100	.3	75.2	4.7		12	70.5	17.5	2969	19	21.5	49	7399	9.5	1		S. D.	Reg.
8.	10.9.37	60	9000	.1	30.4	1.9		9.5	56.6	34	2475	27.5	11.5	52	4680	8	1		S. D.	Reg.
9.	15.9.37	66	9000	.006	4.9	.3%		1	23	76	1800	20	12.5	63	5670	4	.5		D.	Reg.
10.	22.9.37	65	9600	.01	5.7	.36		1.5	25	73.5	2880	30	13.5	51	4896	4.5	1		D.	Reg.
11.	28.9.37	75	16400		3.5	.22			18.6	81.5	5421	33	11	47.6	7790	5	.5		D.	Deg.
12.	6.10.37	56	7500		1.7	.11			10	90	1677	21.5	12	58	4524	7	1.5			

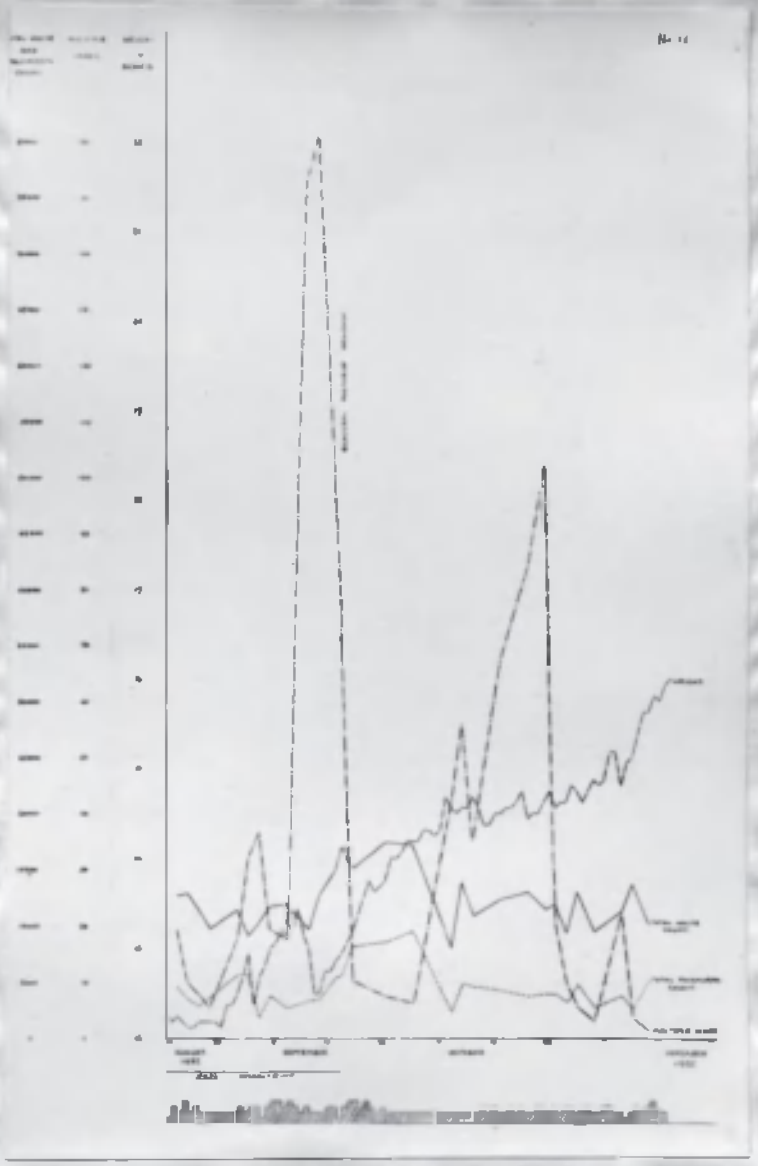
Name:- D.H. No:- 46. Sex:- Female. Age:- 6 months.

Admitted:- 14.8.37. Discharged:- 12.11.37.

History:- This child was admitted with a history of a "cold" two weeks ago. The left ear had been discharging for one week and the stools were loose and green. Occasional vomiting had occurred.

Condition on Examination:- This was a well-nourished infant, not toxic and not dehydrated. Stools were loose but it was taking its feeds well. The right tympanic membrane lacked lustre, but the left tympanic membrane was acutely inflamed and there was considerable discharge. Other examination was negative and the temperature was not elevated.

Progress:- On 21.8.37 the right ear commenced to discharge and on 28.8.37 both ears were discharging profusely and gain in weight had not been satisfactory. During early days of September weight went up, but on 7.9.37 weight loss began and by 10.9.37 considerable weight had been lost and stools were loose. Slight gain in weight then took place and on 15.9.37 bilateral posterior drainage was performed and pus found in both mastoid antra, the right being somewhat worse than the left. On 21.9.37 ears were dry and general condition was fair, but on 28.9.37 there was very slight left discharge. Meanwhile drainage from wounds was satisfactory. Gradual gain in weight occurred and on 22.10.37 the child looked very well, although taking feeds reluctantly. The right wound was practically healed and there was very slight discharge from the left. The right tympanic membrane was slightly red and the left tympanic membrane was normal. The left wound was much slower in healing than the right, but ultimately did on 12.11.37, both tympanic membranes being normal. The child was discharged looking very well. Except after operation when temperature rose to 99.2° F. temperature was normal throughout.



Description of Graph:- The multiple index was high to begin with and rose somewhat with first marked loss of weight (29.8.37). It then rose markedly with fall in weight which occurred on 7.9.37. When operation was done and discharge had ceased, multiple index was falling and gain in weight had occurred. Nevertheless, it was thought that the infant might become toxic and that it was better to operate while general condition was good. After operation the multiple index fell very sharply, About 3.10.37 there commenced a period when gain in weight was not satisfactory and the multiple index rose again. Apart from the reluctance of the left wound to heal, no explanation was obvious for this second rise. The multiple index fell again to normal as final gain in weight occurred. The total white count was never outwith normal limits and gave no indication of the child's condition. The multiple index reflected progress much more accurately.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch I.	M.	J.	St.	Seg	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	15·8·37	56	12700	·01	19·2	1·2	·5	8·5	46·5	44·5	4699	37	16	46	5842	1			D.	Reg.
2.	17·8·37	55	12800	·008	10·0	·63	·5	5	33·5	61	3820	27·5	11	57·5	7360	4			D.	Reg.
3.	19·8·37	49	11300	·02	7·8	·49		3·5	29·5	67	2994	26·5	10·5	60	6780	2·5	·5		D.	Reg.
4.	21·8·37	51	9700	·01	5·4	·34		1·5	24	74·5	3637	37·5	9	52·5	5092	1			D.	Reg.
5.	24·8·37	58	11300	·07	17·6	1·1		7·5	45·5	47	5650	50	12·5	34	3842	2·5		St.	D.	Reg.
6.	28·8·37	41	9100	·1	32	2·0		10·5	57	32·5	5733	63	15·5	20·5	1806	1		St.	S. D.	Reg.
7.	30·8·37	50	10200	·03	36·8	2·3	1	8·5	60·5	30	1938	19	25	55	5610	1			S. D.	Reg.
8.	1·9·37	45	11700	·01	19·2	1·2	·5	1·5	53	45	3802	32·5	12·5	54·5	6376	·5			D.	Reg.
9.	4·9·37	48	11900	·08	17·6	1·1		6·5	47	46·5	2796	23·5	16·5	58	6902	2			D.	Reg.
10.	8·9·37	68	9700	·1	153·0	9·5	1	16·5	73	9·5	3492	26	14	58	4850				S. D.	Reg.
11.	10·9·37	55	12700	·1	161·5	10·1	1	17·5	72·5	9	3856	28	16	55	6985	1			S. D.	Reg.
12.	12·9·37	56	15000	·03	97·6	6·1	·5	13	72·5	14	5475	36·5	8	55	8150	·5			S. D.	Reg.
13.	14·9·37	61	17000	·2	76·8	4·8		10	73	17	5610	33	11	53·5	9095	1·5	1		S. D.	Reg.
14.	16·9·37	42	15000	·03	10·1	·63		4·5	34	61	8100	57	10	35·5	5325	·5		St.	D.	Reg.
15.	22·9·37	51	17400	·01	7·6	·48		2	30·5	67·5	8526	49	10	40	6960	·5	·5	St.	D.	Reg.
16.	27·9·37	51	17200	·01	6·2	·39		1·5	27	71·5	9546	55·5	10	32·5	5590	2		St.	D	Reg.
17.	4·10·37	53	8000	·1	41·4	2·6		6·5	66	27·5	2460	31	11	53·5	4180	4·5			S. D.	Reg.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R P	T.	Type of Left Shift
18.	6·10·37	59	13800	·02	56·0	3·5	·5	8·5	69	22	4968	36	8	54	7452	2			S. D.	Reg.
19.	8·10·37	54	10900	·1	35·2	2·2		9	66·5	30·5	4796	44	10·5	45	4905	·5		2C.	S. D	Reg.
20.	13·10·37	40	12300	·2	67·2	4·2		8	73	19	4305	35	9	53	6519	3			S. D	Reg.
21.	18·10·37	59	13000	·26	84·2	5·2		8·5	75·5	16	3835	29·5	8·5	58	7540	4			S. D	Reg.
22.	21·10·37	66	11600	·03	102·4	6·4	·5	11·5	74·5	13·5	4060	35	7·5	46	5236	1·5			S. D.	Reg.
23.	23·10·37	62	11900	·09	20·8	1·3		8·5	48·5	43	4046	34	16	47	5892	3			D.	Reg.
24.	25·10·37	65	9400	·008	10·0	·63	·5	2·5	36	61	3337	35·5	13	51	4794	·5			D.	Reg.
25.	27·10·37	65	13000	·02	5·7	·36		3·5	24	72·5	4940	38	10	46·5	6046	5·5			D.	Reg.
26.	30·10·37	67	9500		3·2	·20			17	83	2850	30	13	54·5	5177	2·5			D.	Reg.
27.	4·11·37	67	11200	·01	22·8	1·3	·5	7	56·5	42	3808	34	14	51	5712	1			D.	Reg.
28.	6·11·37	72	13600	·006	3·8	·23		1	18	81	1720	20	16	63	8568	1			D	Reg.
29.	9·11·37	57	10100		1·4	·09			9	91	5100	50·5	12	35	3535	2·5		5E.		

