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EPIDEMIC CEREBRO-SPINAL
MENINGITIS IN CHILDREN.

A Clinical Study of 22 Cases.

Thesis for the Degree of M.D.

University of Edinburgh.

by

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Cerebro Spinal Meningitis due to the Diplococcus

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into a series of five periods or waves in which the disease was most prevalent. In the first period from 1805 to 1850 the disease was more prevalent in the United States of America than in Europe. In the

second 1857 - 1880 epidemic occurred in many parts of both Europe and the United States. In the third period 1884 - 1874 outbreaks occurred in widely separated districts of Europe including Russia, Sweden and Germany, also in many parts of Canada and the United States. In the fourth period 1876 - 1884 the epidemics which were present in Europe and the United States were smaller and of a more limited nature. In the fifth period which includes the present time, several small epidemics have occurred in Ireland, Germany, France and the United States.

until comparatively recent years no very serious epidemics occurred in the British Isles but in the year 1863 a severe epidemic broke out in Dublin.

Historical Note.

Cerebro Spinal Meningitis due to the Diplococcus Intracellularis of Weichselbaun occurs both in epidemic form and sporadically as an acute infective fever. The disease was first recognised in Geneva by Vieusseux in 1805.

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Hirsch divides the outbreaks since this date into a series of five periods or waves in which the disease was most prevalent. In the first period from 1805 to 1830 the disease was more prevalent in the United States of America than in Europe. In the second 1837 - 1850 epidemics occurred in many parts of both Europe and the United States. In the third period 1854 - 1874 outbreaks occurred in widely separated districts of Europe including Russia, Sweden and Germany, also in many parts of Canada and the United States. In the fourth period 1876 - 1884 the epidemics which were present in Europe and the United States were smaller and of a more limited nature. In the fifth period which includes the present time, several small epidemics have occurred in Ireland, Germany, France and the United States.

Until comparatively recent years no very serious epidemic occurred in the British Isles but in the year 1866 a severe epidemic broke out in Dublin.

Much/

Much about the same time a few cases were noted in different parts of England and small epidemics continued to occur. During the last two years more serious outbreaks have been present in the United States especially New York, and in Belfast and Glasgow. Within the last six months an epidemic has broken out in Edinburgh and Leith with a few cases in the surrounding districts and other parts of Scotland.

Etiology.

When occurring in epidemic form the disease is singularly localised and does not tend to spread widely from the chief focus of infection.

Predisposing factors in the occurrence of an epidemic appear to be over crowding of individuals in houses of poor sanitation, and Osler² notes the fact that young soldiers in large barracks are very liable to an attack. Epidemics occur both in large towns and country districts and Osler⁴ states that one of the worst epidemics on record occurred in 1906 amongst the Silesian miners and in the scattered mountain villages of West Virginia. Cold seems to be another factor in the production of epidemics as most of them have occurred in the Winter or Spring months. According to Ormerod¹ the disease has no predilection/

predilection for sex but as regards age children and young adults are far more commonly attacked than persons of more advanced years. ⁵

Koplik states that of his 37 cases in the Mount Sinai Hospital, New York, 60% occurred in children under two years of age, 77% were under four years and that the average age was two years. The youngest child of this series being four months old and the oldest fourteen years.

The disease appears to be only very mildly infectious and there are few instances in which more than one case occurred in the same house. Osler³ has reported a family in which five cases occurred in rapid succession in one house within six weeks.

As to the methods of propagation, Ludwig Jehle¹⁰ is of the opinion that healthy adults who having come in contact with patients harbour the organism in the naso-pharynx and by hawking and spitting cause the disease to spread. According to this observer children placed through a wrong diagnosis in a meningitis ward do not harbour the organism in the naso-pharynx.

According to Osler,⁴ Osteremann in 1906 examined the throats of 24 persons who had been exposed to the disease and found the organism present in/

in 17. In many respects the disease is not unlike pneumonia and many believe that the two organisms are closely allied. It is now generally recognised that posterior basic meningitis is a sporadic form of cerebro-spinal fever and apart from the degree of virulence there is no marked difference between the organisms causing both forms of the disease.

Symptoms. Mode of Onset.

In almost every case the onset is abrupt and the patient within an hour or two of being in perfect health is suddenly seized with fever, headache, vomiting and extreme restlessness followed in a very short time by pain and stiffness in the muscles of the neck. Convulsions are common in the early stages of the disease especially in younger children.

Any one of these symptoms may be the first noted in the onset of the disease and their course depends largely on the severity of the type of the disease.

Classification. ² Osler groups the different forms into three classes.

1. A Malignant Form. in which the patient may die in from 10 to 24 or 48 hours. According to Ormerod these cases are more common at the commencement of an epidemic and in them cutaneous haemorrhages are more/

more common than in the other forms.

2. The Ordinary Form in which the patient may die or may show signs of recovery after a few days but the convalescence is in cases of recovery usually extremely tedious.

3. Anomalous Forms.

a. Abortive Form which after an onset of great severity the patient passes after a day or two into a rapid convalescence.

b. An Intermittent Form in which the patient may show signs of partial recovery after a few days but has one or more relapses during the course of the disease.

c. The Chronic Form where the disease may last for several months and dies at the end of this time from exhaustion in a state of extreme emaciation.

As a rule the fever continues for some time and amongst the other symptoms one notes the onset of delirium, cutaneous hyperaesthesia, rashes, which may be purpuric, erythematous, papular, or which in very severe forms may amount to actual haemorrhages. Herpes frequently occurs and a leucocytosis is a constant feature. With regard to the special senses blindness and strabismus are fairly frequent and deafness is of common occurrence. Joint complications are/

are noted especially in adults and disorders of the respiratory system usually occur.

Symptoms in Detail.

1. Nervous. The symptoms of epidemic cerebro-spinal meningitis are naturally very similar in many respects to other forms of meningitis, it has however this peculiarity namely that the spinal manifestations are as a rule more in evidence than the cerebral and the symptoms generally are more acute.

Headache: is usually one of the first symptoms and is very intense. Osler² states that it is usually frontal but Ormerod¹ records it as occurring mostly in the occipital region and the back of the neck.

The whole spinal column may become the seat of this severe pain which may later radiate into the limbs and abdomen and be accompanied by very marked cutaneous hyperaesthesia. This latter symptom often becomes so marked that the child cannot bear to be touched or handled in any way and even when comatose resents interference of any kind.

Rigidity of the Neck: as a rule occurs early in the disease. According to Koplik⁵ it was present in 82 of Councilman's 111 cases. The rigidity may pass down the whole length of the spinal column and together/

together with the head retraction which as a rule accompanies it, causes in many cases a marked degree of opisthotonos.

Head Retraction: is a fairly constant symptom and usually occurs at some period of the disease, it often varies in degree but may become so marked as to prevent the patient swallowing. Any attempt to undo this spasm of the muscles of the neck causes the patient great pain especially in the early stages of the disease.

Convulsions of both tonic and clonic type sometimes occur especially at the onset of the disease and as the result of cortical irritation, twitching, tremors and spasms of the limbs are also not uncommon.

Paralysès of the limbs and face occur but are not common. Paralysis of the muscles of the eye causing squinting is however a fairly frequent symptom and Osler³ quotes Randolph as having found strabismus present in seven of forty cases.

Reflexes. According to Koplik⁵ of the cases he examined both skin and tendon reflexes were present in the early stages but were apt to disappear in rapidly fatal cases. Babinsky's sign was found by the same observer to be present in four out of twenty-five cases.

Kernig's Sign:/

Kernig's Sign: is usually present and in some cases becomes very marked. Koplik in a series of thirty-seven cases found this sign present in all of them.

The Eye. Ormerod states that suffusion of conjunctiva is noted by many observers. In addition to strabismus Koplik notes that the pupils may be contracted or dilated and that they are sometimes unequal. In some cases he found only slight reaction to light, in others none at all. Ptosis and nystagmus sometimes occur.

Psychical Disturbances . Almost always occur and the degree of extreme irritability and restlessness especially at the onset of the illness is characteristic. On the other hand although delirium almost maniacal at times, and coma are frequently present it is a feature of the disease that consciousness is often retained throughout the whole course of the illness.

Vomiting: is usually an early symptom and is as a rule cerebral in origin. although gastric disturbance is often demonstrated by furring of the tongue. According to Ormerod when the symptom appears late in the course of the disease especially if accompanied by convulsions and coma it indicates distension of the ventricles and the onset of internal hydrocephalus.

Respiratory. Coryza of the nose and throat has been frequent/

Respiratory/

frequent in some epidemics and a mucous discharge from the nostrils is not uncommon.³ In ten of fifteen cases examined by Councilman the meningococcus was found in the secretion of the naso-pharynx.

According to Ormerod¹ pulmonary congestion and collapse are frequent, and broncho-pneumonia has complicated several epidemics. Osler states that of a series of twenty-three cases, pneumonia occurred in three of them.

Circulatory. Osler notes that the pulse rate may be slow or at any rate not increased in frequency, even when the temperature is high. Both he and Ormerod note great variation in the rate from time to time. The latter observer, states as to the quality of the pulse that it is usually compressible and of low pressure.⁶ Koplik in his series of thirty-seven cases found irregularity of the pulse in many of them. As a rule the pulse rate is accelerated in children and may be abnormally slow in adults and in them is often full and bounding.²

Digestive. Vomiting, loss of appetite and thirst are common at the onset of the illness and the former may continue throughout the course of the disease. As a rule the bowels are constipated but diarrhoea/

diarrhoea has been noted in a few cases, and may become enteric in type. The abdomen usually becomes flattened as the disease progresses and may become scaphoid in shape. The tongue according to Ormerod only shows signs of grave constitutional disease in severe cases or in the later stages of the disease.

Integumentary. According to Osler² labial herpes occurs with a frequency almost equal to that in pneumonia. According to the same observer the petechial rash is very variable but seems to have been more in evidence in the early American epidemics than in Europe. According to Ormerod eruptions of herpes zoster may occur on the limbs and trunk and are often symmetrical. Erythema or a dusky mottling may be present and rose coloured hyperaemic spots similar to those in typhoid fever have been noted by Koplik.⁵ As a rule the tache cerebrale is present.

Urinary. The urine sometimes contains albumen. Osler² states that in the malignant type haematuria is sometimes present and that in some instances glycosuria has been noted.

Haemopoietic. The spleen sometimes shows slight enlargement. The blood practically always shows a well marked leucocytosis. This is present early in the disease and is due to an increase in the polymorphonuclear leucocytes. Ormerod states that in thirty-three/

thirty-three cases reported by Councilman there was a leucocytosis ranging from 9350 to 31000. Osler finds the leucocytosis to be from 25000 to 40000 per cubic millimetre and that it persists even in protracted cases. ⁵ Koplik states that he found a leucocytosis to some extent in all of his thirty-seven cases and that it ranged from 20000 to 55000, but this same observer holds that a prognosis cannot be made on this point alone.