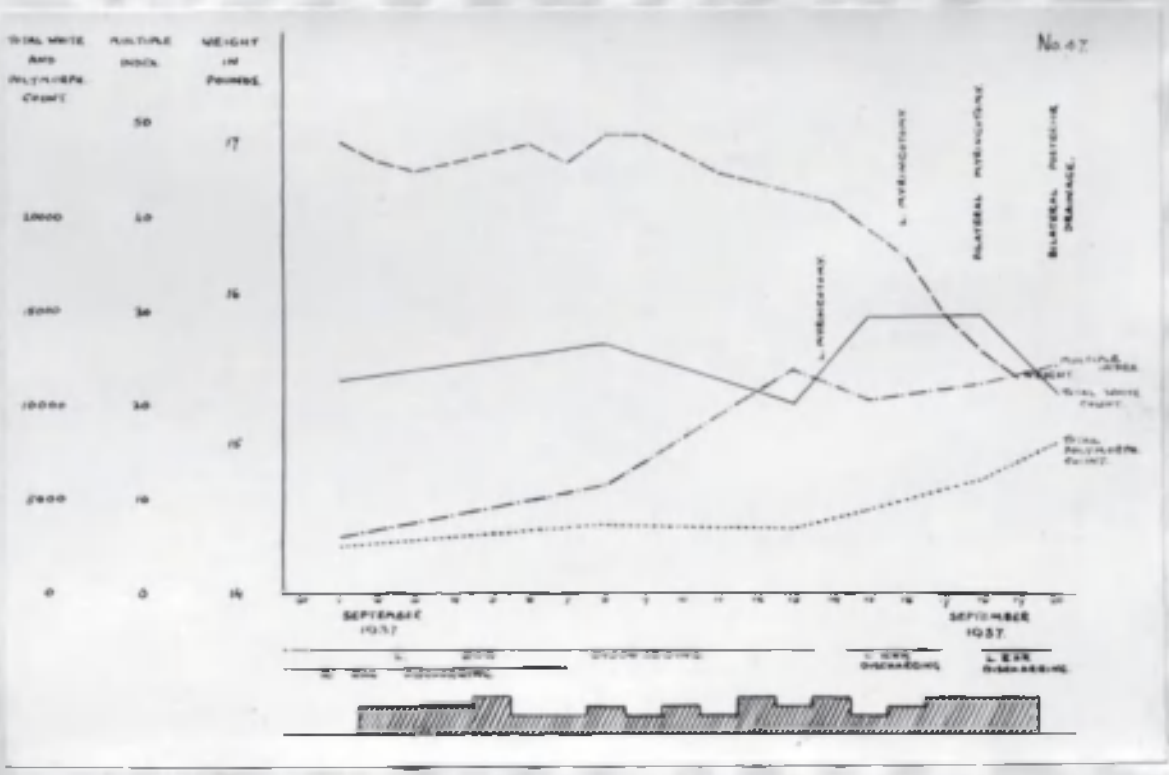
Name:- B.Y. No:- 47. Sex:- Male. Age:- 5½ months.

Admitted:- 31.8.37. Died:- 20.9.37.

History:- This child was admitted with a history of bilateral otorrhoea of three days' duration and "cold" also of three days' duration. There was no diarrhoea or vomiting, and the infant had been taking its feeds well and gaining weight.

Condition on Examination:- This child was well-nourished with slight nasal discharge and some naso-pharyngitis. Both ears were discharging, the left rather more than the right. Other examination was negative and the child was apyrexial.

Progress:- On 8.9.37 the child's weight was satisfactory and it looked well. The left ear was discharging profusely but the right was dry and the tympanic membrane slightly injected. By 13.9.37 weight was stationary and the ears were unchanged, except that the injection of the right tympanic membrane was much more marked. On 14.9.37 left otorrhoea had ceased and weight loss had occurred. Left myringotomy was performed and thick pus released. Left myringotomy had to be repeated with liberation of pus on 16.9.37, when the right tympanic membrane was only slightly injected. On 18.9.37 temperature was 100° F., loss of weight continued and the child looked very toxic. Bilateral myringotomy was performed and pus obtained on the left side but only blood on the right. On 20.9.37 bilateral posterior drainage was performed and pus found on both sides. Unfortunately the infant died on the same day.



Description of Graph:- The multiple index was elevated at the beginning of the illness but not markedly so. It gradually rose until 15.9.37 when myringotomy was performed. This was followed by a slight fall and then the multiple index continued to rise slowly until death. There is convergence of weight and multiple index curves - indicating a bad prognosis. The total white count never rose outwith normal limits and only towards the end was there any neutrophilic response. The multiple index here accurately reflected the progress of the case.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	1·9·37	53	11300	·01	6·0	·38		2·5	25·5	72	2599	23	9·5	60·5	6836	6·5	·5		D.	Reg.
2.	8·9·37	51	13300	·04	11·6	·73		5	37·5	57·5	3790	28·5	10·5	54·5	7148	6	·5		D.	Reg.
3.	13·9·37	54	10100	·05	24·0	1·5		4·5	55·5	40	3585	35·5	11·5	49·5	4999	3	·5		D.	Reg.
4.	15·9·37	51	14800	·05	20·8	1·3		4·5	53·5	42	4514	30·5	11	56·5	8362	2			D	Reg.
5.	18·9·37	62	14900	·01	21·4	1·4	·5	8·5	50·5	40·5	6109	41	8	50·5	7514		·5	St.	D	Reg.
6.	20·9·37	52	10900	·01	24·0	1·5	·5	11	49·5	39	8175	75	9	16	1745			S. St.	D.	Reg.

Name:- M.B. No:- 48. Sex:- Female. Age:- 7 months.

Admitted:- 11.9.37 Died:- 15.9.37.

History:- This child was admitted with a history of diarrhoea and vomiting of one week's duration.

Condition on Examination:- Child was very ill and toxic. Stools were very loose, ears appeared normal and temperature was not elevated.

Progress:- Two days later infant was very ill, toxic and dehydrated. Stools were very loose, but there was no vomiting and child was taking its feeds well. Temperature rose to 101° F. and left tympanic membrane was dull red and bulging a little. On 14.9.37 both tympanic membranes were bulging and bilateral myringotomy was performed. Pus was obtained from left side, but not so much from right. The following day both ears were discharging, but the child was very grey and toxic and ultimately died.

Blood Investigations:- Only two estimations were made on this case and it will be seen that total white count rose markedly at second estimation. Neutrophilic response was good at second estimation. Multiple index was very high at first and although it fell considerably after myringotomy, it still remained high.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	13.9.37	96	14900	.07	102.4	6.4	1	13	72.5	13.5	5215	35	10	54.5	9120	.5			S.D	Reg.
2.	15.9.37	78	28800	.07	64	4.0	1.5	14	60.5	20	15696	54.5	12	33.5	9648			S.St	S.D.	Reg.

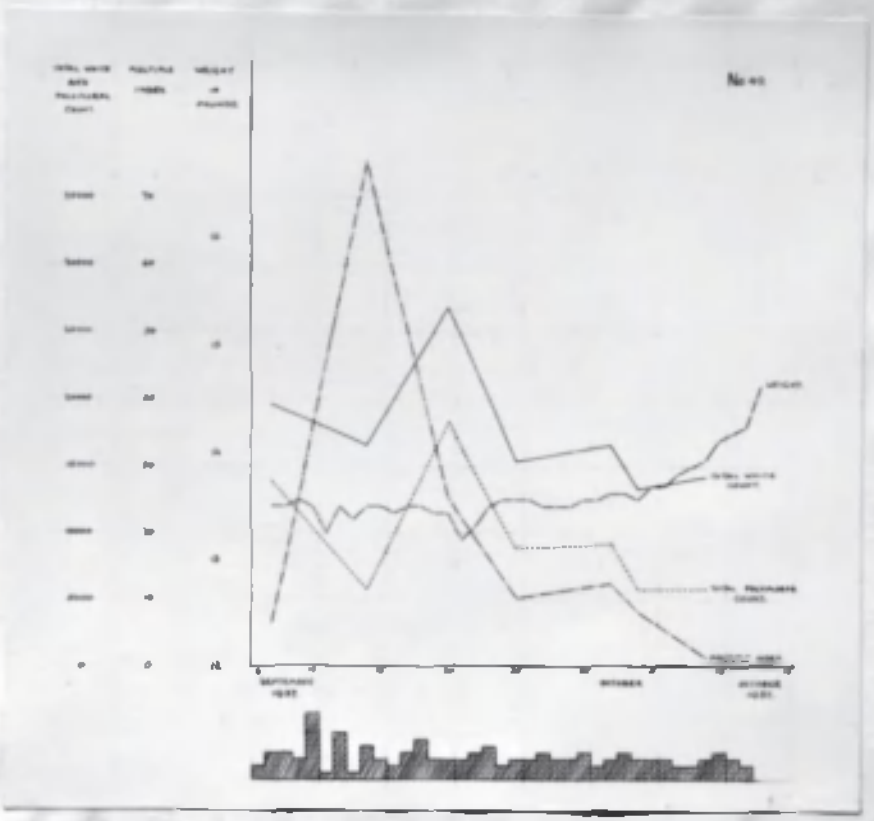
Name:- L.L. No:- 49. Sex:- Male. Age:- 7 months.