Temperature. According to Ormerod this does not conform to that of any other disease nor has it a type of its own. He also states that maintained elevation of any high degree is exceptional and that the average varies from 101° - 103° F.

In the severe stages of the disease there may be sudden elevations up to 106° F. but in chronic cases of long duration there may be no fever towards the end of the illness.

Osler describes three forms which occurred in his series of cases.

1. A continuous pyrexia similar to that seen in typhoid fever.
2. A remittent type, with daily excursions from three to five degrees.
3. An intermittent form with daily paroxysms.

Elsewhere² the same observer states that the temperature is/

is irregular and variable and that there is no uniform or typical curve throughout the disease.

⁵ Koplik notes that in children the temperature is more frequently of the intermittent type. Occasionally in its excursions the temperature may fall below the normal.

Complications and Sequelae.

The Eye. Osler states that Randolph found optic neuritis in seven of forty cases examined. And ⁵ Koplik analysing Councilman's cases found conjunctivitis in some, also desiccating keratitis. ⁶ Koplik states that he found the meningococcus in the discharge from cases which were complicated by conjunctivitis and that in one case where double optic neuritis was present, this latter symptom disappeared before the patient was discharged.

The Ear. The auditory apparatus is not unfrequently affected and usually the labyrinth is involved permanently. Osler quotes Moos as having found that of sixty-four cases of recovery from the disease deafness was present in 55% of these. According to ¹³ Love this disease is one of the commonest causes of deaf mutism.

Usually the deafness comes on in the first or second/

second week. In cases of recovery which are complicated by deafness the gait according to Politzer¹² is often staggering or waddling but this latter phenomenon usually disappears after a few months.

Chronic Hydrocephalus. When symptoms of this complication are present they usually occur during the period of convalescence and may consist of headache, vomiting, coma and convulsions.¹⁴ Koplik believes that this is due not so much to the occlusion of the foramen of Majendi as to inflammatory changes in the blood vessels and lining structures of the ventricles of the brain. Recovery from this complication is very rare.

Joint Disease. Implication of joints has according to Osler been a frequent complication of certain epidemics and the same observer states that many joints may be simultaneously affected. Swelling pain and exudation may be present and the latter may be either serous or purulent.

Ormerod states that in some instances the appearance of joint affections has coincided with the amelioration of the meningeal symptom.⁵ Koplik found no joint complications in children.

Pyæmic Conditions. Such as endo and pericarditis pleurisy etc., have been noted but are apparently rare.

Emaciation: is often rapid and extremely marked especially in the chronic form of the disease.

The material on which this study is based has been derived from cases admitted to the wards of the Sick Children's Hospital, Edinburgh, during the last six months.

In every case Dr. Stuart McDonald has confirmed the diagnosis either by examination of the Cerebro-Spinal fluid obtained by lumbar puncture during life or by post mortem examination.

In the greater majority of cases both these procedures were carried out.

I have to thank Drs. Melville Dunlop, Thomson and Fowler for their kindness in placing notes on cases occurring in their wards at my disposal. Several of the later cases were removed to the City Hospital and I have to thank Dr. Kerr for allowing me to continue my observations on them and for the use of notes regarding their treatment and progress. Lastly I have to thank Dr. Fowler for the use of several of the photographs which illustrate cases occurring in his ward.

Case No. 1. William Campbell. Aged $3\frac{1}{2}$ years.

Admitted 6/10/06. Discharged 6/10/06. Result Death.

Complaint. Vomiting, feverishness and difficulty
in breathing.

Duration. 2 days.

Family History etc. Patient was the 8th of 10 children. The parents were healthy and there was no history of hereditary disease. The house was dry and well ventilated, and the child had been getting out of doors every day.

Previous Health. Child was bottle fed, had thrived well and with the exception of slight rickets had always been particularly healthy.

Present Illness. On October 4, the patient got very wet while playing in the street in the afternoon and on his return home complained of not feeling well. He was put to bed and went to sleep. About 6-30 p.m. he awoke and commenced to vomit, and continued to do so until he was admitted. He was very feverish, thirsty and had a slight cough. During the night he was very restless and slept very little. The following morning he complained of severe headache and became unconscious during the evening.

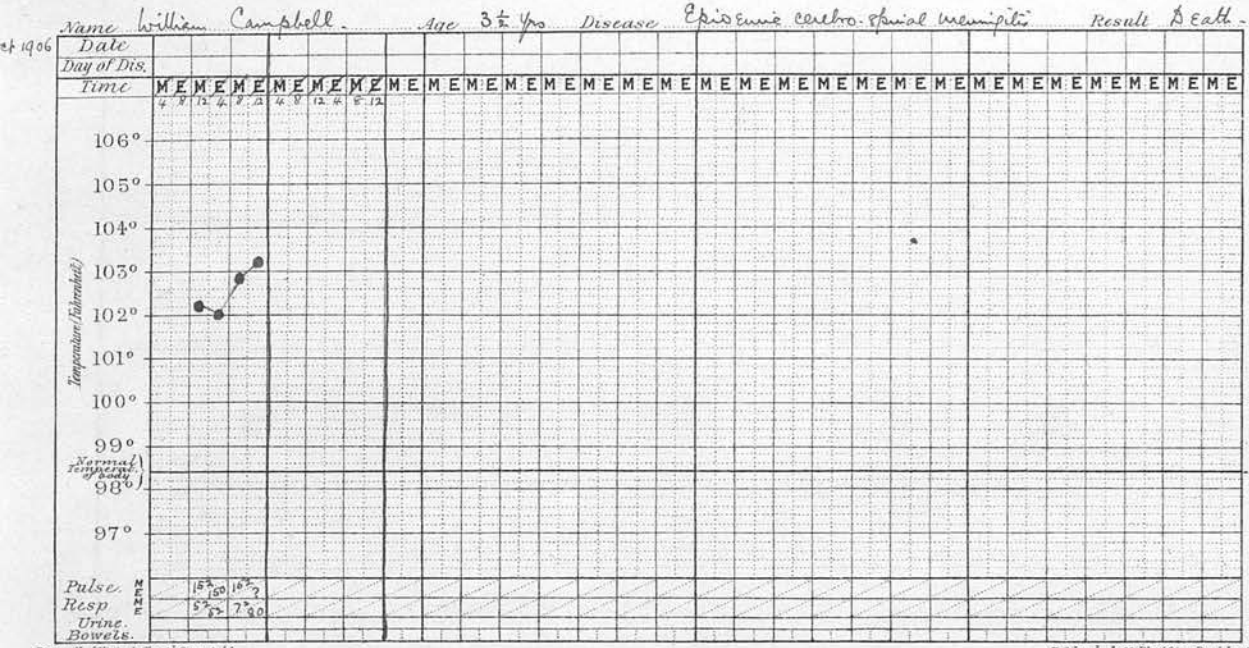
State on Admission. The child was well developed
and/

and nourished, but was very much collapsed and quite unconscious. He lay in a semiflexed attitude and remained fairly quiet if undisturbed but screamed out if anyone touched him. The skin was hot and dry but there were no herpes or purpuric spots. The abdomen was very much retracted and there was no enlargement of the liver or spleen. The neck was rigid and the head was slightly retracted. The respirations were 52 per minute and quite regular. The pulse was 152 per minute and was regular but of small amplitude and low tension. The temperature was 102. The plantar reflex was normal, but the knee jerks were absent. Kernig's sign was well marked. The pupils were equal and reacted to light. The heart and lungs were normal. No urine was obtained for examination.

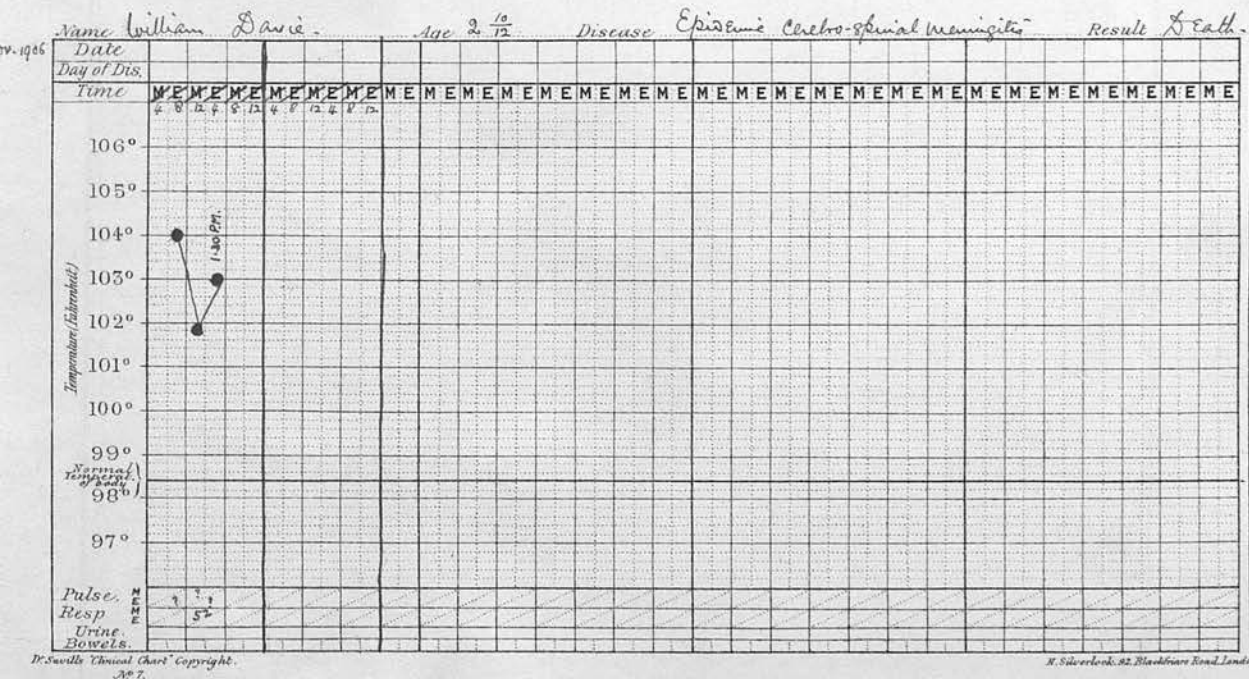
Progress. Shortly after admission the patient was lumbar punctured and 3^{vi} of turbid escaped under considerable tension. On examination the fluid was found to contain many cells mainly polymorphs and great numbers of meningococci, many of the latter being intracellular. The child remained unconscious gradually getting weaker and died about midnight.

Permission for a post mortem examination was not obtained.

Temperature Charts.



Case 1. Four hourly chart.



Case 2. Four hourly chart.

Case No. 2. William Davie. Aged $2\frac{10}{12}$ years.

Admitted November 29. Discharged, November 29.

Result Death.

Complaint. Convulsions.

Duration. 3 a.m. November 28.

Family History, etc., Patient was the 9th of 11 children, 4 of whom had died from diseases of early childhood. Both parents were healthy. The house was sunny, dry and well ventilated and the child had been getting out every day.