Admitted:- 6.9.37. Discharged:- 12.10.37.

History:- This child was admitted with a history of vomiting for the past three days. Two weeks previously diarrhoea and vomiting had taken place, but the infant had seemed to recover. Loss of weight had also been noticed.

Condition on Examination:- This was a pale but well-nourished child, no dehydration. The stools were loose and vomiting occasionally occurred, but it took its feeds well. Left tympanic membrane was acutely inflamed and seemed to be bulging posteriorly. The right tympanic membrane was normal. Other examination was negative and the temperature was not elevated.

Progress:- On the following day stools were loose and vomiting still occurred and the ears were unchanged. On 10.9.37 ears were settling with local treatment, and on 20.9.37 weight gain was unsatisfactory and both tympanic membranes were injected. This situation obtained until 4.10.37 when the infant still looked unwell and was not gaining. The ears were still injected. Gain in weight then commenced, and on 11.10.37 ears were normal and general condition was much improved. The infant was discharged well on 12.10.37. The ears never discharged throughout its stay in hospital.



Description of Graph:- This graph shows a marked elevation of multiple index during the more acute stage of the illness. The multiple index remained elevated during the whole period when gain in weight was unsatisfactory, and it was only when gain in weight commenced about 4.10.37 that the multiple index fell to normal and the two curves diverged. The marked rise in the multiple index preceded the rise in the total white count and total polymorphonuclear count. The graph shows the marked disturbance which can accompany quite a mild infection, as this was never more than a mild case of otitis media.

No.	Date	Hb.	Total W. B. Cs.	L I.	M I.	Sch. I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	7-9-37	50	19600	·02	6·4	·40		4	25	71	13916	71	7·5	20·5	4018	·5	·5	S. St.	D.	Reg.
2.	14-9-37	68	16500	·3	15·2	4·7		12·5	70	17·5	5857	35·5	19·5	44·5	7342	·5			S. D.	Reg.
3.	20-9-37	60	16800	·1	25·6	1·6	2·5	10·5	49·5	37·5	18492	69	10	21	5628			S. St.	D.	Reg.
4.	25-9-37	45	15400	·04	10·4	·65		5·5	34	60·5	8932	58	14	28	4312			St.	D	Reg.
5.	1-10-37	64	16600	·02	12·8	·80		2·5	42	55·5	9296	56	15·5	28·5	4731			St.	D.	Reg.
6.	4-10-37	67	13300	·001	8·3	·52		2	32·5	65·5	5918	44·5	16·5	38·5	5120	·5		St.	D.	Reg.
7.	9-10-37	72	14200		1·6	·10			9·5	90·5	5822	41	14·5	42·5	6035	2.		St.		

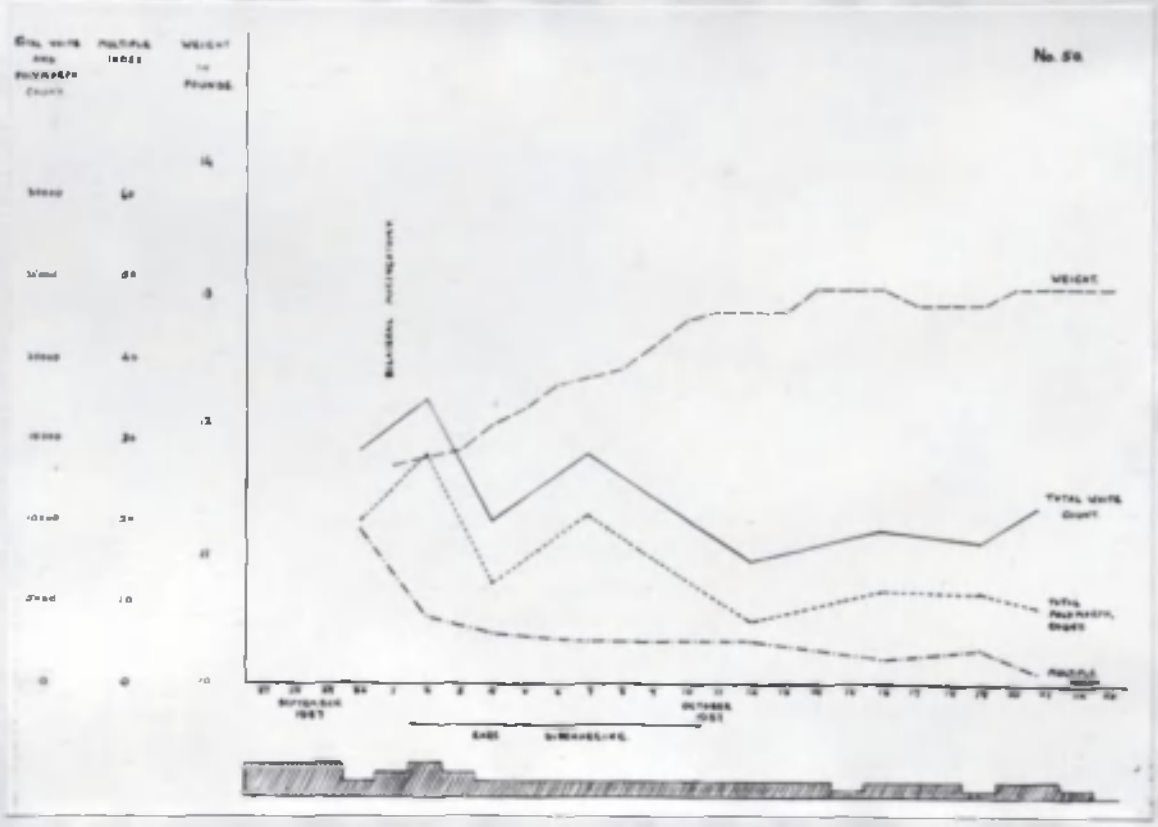
Name:- A.T. No:- 50. Sex:- Female. Age:- 5 months.

Admitted:- 27.9.37. Discharged:- 22.10.37.

History:- This child was admitted with a history of diarrhoea and vomiting for three days, during which it had been refusing its feeds.

Condition on Examination:- The child was fairly well nourished but grey, very ill and toxic-looking, and its eyes were sunken. Its temperature was 102.2° F. and its stools were loose and frequent. There were a few crepitations at both bases but no other physical signs. The tympanic membranes lacked lustre.

Progress:- Three days later, during which its condition did not improve, both tympanic membranes were observed to be injected with slight posterior bulging on the left side, and on 1.10.37 bilateral myringotomy was performed and pus obtained on both sides. On the following day both ears were discharging profusely and within two days of the myringotomy the temperature was normal and the infant gaining in weight. The ears continued to discharge until 13.10.37, when the discharge ceased. Diarrhoea and vomiting ceased and the child was discharged well on 22.10.37.



Description of Graph:- Recovery graph showing devarication of weight and multiple index curves. The multiple index is not unduly high and falls considerably after the myringotomy, and there is a reasonably good neutrophilic response. The second reading of the multiple index gives a more accurate estimation of progress than the total white count or total polymorphonuclear count, both of which had risen. At the fourth reading the multiple index has fallen slightly while the total white count and total polymorphonuclear count have both risen, again giving an accurate prognosis. Throughout the illness the total white count is never markedly high, and does not give an indication of the progress of the case.

No.	Date	Hb.	Total W. B. Cs.	L.I.	M.I.	Sch.I.	M.	J.	St.	Seg.	Total Neutrophiles	P.	W.	L.	Total Lymph	E.	M.	R.P.	T.	Type of Left Shift
1.	30-9-37	69	14500	·02	19·2	1·2		10	44	45	10150	70	14·5	15·5	2247			S. St.	D	Reg.
2.	2-10-37	73	17600	·06	8·4	·53		8	27·5	64·5	14256	81	9	10	1760			S. St.	D	Reg.
3.	4-10-37	62	10,100	·007	6·5	·41	·5	5·5	23·5	70·5	6312	62·5	12·5	19·5	1969	4	·5	St	D	Reg.
4.	7-10-37	63	14300	·03	5·7	·36		4·5	22	78·5	10582	74	11·5	12	1716	2·5		S. St.	D	Reg.
5.	12-10-37	69	7700	·06	5·7	·36	·5	3	23	73·5	4042	52·5	15·5	29	2233	1	2	St.	D	Reg.
6	16-10-37	64	9600		3·3	·21			18	82	5952	62	13·5	21·5	2064	·5	2·5	St.	D	Deg.
7.	19-10-37	65	8800	·006	4·6	·29		1	22	77	5764	65·5	17	16	1320	1·5	1	St.	D	Reg.
8.	21-10-37	72	11000		1·9	·12			11·5	88·5	4895	44·5	12	37	4070	6·5				

V. ANALYSIS OF CASES AND INVESTIGATIONS.

Fifty infants under the age of one year suffering from otitis media or otitis media and mastoiditis, coincident with varying degrees of diarrhoea and vomiting and no other detectable pathology with one exception, have been investigated. No. 33 was found at post-mortem to be suffering also from miliary tuberculosis. Twenty-eight were males and 22 were females. Of the 50 cases, 16 died and 34 recovered.