Previous Health. Patient was a bottle fed baby, and with the exception of measles at the age of $1\frac{3}{12}$ years, had always been a very healthy child.

Present Illness. On November 28 about 3 a.m. the child wakened and had an attack of vomiting, after which he became very restless, moaning and talking in his sleep. Later on in the morning he seemed better but had no appetite, was very thirsty however and complained of dizziness and was afraid of being lifted. All through the day he remained quite quiet but trembled a good deal when handled. In the evening about 10 p.m. he had a convulsion which lasted for 2 hours. After this he slept well until 7-30 a.m. on the following morning when the fits started again and continued until admission.

State on Admission./

State On Admission. When admitted about 9-30 a.m. on November 29, the child, who was very well developed and nourished, was in a state of clonic convulsion. The limbs, especially the upper extremities, were constantly jerking. The face was pale and dusky but there were no herpes, a few purpuric spots however were present on the front of the chest. The pulse was too faint and intermittant to be counted. The respirations were 52 per minute. and irregular. The temperature was 104. The abdomen was somewhat distended but there was no enlargement of liver or spleen. The heart and lungs were normal. The limbs especially at the extremities were bluish and mottled with slight swelling of feet feet and hands. The tongue was furred and the breath foul. Both superficial and deep reflexes were absent, also Kernig's sign. The pupils were dilated, the right being slightly larger than the left, both reacting very slightly to light. No urine was obtained for examination.

Progress. The child was placed in a hot bath for 20 minutes and shortly after was given a few breaths of chloroform to stop the clonic movements. Thereafter he passed into a state of profound coma and died about 2-30 p.m..

Post Mortem Examination./

Post Mortem Examination.

Brain showed hyperaemia of the cortex with excess of slightly turbid fluid in pia-arachnoid. There were some small flakes of lymph at the base of the brain, over the upper surface of the cerebellum and lower part of the sylvian fissure. The cerebro spinal fluid showed great excess of polymorph cells and a few meningococci. The surface of the cord was acutely hyperaemic.

The heart showed cloudy swelling of the myocardium.

Liver and Spleen showed slight enlargement with signs of congestion and toxic poisoning.

continued to vomit everything she drank. Next day she seemed a little better in the morning but towards evening became worse again. Vomiting continued and child complained of heaviness of her head. She became very restless, slept very little and breathing became more rapid. On the following days she was very drowsy and towards evening on January 9 became delirious.

State on Admission. The child was very delirious. Her face cyanosed and dusky, and the extremities were bluish with a curiously mottled appearance. She was extremely restless and was constantly grinding her teeth very forcibly. Apart from the mottling of

Case No. 3. Jean Forrest. Aged 4 years.

Admitted 9/1/07. Discharged 10/1/07. Result Death.

Complaint. Sickness and vomiting.

Duration 4 days.

Family History, etc. Both the parents were alive and healthy. The house was draughty but dry and the patient was getting out daily.

Previous Health. The child was breast fed and had thriven well, and with the exception of measles when three years old she had been fairly healthy.

Present Illness. On the night of January 5th the child started to vomit, and although very thirsty, continued to vomit everything she drank. Next day she seemed a little better in the morning but towards evening became worse again. Vomiting continued and child complained of heaviness of her head. She became very restless, slept very little and breathing became more rapid. ^{two} On the following days she was very drowsy and towards evening on January 8 became delirious.

State on Admission. The child was very delirious.

Her face cyanosed and dusky, and the extremities were bluish with a curiously mottled appearance.

She was extremely restless and was constantly grinding her teeth very forcibly. Apart from the mottling of/

chiefly/

of the extremities there were no eruptions, both herpes and purpuric spots being absent. The pulse was 120 per minute, full and bounding and of good volume but poor tension. The respirations were 24 and the temperature 102.6°F.

The pupils were widely dilated and photophobia was present. The abdomen was much sunken and almost scaphoid. The heart and lungs were normal. The knee jerks could not be elicited and Kernig's sign was absent. The blood showed a leucocytosis of 38,000 and the glycogenic reaction was present.

Progress. The child remained fairly quiet during the early afternoon but later on became very restless, diarrhoea was present and there was some fresh haemorrhage in the motions. As the restlessness increased the patient commenced to have twitching movements of the arms and legs, the left side of the body showing the phenomena first, then ceasing and being followed after the lapse of a short interval by similar movements on the right side.

About 9 p.m. in the evening the pupils had become pin point and the photophobia was less marked. The pulse was very rapid and of extremely poor tension. The child was lumbar punctured and 3½ of milky turbid fluid escaped under slightly increased tension. Film preparations of the fluid showed many cells chiefly/

chiefly polymorphs and great numbers of meningococci many of which were within the cells. During the night the convulsive phenomena of the limbs continued and at 2 a.m. the following morning the child had a violent convulsion. Later on in the morning she became very restless, the neck and back showed some rigidity and the head became slightly retracted. The child became very collapsed and cyanosed death occurring about mid-day January 10th.

Post Mortem Examination.

The pericardium and plurae were healthy and there was no free fluid.

The heart showed some pallor of the myocardium but was otherwise healthy, there were no petechiae. on the surface.

The lungs showed some small patches of chronic pleurisy on the surface, and also showed areas of lobular collapse and congestion. There was no pneumonic consolidation.

The spleen was acutely congested.

Both the liver and kidneys showed cloudy swelling and signs of toxic poisoning.

The brain showed acute basal meningitis with a somewhat scanty purulent exudate over the base, especially over the interpeduncular space and spreading slightly over/

Case No 4. Mary Fortune. Aged $1\frac{6}{12}$ years. Admitted 12/1/07. Discharged 30/1/07. Result death.

Complaint. Vomiting, irritability and fits.

Duration of Illness. 7 days.

Family History etc. Both parents were healthy, but lived in a rather badly ventilated lodgings. There was one other child who was quite healthy. The patient had been getting out very little.

Previous Health. The child who was on the breast, had had no infectious disease and apart from slight diarrhoea and vomiting due to improper feeding, scraps having been given as well as the breast, had been fairly healthy.

History of Present Illness. Three days before the onset of the present illness the child had fallen on the back of her head but nothing was noticed wrong with her until January 5 when she was seized with a convulsion in which the eyes were turned inwards, vomiting and seemed dazed all day. She continued to vomit at intervals, and has been drowsy and very thirsty. At night she seemed worse than during the day and has been very restless, sweating a lot and awakening occasionally with a scream as if in pain.

State on Admission. The patient who was big for ^{her} age was well nourished and lay in a very irritable state with

with flushed face and marked head retraction. There was no rigidity of the limbs and Kernig's sign was also absent. The pulse was 156 per minute and of moderate volume and tension. The respirations were quite regular 72 per minute and the temperature 104^o F. Both knee jerks were active and the pupils were equal and showed slight dilatation.

The heart and lungs were normal.

The blood on the 10th day of the disease showed a white corpuscle count of 15,000 and the glycogenic reaction was present.

Progress. On January 15 the patient was lumbar punctured and 37 of milky cerebro-spinal fluid escaped. Film preparations showed many polymorph cells and a few meningococci, some of which were intracellular. In the evening lumbar puncture was repeated and after M 40 had escaped the child showed signs of distress, throwing her arms about and sighing deeply. M. 20 of a 1% solution of lysol were now injected followed by M.20 of normal saline solution. After this the child spent a quieter night and the following day, January 16 seemed much the same. The pupils were equal and dilated and the fundi examined by Dr. Berry showed nothing abnormal. The right knee jerk was increased and a slight degree of Kernig was present/

present. Lumbar puncture was again performed 10 c.c. of fluid being allowed to escape followed by the injection of a similar quantity of 1% solution of lysol. On January 17 there was little change. On the 18th the child lay in an attitude of flexion with very marked retraction of the head. Both abdominal and plantar reflexes were now absent. Organisms were still present in the cerebro-spinal fluid of which was removed by lumbar puncture. On January 21 the child was apathetic but could see things held before her eyes. All through the following day January 22 she was very restless, rather collapsed and was grinding her teeth frequently. Vomiting occurred occasionally and there seemed to be uneasiness about the mouth as the patient bit anything she could manage to get into it. During the following three days the grinding of the teeth and the head retraction became more marked while the knee jerks and Kernig's sign were absent. Great irritability was still present but the child was still able to swallow. On January 26 the child was very apathetic but the knee jerks had returned and were slightly increased. 3 c.c. of 1% solution of collargol and later 3 c.c.s of a 5% solution were injected into spinal canal. After the second injection the child began to have fine twitching movements of the head and arms, and became/

became very restless. About 2 hours later she sweated very much. On the January 27 the pupils were pin point, the plantar reflex was absent, the knee jerks however were still active, As the child could not now swallow properly nasal feeding was instituted. The head was now so much retracted that the occiput rested on the shoulders. The tremors returned, but later the child lay quite quiet. On January 28 the plantar reflex was slightly present. On January 29 the child was a good deal worse, the lips, cheeks and extremities blue and mottled. The pupils were dilated but reacted sluggishly to light. Early on the following day January 30 the pulse became very feeble, fibrillary twitching of the head returned, and the child died about 8 a.m.

Post Mortem Examination.

The **brain** showed a well marked basal meningitis, the vertex was not implicated. There was some brownish staining of the tissues at the base from the injection of silver salts.

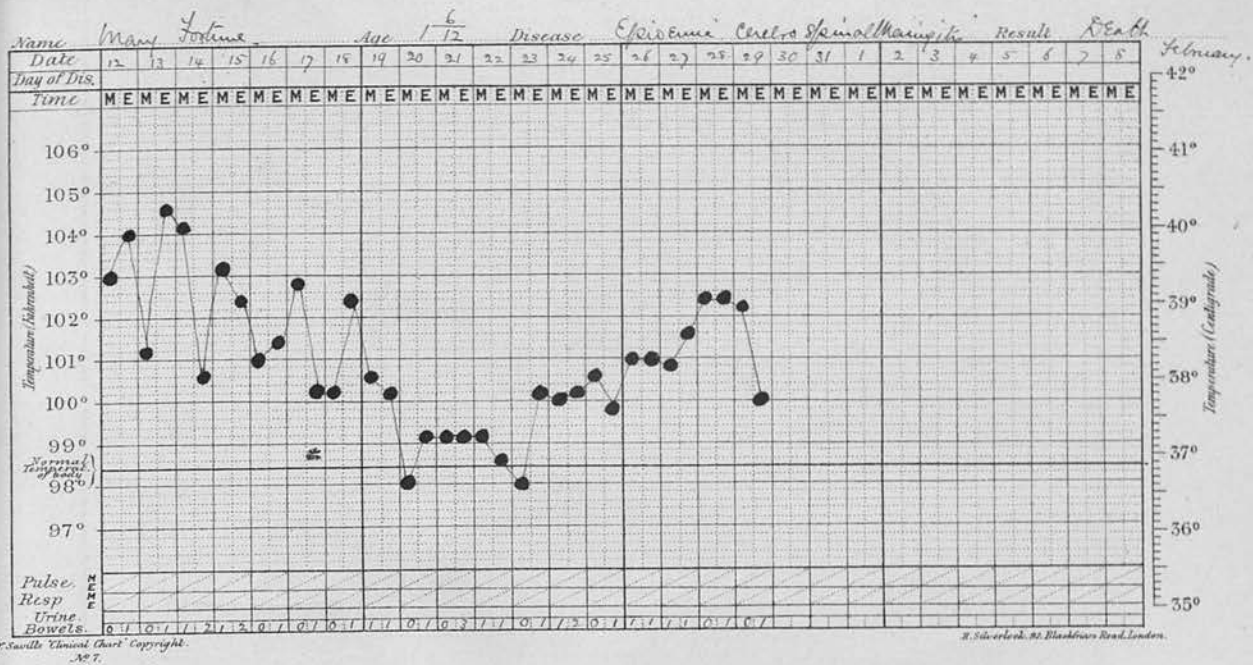
The cord showed a diffuse lepto-meningitis and there was the same brownish discoloration of the tissues as seen at the base of the brain.