The cases have been grouped according to a clinical classification (Ref. 68) depending upon the severity of the illness and the presence or absence of dehydration and toxicity, as follows:-

(1) Mild Group - Cases unaccompanied by dehydration or toxicity throughout the illness - 21 cases (Nos. 46, 40, 42, 45, 17, 6, 9, 3, 21, 18, 25, 27, 31, 28, 22, 15, 23, 2, 11, 12, 49). None of this group ever showed classical signs of mastoiditis, i.e. redness, swelling and oedema over the mastoid process. (Refs. 15, 16).

(2) Toxic Group - Cases admitted very ill with varying degrees of dehydration and toxicity and cases which became very ill, dehydrated and toxic while in hospital - 25 cases (Nos. 48, 47, 41, 50, 1, 7, 16, 13, 5, 19, 4, 10, 29, 20, 30, 32, 26, 33, 36, 38, 43, 44, 39, 14, 8). None of this group ever showed classical signs of mastoiditis, i.e. redness, swelling, oedema over the mastoid process. Of this group 15 were proved either at operation or at autopsy to have pus in one or both mastoid antra. Nine recovered and while they suffered from otitis media, were not proved to have infection of the mastoid antra. One case died and autopsy was refused. These subdivisions are taken into account in some of the subsequent analyses. (Refs. 7, 4, 3, 15, 16, 10, 17, 18, 19, 20, 21, 24, 26, 27, 29, 30, 31, 32).

(3) Classical Group - cases presenting the classical picture with redness, swelling and oedema over the mastoid process - four cases (Nos. 35, 37, 34, 24). (Ref. 44).

MILD GROUP.

AGE GROUP & NUTRITIONAL CONDITION	NO. OF CASES	RECOV-ERED	DIED	OPERATION R	OPERATION D	P.M.	PERCENTAGE MORTALITY.
0-3 months N	3	3	-	0	-	-	-
0-3 months H	3	3	-	2	-	-	-
0-3 months A	0	0	-	0	-	-	-
Total	6	6	-	2	-	-	-
3-6 months N	4	4	-	-	-	-	-
3-6 months H	4	4	-	-	-	-	-
3-6 months A	0	0	-	-	-	-	-
Total	8	8	-	-	-	-	-
6-9 months N	3	3	-	0	-	-	-
6-9 months H	3	3	-	2	-	-	-
6-9 months A	1	1	-	1	-	-	-
Total	7	7	-	3	-	-	-
Grand Total	21	21	-	5	-	-	-

N - Normal weight or within 20% of normal weight.
H - Hypothrepsia: 60-80% of normal weight.
A - Athrepsia: less than 60% of normal weight.
R - Recovered.
D - Died.

It will be seen that the cases are spread fairly evenly over the three age-groups, there being no undue preponderance in any one group and that the majority are infants of normal weight,

or hypothreptic infants. There is only one athreptic infant in this group. Five infants were operated upon and all five recovered.

TOXIC GROUP.

AGE GROUP & NUTRITIONAL CONDITION	NO. OF CASES	RECOV-ERED	DIED	OPERATION R	OPERATION D	P.M.	PERCENTAGE MORTALITY.
0-3 months N	1	0	1	-	0	1	
0-3 months H	4	1	3	-	2	3	
0-3 months A	0	0	0	-	0	0	
Total	5	1	4	-	2	4	80%
3-6 months N	4	2	2	0	2	0	
3-6 months H	11	4	7	1	2	4	
3-6 months A	0	0	0	0	0	0	
Total	15	6	9	1	4	4	60%
6-9 months N	4	3	1	-	-	1	
6-9 months H	0	0	0	-	-	0	
6-9 months A	1	0	1	-	-	1	
Total	5	3	2	-	-	2	40%
Grand Total	25	10	15	1	6	10	60%

This table shows that the greatest number of cases occurred in the age group 3-6 months, but that the highest death rate was in the age group 0-3 months. The majority are

infants of normal weight or hypothreptic infants, only one being athreptic. Eighty-five per cent. of those operated upon died but only 50 per cent. of those treated conservatively died. (Refs. 40, 43, 65).

CLASSICAL GROUP.

Of the four cases three were of normal weight and one was hypothreptic. All were operated upon with three recoveries and one death.

Family History and Sociological Conditions.

Particulars were taken with regard to presence in the parents or other members of the family of:-

(1) Influenza.
(2) Sore Throats.
(3) Nasal Discharge.
(4) Ear Discharge.
(5) Bronchitis.
(6) Pneumonia.
(7) Skin Disease.

Group	Percentage with history of infection in the family.	Overcrowding
Mild (21 cases)	57%	42%
Toxic (25 cases)	64%	44%
Classical (4 cases)	75%	nil.
Average	64%	40%

The percentage of infection in the families is quite high, the commonest being sore throats and influenza in the parents and bronchitis and pneumonia in the siblings. The percentage of overcrowding is remarkably low considering the sociological group from which these patients were taken and appears not to be a factor of great importance. (Ref. 48).

Previous Illnesses of the Child:- Fourteen infants had a history of previous illness:-

Enteritis - Nos. 3, 31, 22, 14.
Enteritis and Otitis Media - No. 15.
Broncho-Pneumonia and Bronchitis - Nos. 42, 16, 26.
Broncho-Pneumonia and Otitis Media - Nos. 17.
Whooping Cough - No. 36.
"Rash" - No. 2.
? Diphtheria - No. 30.
"Marasmus" - No. 40.
Impetigo - No. 18.

Obstetrical History:-

(1) Asphyxia at birth - 7 infants were described as "blue" shortly after birth.

(2) Length of labour - Times varied from one hour to five days, the majority being of average duration.

(3) Instrumental deliveries, etc. - There were: 1 Forceps delivery; 2 Dry labours with the cord round the neck; 1 Breech delivery.

(4) Convulsions at birth: - none.

The obstetrical histories showed nothing worthy of note.

	BREAST FEEDING				BOTTLE FEEDING		VITAMINS			
GROUP	Entirely Breast Fed	More than 3 mths.	1-3 mths	None or less than 1 mth.	Satis-factory	Unsatis-factory	Full	A & D	C	None
Mild	0	3	8	10	12	9	8	3	3	7
Toxic	1	0	15	9	17	8	8	6	3	8
Classical	1	0	1	2	4	0	1	0	1	2
Total	2	3	24	21	33	17	17	9	7	17

The great majority had less than three months breast feeding, but subsequent bottle feeding was fairly satisfactory. Supply of vitamins was most unsatisfactory. (Refs. 26, 40, 43, 48, 54, 68).

Analysis of Symptoms:- For the purpose of this analysis the toxic group has been divided into those admitted in a dehydrated, toxic condition, i.e. initially toxic and those who became so while in hospital, i.e. toxic later.

SYMPTOMS	Initially Toxic (17 cases).		Toxic Later (8 cases)		Mild (21 cases)		Classical (4 cases)	
	No.	%age	No.	%age	No.	%age	No.	%age
Upper respiratory infection, e.g. ("cold", cough, infection of mouth)	6	35%	3	37%	4	19%	nil	nil
Vomiting	13	76%	6	75%	13	61%	1	25%
Diarrhoea	16	94%	4	50%	12	57%	nil	nil
Constipation	nil	nil	1	12%	1	4%	nil	nil
Restlessness, Head Rolling, etc.	9	53%	1	12%	7	33%	4	100%
Loss of Weight	13	76%	4	50%	6	28%	nil	nil
Refusal of Food	6	35%	2	25%	4	19%	nil	nil
Nasal Discharge	2	11%	2	25%	4	19%	1	25%
Aural Discharge	3	17%	3	37%	11	52%	1	25%
Convulsions	1	5%	1	12%	2	9%	nil	nil
Rigor	nil	nil	nil	nil	nil	nil	nil	nil
Duration of Illness	1 day-4 weeks		2 days-1 week		1 day-5 weeks		1 day-2 weeks	

It will be seen from this table that the commonest symptoms in order of frequency are diarrhoea, vomiting, loss of weight and restlessness, and that the maximum incidence of diarrhoea occurs in the initially toxic group. It is noteworthy that the incidence of aural discharge is considerably higher in the mild group than in the toxic groups. In eleven cases in the mild group one or both ears were discharging on admission. Of the remaining ten in the group, five were assisted by myringotomy, unilateral or bilateral, three discharged spontaneously, and two settled with local treatment. In the eight cases which became toxic drainage was difficult to maintain and myringotomy was often repeated. (Refs. 2, 3, 4, 7, 10, 14, 15, 16, 17, 18, 19, 20, 21, 24, 26, 27, 28, 30, 32, 34, 36, 40, 41, 43, 44, 45, 47, 48, 49, 54, 59, 60, 61, 62, 63, 64, 65, 68).