The lungs showed scattered patches of broncho-pneumonia and there was also considerable congestion of oedemia of/
of/

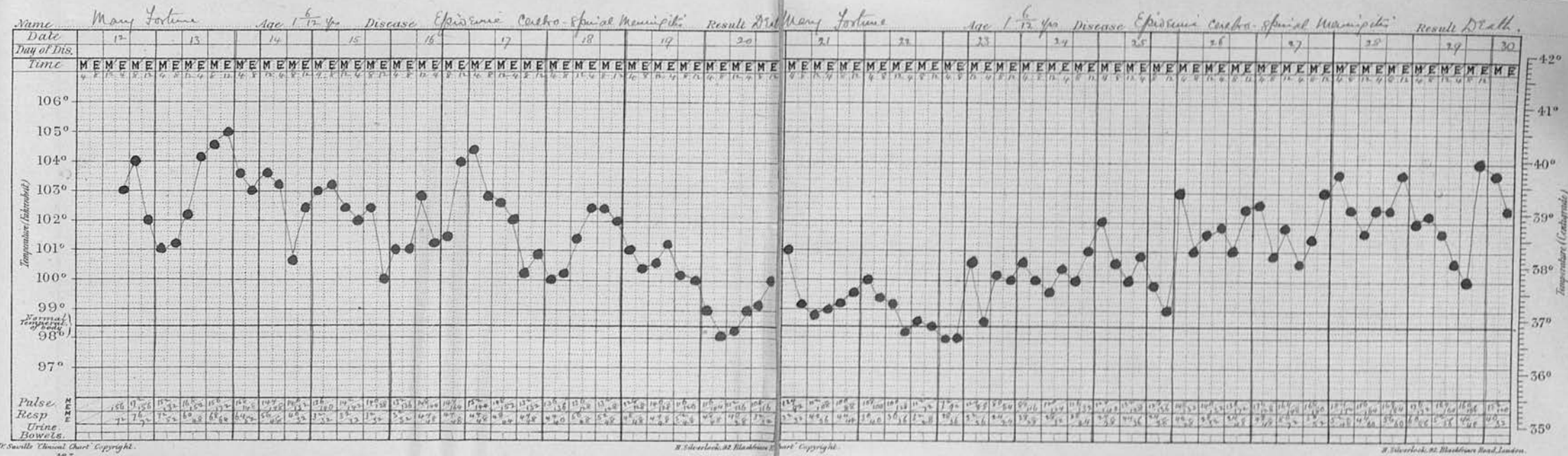
of both lungs.

The other organs showed signs of acute toxic poisoning.

Temperature Charts.



Case 4.



Case 4. Four hourly chart.

The head was slightly retracted and there was a marked degree of hyperaesthesia.

The heart and lungs were normal and there was no enlargement of the liver or spleen.

As regards the superficial reflexes, both the plantar and abdominal reflexes were present. Both knee jerks were active and Kernig's sign was slightly present.

The pupils were moderately dilated and equal but did not react to light. There was no photophobia.

The urine contained nothing abnormal.