Temperature.

(1) Mild Cases.

Case No.	Maximum First 24 hours	Maximum Second 24 hours	Maximum Third 24 hours
46	98.2	98.2	98.2
40	101	99	98.4
42	98.6	98.4	98.4
49	98.8	98.4	98.8
45	98.8	98.4	98.2
17	99.8	99.6	98.4
6	99.4	99.4	98.6
9	98.6	98.4	98.4
3	99	99	99
21	98.8	99.6	100.6
18	98.4	98.4	98.4
25	98.4	98.4	98.4
27	98.6	98.8	98.6
31	98.8	98.4	98.4
28	98.2	98.2	98.2
22	99	100	98.2
15	98.4	98.4	98.4
23	99.8	99.2	98.4
2	98.8	99.4	98.8
11	98.2	98.6	98.2
12	98.6	98.2	98.6
Average	98.9	98.7	98.5

(2) a. Toxic on Admission.

Proved Mastoiditis.

Case No.	Maximum First 24 hours	Maximum Second 24 hours	Maximum Third 24 hours
48	98.8	98.8	101
1	100	103.8	103
7	98.8	98.2	98
16	99.2	98.8	99
30	103.8	100.8	103
32	98.6	98.4	98.4
33	100.6	99.8	99.6
36	99.2	101.2	101.2
43	101.4	100.6	101.8
44	101.6	103.4	103
Average	100.1	100.3	100.8

A Post-mortem examination was not obtained on Case No. 38

Acute Otitis Media only.

Case No.	Maximum First 24 hours	Maximum Second 24 hours	Maximum Third 24 hours
50	103.2	102.2	103.6
4	99.4	98.4	99.2
10	103.2	102.6	101.8
29	99.8	99.8	99.8
20	98.6	98.4	98.4
26	103.2	99.8	98
Average	101.2	100.2	100.1

(2) b. Cases which became Toxic.

Case No. & Type of Case	Maximum Temperature during Toxicity
47 - Mastoiditis	101.8
41 - "	104
13 - "	102.2
5 - "	101.8
19 - Acute Otitis Media	103
39 - " " "	100.6
14 - " " "	99.8
8 - Mastoiditis	103
Average	102

(3) Classical Cases.

Case No.	Maximum First 24 hours	Maximum Second 24 hours	Maximum Third 24 hours
35	99.6	99	98.8
37	100.2	99.6	99.8
34	98.8	98	98
24	99.6	99.2	99.2
Average	99.5	98.9	98.9

These analyses of temperatures show that in the mild cases and in the classical cases temperatures are not markedly elevated. In the toxic cases temperature tends to be on the whole higher, but is no help in making a diagnosis between mastoiditis and simple acute otitis media. (Refs. 27, 49, 99).

APPEARANCES OF TYMPANIC MEMBRANES.

Type of Case	Apparently normal		Mildly injected		Red & Lack-Lustre		Very Red & Bulging		Red & Posterior Bulge		Pale & Lack-Lustre		Debris		Slight Discharge		Copious Discharge	
	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.
Mild Cases (21) Percentage	0	2 4%	5	3 19%	6 26%	5	2 9%	2	3 9%	1	6 23%	4	0	1 2%	0 4%	2	7 28%	5
Toxic Cases (Mastoiditis (15)	1 3%	0	4 26%	4	7 50%	8	0 6%	2	1 13%	3	2 16%	3	-		0 6%	2	0 6%	2
Toxic Cases (Acute Otitis Media (9)	-		2 11%	0	0 11%	2	2 16%	1	1 22%	3	3 27%	2	-		2 11%	0	0 5%	1
Classical Cases (4)	0 25%	2	0 12%	1	-		2 25%	0	1 25%	1	-		-		-		2 37%	1

Leaving out of consideration the cases of classical mastoiditis, the highest percentages of acutely pathological drums occur in the toxic group of cases and the highest percentage of drums showing redness with posterior bulge, regarded by some authors as indicative of mastoid involvement, occurs in cases of toxic otitis media, which were never proved to have mastoiditis. Doubt is therefore cast on the value of this sign. The table also shows that the incidence of aural discharge is considerably higher in the mild cases and classical cases than in the toxic group. (Refs. 2, 10, 14, 15, 16, 24, 49, 51, 59, 60).

Bacteriological Analysis.

Swabs were taken from maternal and paternal nasopharynges and from the infants' nasopharynges and ears. Swabs were also taken as often as possible at operation and in the post-mortem room. An attempt has been made to analyse these results in the following tables. The first three tables indicate the organisms which were found - common to both parents and infant, to the infant and one parent, and in the infant alone. The fourth table sets out the organisms found in the infant's ear swabs, and the fifth table indicates the incidence of organisms common to the infant's nasopharynx and ears. Then follow tables of such operation and post-mortem swabs as were obtained.

BACTERIOLOGICAL SURVEY.

(A) TOXIC CASES - 25.

ORGANISMS	All Three 17	%age	Father & Baby 15	%age	Mother & Baby 22	%age	Baby 23	%age
(1) Respiratory Group								
(Pneumococcus	5	29%	6	40%	10	45%	15	65%
(M.Catarrhalis	1	5%	4	26%	5	22%	15	65%
(Diphtheroids	-	-	5	33%	2	9%	14	60%
(K.L.B.	-	-	-	-	-	-	-	-
(2) Pyogenic Group								
(Staphylococcus	12	70%	12	80%	21	95%	22	95%
(Streptococcus	1	5%	4	26%	2	9%	7	30%
(3) Coliform Group								
(B. faec. alk.	-	-	-	-	-	-	1	4%
(B.Morgan	-	-	-	-	-	-	1	4%

(B) MILD CASES - 21.

ORGANISMS	All Three 9	%age	Father & Baby 9	%age	Mother & Baby 19	%age	Baby 21	%age
(1) Respiratory Group								
(Pneumococcus	3	33%	5	55%	7	36%	13	61%
(M.Catarrhalis	1	11%	1	11%	6	31%	13	61%
(Diphtheroids	-	-	1	11%	4	21%	11	52%
(K.L.B.	-	-	-	-	-	-	1	4%
(2) Pyogenic Group								
(Staphylococcus	9	100%	9	100%	18	94%	21	100%
(Streptococcus	-	-	1	11%	2	10%	4	19%
(3) Coliform Group								
(B.Coli	-	-	-	-	-	-	1	4%
(B.Morgan	-	-	-	-	-	-	2	9%
(B.proteus	-	-	-	-	-	-	1	4%

(C) CLASSICAL MASTOIDITIS - 4.

ORGANISMS	All Three 2	%age	Father & Baby 2	%age	Mother & Baby 4	%age	Baby 4	%age
(1) Respiratory Group								
(Pneumococcus	-	-	-	-	1	25%	3	75%
(M.Catarrhalis	-	-	-	-	-	-	-	-
(Diphtheroids	-	-	1	50%	1	25%	2	50%
(K.L.B.	-	-	-	-	-	-	-	-
(2) Pyogenic Group								
(Staphylococcus	2	100%	2	100%	4	100%	4	100%
(Streptococcus	-	-	-	-	1	25%	3	75%

INFANTS' EAR SWABS.

ORGANISMS	Classical - 4		Toxic-21		Mild - 19	
	No.	%age	No.	%age	No.	%age
(1) Respiratory Group						
(Pneumococcus	-	-	4	19%	3	15%
(M.Catarrhalis	-	-	1	4%	-	-
(Diphtheroids	1	25%	6	28%	4	21%
(K.L.B.	-	-	1	4%	1	5%
(2) Pyogenic Group						
(Staphylococcus	4	100%	18	85%	14	73%
(Streptococcus	1	25%	-	-	-	-
(3) Coliform Group						
(B.Coli	-	-	1	4%	-	-
(B.Morgan	-	-	-	-	3	15%
(B.faec. alk.	-	-	1	4%	-	-
(B.proteus	-	-	-	-	1	5%

Incidence of Organisms common to Infants' Nasopharynx & Ears.

ORGANISMS	Classical - 4		Toxic-18		Mild -16	
	No.	%age	No.	%age	No.	%age
(1) Respiratory Group						
(Pneumococcus	-	-	4	22%	2	12%
(M.Catarrhalis	-	-	-	-	-	-
(Diphtheroids	1	25%	1	5%	3	18%
(K.L.B.	-	-	-	-	-	-
(2) Pyogenic Group						
(Staphylococcus	4	100%	16	88%	13	81%
(Streptococcus	-	-	-	-	-	-

Operation and Post-Mortem Swabs.

Mild Cases.

Case No.	Ear Swabs	Operation Swabs
3	R. Staph. Alb. L. Staph. & Pneumo.	Sterile
2	R.) Staph. & L.) Diphtheroids	Staph. Pneumococci B. coli
12	R.) L.) Staph. Alb.	Sterile

Toxic Cases.

Case No.	Ear Swabs	Operation Swabs	P.M. Swabs
47 Op.	R. Staph. Alb. L. Staph. & Diphtheroids	Sterile	-
41 Op. & P.M.	R. Staph. Alb. & B. Faec. Alk. L. Staph. Alb.	Sterile	Staph. & Diphtheroids
7 P.M.	R. Staph. Alb.	-	Pneumococci
16 Op.	nil	Sterile	-
13 Op.	R. Staph. Aur. L. K.L.B.	R. Staph. L. Sterile	-
5 Op.	nil	Sterile	-
30 P.M.	L. Staph. Aur.	-	L. & R. Mastoids L. & R. Middle Ear B. Coli; Strep. & Pneumo.
32 P.M.	nil	-	Staph. Aur.
36 P.M.	R. & L. Staph. Alb.	-	R. & L. Mastoids - Staph. Alb.
43 P.M.	R. Staph., Pneumo.IV & Diphtheroids L. Staph. & Diphtheroids	-	R. & L. Mastoids - Pneumo. & B. coli.

Classical Cases.

Case No.	Ear Swabs	Operation Swabs	P.M. Swabs
35 Op. & P.M.	R. Staph. Alb. L. Staph. & Strep.	Staph. Alb.	L. mastoid - Strep.
37 Op.	R. Staph. Alb.	Strep.	-
34 Op.	R. Staph. Alb.	Staph. Alb.	-
24 Op.	R. Staph. Aur.	Staph. Aur.	-

As the cultures from these swabs almost invariably produced a mixed growth it is difficult to draw conclusions. In all the tables staphylococci predominate and it is difficult to say what part, if any, this ubiquitous organism plays. On the other hand it is the commonest organism found in the operation and post-mortem swabs, which suggests a certain degree of pathogenicity in such cases possibly higher than is generally supposed. Pneumococci and M. catarrhalis appear next most frequently. (Refs. 2, 10, 22, 24, 26, 36, 38, 39, 40, 53, 60).

Having regard to the fairly high incidence of infection in the family histories it is possible that infection of the upper respiratory type may be conveyed from parent to child,

particularly from the mother, during acts of nursing, etc., and that measures to avoid such spread of infection might have a beneficial effect. The incidence of streptococcal infection is remarkably low, which is at variance with the findings of other workers. (Refs. 12, 14, 15, 16, 24, 26, 27, 43, 45, 57, 65).

The type of organismal infection seems usually to be mixed and does not appear to exert any influence on the clinical manifestations, the incidence of the various organisms being roughly parallel in the three clinical groups. (Refs. 22, 34, 36, 53).

The relatively large number of sterile operation swabs is disappointing (Refs. 34, 57) and a possible explanation is that owing to the small aperture made in the bone it is not possible to obtain a satisfactory swab. Organisms of the coliform group are relatively uncommon. In only four cases did the bacteriological findings in faeces or urine correspond with that in the ear, i.e. No. 45, B. proteus in ear, urine and faeces, No. 8, B. Morgan I in ear and faeces, and No. 14, B. Morgan I in ear and faeces, and No. 40 B. Morgan I in ear and faeces. (Refs. 36, 37, 43, 39).

Urine.

Abnormal Constituents	Mild Group 21 cases	Toxic Group 25 cases	Classical Group 4 cases
Albumin - faint trace	11	8	3
- cloud	1	1	-
Pus	1	-	-
Casts - hyaline & granular	-	2	-
Red Blood Cells	1	-	-
Organisms - B.coli	6	4	1
B.proteus	1	-	-
B.Morgan I	1	1	1
" " 5	-	-	1
" " 14	-	-	2
B.carolinus	1	-	-
Normal	2	5	-
Not obtained	3	8	1

These were not catheter specimens as none of the cases presented symptoms suggestive of urinary infection. The high incidence of albuminuria is probably of the febrile type. (Refs. 18, 43).

Faeces.

Organisms	Mild Group 21 cases	Toxic Group 25 cases	Classical Group 4 cases
B. Morgan I	12	11	2
" " 5	-	1	-
" " 14	-	2	1
B. proteus	2	-	-
B. Asiaticus	1	-	-
Negative	6	11	2
Not obtained	-	1	-

Agglutination reactions were performed in eight cases in which B. Morgan was found in the faeces.

Agglutination	Mild Cases	Toxic Cases
up to 1/50	1	1
up to 1/100	1	-
up to 1/150	-	1
up to 1/200	1	-
up to 1/250	-	1
Negative	1	1

From these figures it will be seen that B. Morgan I was the commonest organism found in the faeces. The mild group, clinically not seriously ill, showed the highest number. In the toxic group and in the classical group as many examinations were negative as were positive for B. Morgan I. The agglutination tests both positive and negative are equally distributed in the two groups, mild and toxic. The pathogenicity of this organism would therefore seem to be very doubtful. (Refs. 29, 37, 40).

Blood Cultures.

These were taken from the fontanelle with strict aseptic precautions and 42 cases were so examined. Cultures were repeated in two cases in the toxic group (Nos. 30 & 38) who developed petechial rashes suggestive of a septicaemic condition. All the cultures were negative except one (No. 48)

obtained in a very ill infant in the toxic group - haemolytic staphylococcus was grown. The ear swabs in this case grew staphylococci but unfortunately post-mortem swabs were not taken. These results suggest that in the very ill cases the condition is not a septicaemic phenomenon. (Refs. 15, 16, 37, 43).

Mantoux Reactions.

Mantoux reactions were performed in 46 cases and were negative in all but two cases (Nos. 33 & 24). In No. 33 Mantoux 1/1,000 was strongly positive, as was the patch tuberculin test, and this infant was found at autopsy to be suffering from miliary tuberculosis as well as bilateral otitis media and mastoiditis. No. 24, a case in the classical group, was found to be Mantoux positive on two occasions. The condition of the mastoid was thought to be probably tuberculous by the surgeon at the time of operation, an opinion supported by the time which the ear took to heal. The chest was X-rayed on two occasions and gastric lavage was performed and a specimen sent for guinea-pig inoculation, all with negative results, and all attempts to prove the tuberculous nature of the mastoid infection failed. Washings from the ear were inoculated on Löwenstein's medium but tubercle bacilli were not grown.

Blood Counts.

An attempt has been made to assess the value of the blood counts by considering the results of the first three

estimations made and in the cases which developed the toxic picture, the estimation made at the height of the toxicity. In the section dealing with the clinical résumés full details of all blood estimations are given and the graphs are commented upon fully, and at this point only the total white counts and multiple indices will be dealt with.

(1) Mild Cases.

Case No.	FIRST ESTIMATION			SECOND ESTIMATION			THIRD ESTIMATION		
	T.W.C.	T.P.C.	M.I.	T.W.C.	T.P.C.	M.I.	T.W.C.	T.P.C.	M.I.
46	12,700	4,699	19.2	12,800	3,520	10.0	11,300	2,994	7.8
40	12,500	1,187	19.2	10,700	1,177	4.7	13,500	5,602	1.7
42	19,300	12,159	3.3	19,900	10,477	3.2	14,400	4,608	1.2
49	19,600	13,916	6.4	16,500	5,857	75.2	26,800	18,492	25.6
45	12,200	2,196	8.1	11,200	4,256	4.6	10,300	2,795	4.8
17	15,000	5,025	8.1	17,100	2,821	5.6	24,600	11,070	7.8
6	16,700	6,012	16	16,300	3,749	30	16,100	6,279	10.5
9	14,800	4,514	5.4	20,000	13,800	2	9,100	3,640	2.4
3	11,700	1,638	29	12,900	3,870	48	14,000	6,440	13
21	21,500	4,212	36.8	15,000	4,054	15.4	19,600	5,292	16
18	11,100	8,547	3.3	10,000	3,350	4.1	7,100	2,272	3.6
25	11,200	4,592	8.9	7,700	2,117	6.2	10,600	4,081	7.5
27	13,700	3,288	9.1	14,600	7,091	35	12,000	4,980	16
31	9,400	3,243	20.8	10,100	3,232	30.4	9,200	3,450	6
28	17,600	6,864	5.1	13,500	6,615	9.1	15,300	5,672	5.7
22	17,000	6,205	5.2	14,100	4,089	2.5	13,300	4,522	3
15	10,100	2,727	1.7	13,900	3,450	3.6	14,800	4,736	4.1
23	14,800	6,734	0.9	16,000	4,320	.4	-	-	-
2	18,000	4,140	14	20,000	5,800	3.8	11,000	7,040	5
11	17,800	3,560	8.5	12,700	4,508	6	14,500	4,567	2.2
12	12,600	1,853	3.2	15,200	3,040	2.5	22,300	5,129	3.3
Average	14,700	5,156	11.5	14,200	4,847	14.4	14,400	5,685	7.3

(2) Toxic on Admission. A. Proved Mastoiditis.

Case No.	FIRST ESTIMATION			SECOND ESTIMATION			THIRD ESTIMATION		
	T.W.C.	T.P.C.	M.I.	T.W.C.	T.P.C.	M.I.	T.W.C.	T.P.C.	M.I.
48	14,900	5,215	102.4	28,800	15,696	64	-	-	-
1	13,000	7,280	4	13,500	9,685	8.7	-	-	-
7	20,900	3,616	12.6	7,700	1,925	9.1	21,900	9,636	8.1
16	26,900	12,912	8.8	13,500	7,087	11	-	-	-
30	18,200	3,458	121.6	22,200	13,320	51.2	34,700	26,025	46.4
32	22,900	8,816	12	20,600	6,901	19.2	26,200	15,851	32
36	19,100	8,308	80	24,400	16,226	11.6	-	-	-
43	22,400	13,664	38.4	15,100	8,889	40	20,500	11,787	17.6
44	17,000	9,605	30.4	28,100	15,033	40	28,700	17,507	27.2
Average	19,400	8,297	45.4	19,300	10,652	28.3	26,400	16,161	26.2

B. Acute Otitis Media only.

Case No.	FIRST ESTIMATION			SECOND ESTIMATION			THIRD ESTIMATION		
	T.W.C.	T.P.C.	M.I.	T.W.C.	T.P.C.	M.I.	T.W.C.	T.P.C.	M.I.
50	14,500	10,150	19.2	17,600	14,256	8.4	10,100	6,312	6.5
4	19,000	5,130	7	8,000	2,920	15	8,200	2,173	3.6
10	13,400	2,546	7.6	14,000	8,820	2.4	13,500	7,492	2.5
29	25,800	9,030	49.6	18,200	7,371	38.4	13,800	4,347	11.5
20	12,800	7,296	28.5	31,800	15,423	2.7	60,600	45,147	3
26	18,000	7,830	15	14,800	3,575	10	10,000	4,750	9.6
Average	17,200	6,997	21.1	17,400	8,727	12.8	19,300	11,703	6.1

(3) Became Toxic - Maximum readings at height of toxicity.

Case No.	MASTOIDITIS			Case No.	ACUTE OTITIS MEDIA		
	T.W.C.	T.P.C.	M.I.		T.W.C.	T.P.C.	M.I.
47	10,000	8,175	24	19	22,600	11,639	72
41	12,500	7,437	76.8	39	11,200	7,560	28.8
13	24,000	4,480	83.2	14	13,800	6,348	16
5	18,000	4,950	33				
8	21,000	4,410	20				
Average	17,100	5,890	47.4		15,800	8,515	38.9

(4) Classical Group.

Case No.	FIRST ESTIMATION			SECOND ESTIMATION			THIRD ESTIMATION		
	T.W.C.	T.P.C.	M.I.	T.W.C.	T.P.C.	M.I.	T.W.C.	T.P.C.	M.I.
37	35,100	14,724	2.5	23,100	10,279	2.7	12,300	5,104	1.9
34	13,100	6,681	10.4	12,400	5,952	4.9	12,900	4,450	2.2
24	17,800	9,256	6.7	14,500	4,857	4.6	20,600	9,270	2.5
Average	22,000	10,220	6.5	16,600	7,029	4.0	15,200	6,274	2.2
35	24,500	8,880	10.5	13,200	6,534	6.4	10,600	5,247	36.8

These tables show that in the mild type the average total white count remains about the level of a high normal with a not unduly raised multiple index which falls. In the next four groups the average total white counts are elevated but not in such a way as to be of diagnostic help. (Refs. 18, 24, 26, 27, 30, 43, 59, 93, 94).

In the toxic cases of proved mastoiditis the average multiple index is about four times as high as in the mild cases and shows a sustained elevation. (Refs. 95, 96, 98, 99).

In the toxic cases of acute otitis media only, the average multiple index is about twice as high as in the mild cases, and shows gradual improvement. The cases which became toxic while in hospital show a high average multiple index at the height of toxicity, those with acute otitis media only being slightly lower than those with mastoiditis. The classical mastoids show an average multiple index about half that in the mild cases, with gradual improvement. Case 35 must be left out of the classical group as it was complicated by a latent mastoiditis on the other side, which caused the marked elevation of the third multiple index reading. While a close scrutiny of these tables will reveal exceptions to the above average readings, it is suggested that the height of the multiple index may be of some diagnostic significance, taken, as it always must be, in conjunction with the clinical findings and the clinical condition of the child. The height of the multiple

index is of no value in selecting an optimum time to operate as degree of response varies from infant to infant, e.g. Nos. 45 & 49.) (Ref. 74).

OPERATIVE RESULTS.

(1) Mild Cases. Five cases in this group were operated upon and all five recovered. Nos. 3, 12 & 46 had bilateral posterior drainage, No. 2 had right and No. 40 left posterior drainage. None of these cases was in a toxic state at the time of operation. The general condition of Nos. 2, 12 & 40 had been rendered as good as possible by previous treatment. In cases Nos. 3 & 46 the general condition had deteriorated and marked weight losses had occurred a few days before the operation and it is possible that the operation prevented the onset of the toxic picture in these two instances.

(2) Toxic Cases. Seven cases in this group were operated upon and only one recovered. Nos. 47, 41, 1, 16, 13 and 8 had bilateral posterior drainage and No. 5 had right posterior drainage only. Nos. 1 and 16, both of whom died, were toxic and very ill on admission. Nos. 5, 13, 41 and 47 became toxic while in hospital and operation was performed with uniformly fatal result after the toxic picture was well established. No. 8, which recovered, became toxic while in hospital but recovered therefrom with general treatment and was not operated upon until its

second admission to hospital, when its general condition was much improved and there was no evidence of dehydration or toxicity.

In the clinical survey made of all the 1936 cases (Ref. 68) the death rate in this group is considerably higher than in the present series, 29 of whom belong to the year 1937. This improvement may be due to the fact that operative treatment for such cases had almost been abandoned in 1937, only two cases of this group being operated upon admitted in the year 1937 (Nos. 41 & 47). (Refs. 9,10, 14, 15, 16, 17, 19, 22, 25, 27, 31, 39, 42, 43, 45, 47, 48, 53, 55, 59, 60, 61, 63, 64, 68).

(3) Classical Cases. The four cases in this group had right posterior drainage performed with one fatal result, Nos. 34, 35, 37 & 24. Nos. 34 & 37 made uninterrupted recoveries. No. 24, which was thought to be tuberculous, had a long and unsatisfactory convalescence involving several re-admissions to hospital and culminating in a right radical operation before satisfactory healing could be obtained. The fatal case, No. 35, suffered also from a latent mastoiditis on the left side, and it is possible that, if both mastoids had been operated upon at once, this infant's life might have been saved. (Ref. 24).

POST-MORTEM EXAMINATIONS.

Post-mortem examinations were conducted in 11 cases, 10 from the toxic group and one from the classical group.

No. 7:- Purulent gelatinous material was found in left mastoid antrum. The stomach was dilated and there was a small infarct in the left kidney. Examination of maxillary antra and other examination was negative.

No. 13:- Right mastoid antrum was well drained at operation but on the left side bone was unhealthy and the antrum contained pus. The large intestine was distended and slightly injected, the kidneys were pale and toxic and the right lung showed some basal congestion. Other examination was negative.

No. 30:- There was a petechial rash on the left side of the abdomen and bilateral mastoiditis with pus in both antra and middle ears. Bone of both mastoid processes was soft and necrotic. The lungs showed septic broncho-pneumonia, both bases being consolidated with bronchitis elsewhere. The spleen was of the septic diffluent type and the brain was oedematous and congested. Other examination was negative.

No. 32:- Pus was found in left mastoid antrum and middle ear and some muco-pus in right mastoid antrum and middle ear. Liver and kidneys were pale but other examination was negative.

No. 33:- Pus was found in both mastoid antra and middle ears. There was a Ghon's focus in the right lung with an enlarged hilar gland and there were miliary tubercles throughout lungs. The spleen and peritoneum were studded with tubercles. Other examination was negative.

No. 36:- There was pus in the right mastoid antrum while on the left side there was very extensive purulent mastoiditis. Other examination was negative.

No. 41:- Pus was found in posterior mastoid cells on left side, which had not been adequately drained. Right side was satisfactorily drained. The lungs showed congestion of both bases and the left kidney was somewhat enlarged and very haemorrhagic possibly due to the blood transfusion. Other examination was negative.

No. 43:- Considerable quantities of muco-pus were found in both mastoid antra. There was basal congestion of both lungs and slight injection of the small bowel, swabs from which were negative.

No. 44:- There was bilateral mastoiditis with rather more pus on right side than left side. The lungs showed slight basal congestion and the liver was enlarged and fatty. Other examination was negative.

No. 48:- The bone of both mastoid processes was soft and necrotic and the antra contained pus. The large intestine was mildly injected but other examination was negative. This case had a positive blood culture during life.

No. 35:- This was a case of right classical mastoiditis and unfortunately only a partial post-mortem examination was allowed. The right mastoid antrum was satisfactorily drained at operation.

On the left side there was no external evidence of mastoiditis, but when an incision was made over the mastoid process a commencing sub-periostial abscess was discovered with a sinus, through which a probe could be put, leading into the mastoid antrum which was full of pus. There was also pus in the left middle ear. Examination of the rest of the body was not permitted.

The noteworthy features of these autopsies are:-

(1) The almost invariable bilaterality of the infection of the mastoid antra. (Refs. 10, 26, 43, 49, 59).

(2) The absence of intracranial complications, such as sinus thrombosis and intracranial abscess found in older patients. (Refs. 13, 46).

(3) The absence of intestinal lesions sufficiently gross to account for the extreme illness of these infants. (Refs. 10, 42, 43, 59, 66).

(4) In certain cases the impression was gained of a severe toxaemic or septicaemic state, although the latter view is not supported by the results of the blood cultures. (Refs. 15, 16).

HISTOLOGICAL APPEARANCES.

Sections have been prepared of several cases and photomicrographs taken. The magnification is x 85 in all these sections.

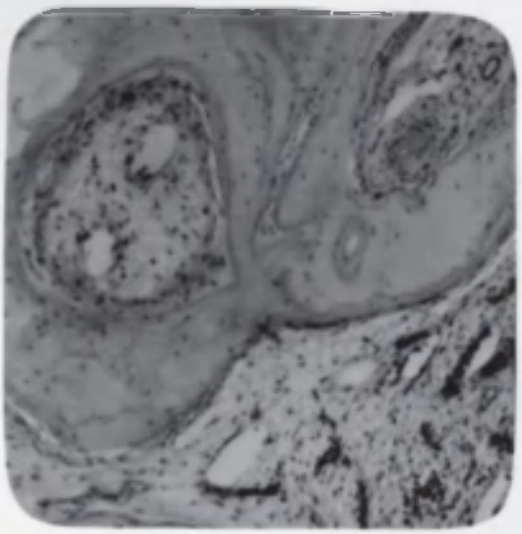


FIGURE 1. This is a section of bone taken from a normal infantile mastoid process. It shows the bony walls surrounding the cells, which are filled with loose, myxomatous tissue. (Refs. 14, 15, 16, 22, 23, 61).

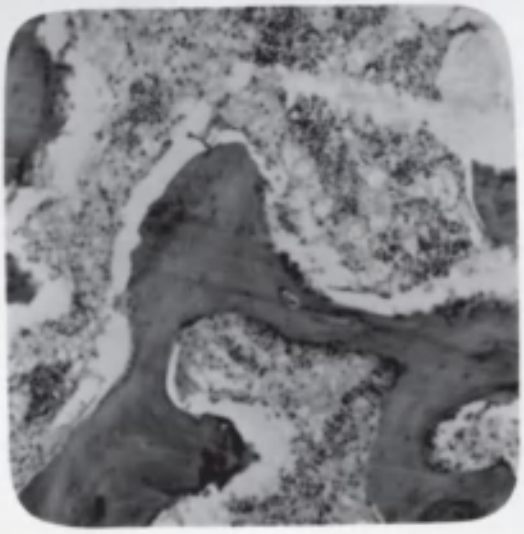
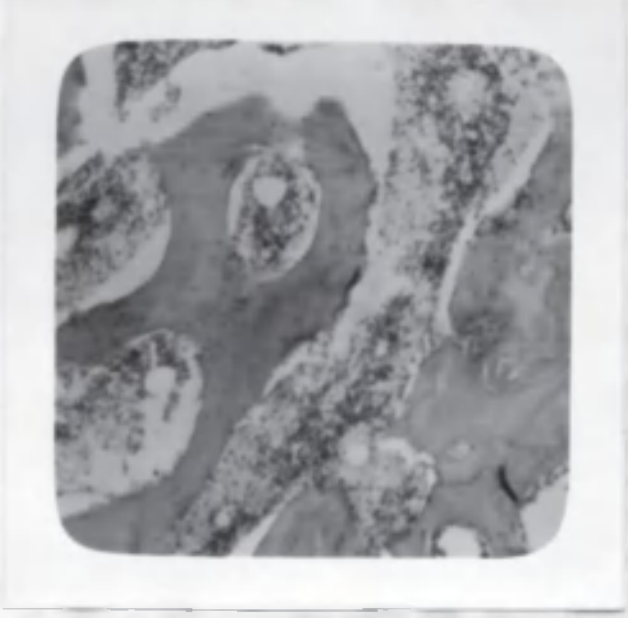


FIGURE 2. (Case No. 43, Left Mastoid). This section shows acute inflammatory reaction. Numerous inflammatory cells can be seen in the myxomatous tissue.



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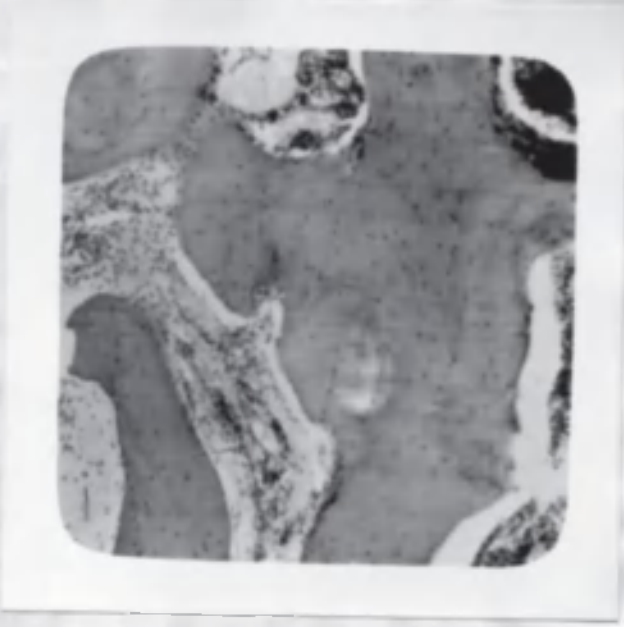

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FIGURES 3 & 4. (Case No. 44, Left Mastoid). These sections show a similar picture with large numbers of pus cells in the myxomatous areas. At several points the inflammatory process appears to be affecting the bone.

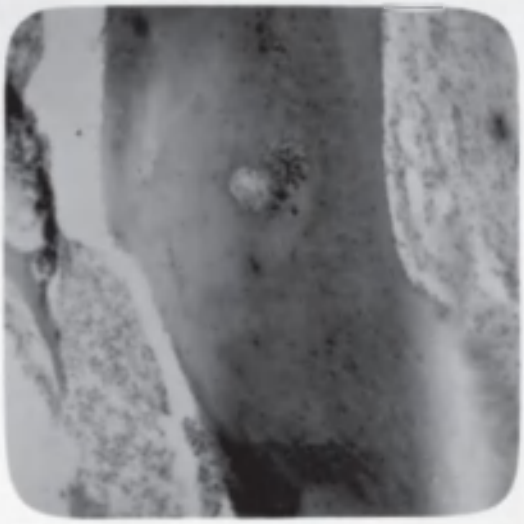

FIGURE 5. (Case No. 44, Right Mastoid). This section shows a collection of inflammatory cells occurring in one of the bony walls.

VI. CONCLUSIONS BASED ON PRESENT INVESTIGATION.

I. Otitis media and otitis media and mastoiditis play a considerable part in the morbidity and mortality rates of infancy.

II. Infections of the mastoid antra in infancy do not usually manifest themselves with the classical picture of redness, swelling, and oedema over the mastoid process. More frequently they remain latent and can give rise in a certain proportion of cases to a clinical picture characterised by diarrhoea, vomiting, dehydration, extreme toxicity and loss of weight - i.e. symptoms chiefly referable to the gastro-intestinal tract, and the toxicity is often more marked than the dehydration.

III. The presence or absence of this toxic picture appears to depend on the absence or presence of satisfactory drainage, and the highest death rate occurs in the earlier months of life. In the classical type of mastoiditis where infection is tending to spread outwards, the toxic picture never supervenes.

IV. Overcrowding in the home and previous obstetrical history do not influence the occurrence of these lesions.

V. The majority were artificially fed but on the whole the artificial feeding was good. It is possible that if breast feeding were more prevalent these infants would not be so prone to infection.

VI. Temperature is not of great diagnostic aid.

VII. The most acutely pathological drums are found in the toxic cases, but doubt is cast on the value of redness and posterior superior bulging as an indication of involvement of the mastoid antrum.

VIII. The nature of the infecting organism or organisms does not influence the clinical picture. It is suggested that the staphylococcus may possess a higher degree of pathogenicity in these infections than is generally supposed. There is quite a high incidence of infection in the families and possibly measures to deal with spread of infection from naso-pharynges of those in attendance, e.g. wearing of masks, might cause a reduction in the number of such cases.

IX. In the toxic group the condition appears to be one of toxaemia rather than septicaemia.

X. The lesions are rarely tuberculous in nature.

XI. Ordinary white counts and differential counts are of no value in prognosis or differential diagnosis.

XII. Analysis of the polynuclear cells, on the lines suggested by Schilling and others, is applicable to infants of this age group. The use of some index of "left shift", such as the multiple index employed in the present series, is possibly of diagnostic value and certainly of prognostic value. Single counts are not nearly so useful as a series of estimations. The height of multiple index is of no value as an indication of when to operate, as each infant's response to its infection varies. Such counts must always be considered in conjunction with the clinical condition. An infant's weight has long been regarded as a good indication of its progress and the manner in which the multiple index rises with loss of weight and falls with gain in weight is quite striking. As the multiple index and kindred indices are established as reliable indices of infection somewhere in the body and as the multiple index in the present series fell and rose according to the success or non-success of treatment directed against the aural infection, it seems reasonable to conclude that the aural infection was the immediate cause of the infant's illness.

XIII. Major operation is contraindicated during the acute toxic phase of the illness. Conservative treatment, with repeated myringotomies if necessary, seems to give more satisfactory results. When the infant's general condition has improved and there is no evidence of toxicity or dehydration operation may be

considered if otorrhoea persists. Operation is always indicated for the classical type of mastoiditis in which toxicity and dehydration do not occur.

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