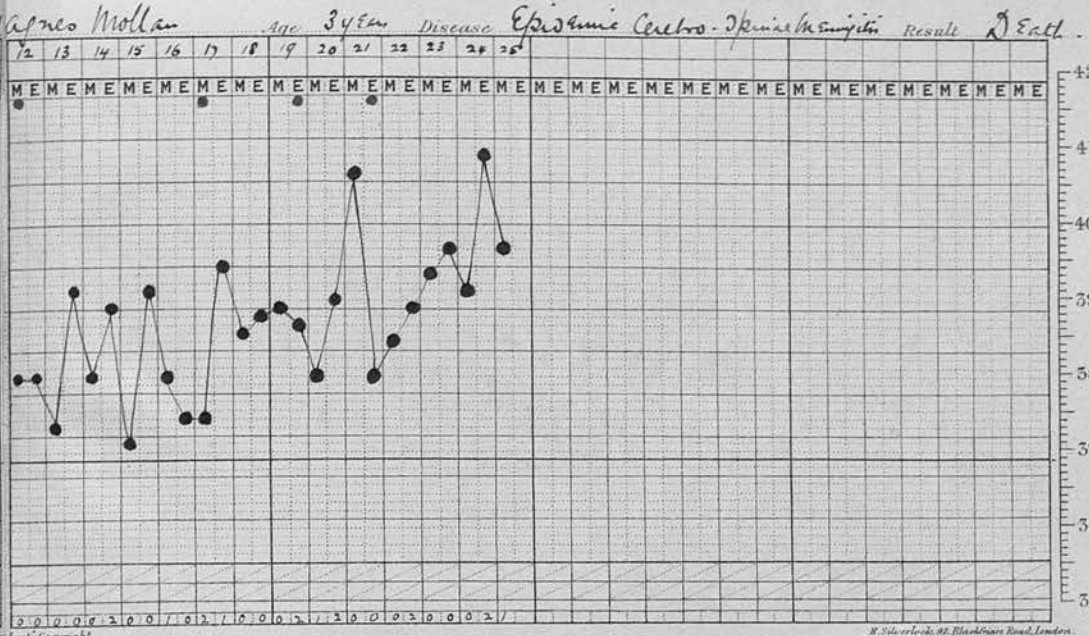
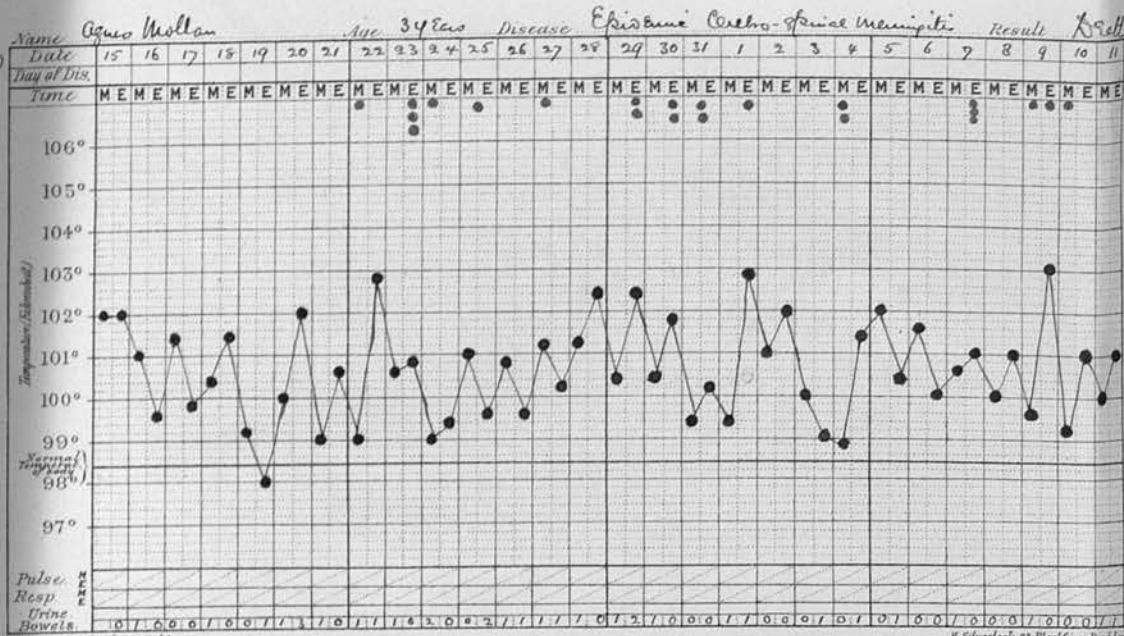
The blood showed a white corpuscle count of 14500 and the glycogenic reaction was present.

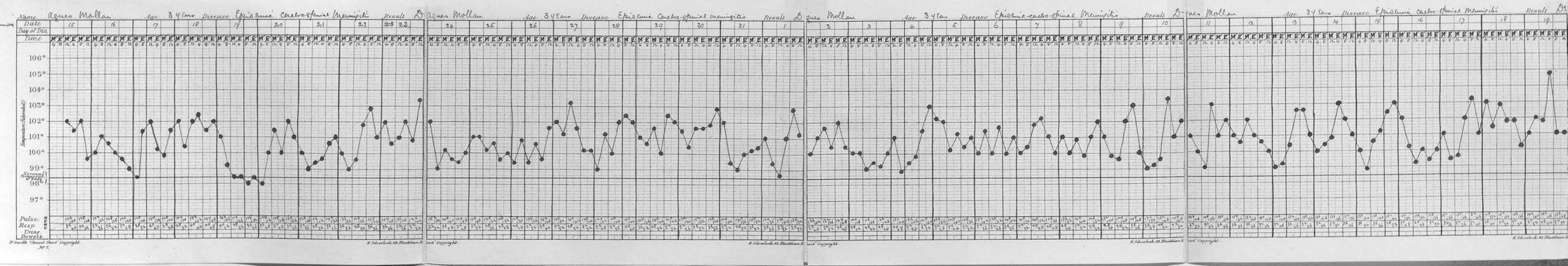
Progress. On January 18 the child had become very irritable with slight rigidity of the back and slight head retraction. The abdominal reflexes and knee jerks were now absent. Otherwise the condition of the patient was much the same. On January 21 the knee jerks were present again and the white blood corpuscles now numbered 15000. On the following day January 22 the white corpuscles numbered 29000 and towards evening the child became delirious. Lumbar puncture was performed and about 20 c.c. of cloudy fluid escaped under increased tension. The examination of film preparations showed meningococci within the cells which were mainly polymorphs. After the lumbar/

lumbar puncture the child seemed relieved and slept quietly, awakening quite sensible the following morning. The base of the brain was largely free.

The following evening January 23 5 c.c. of 1% solution of colargol were injected into spinal canal after the removal of a similar quantity of cerebro-spinal fluid. This was followed by extreme restlessness and violent delirium on the part of the patient who had to be controlled by the administration of chloroform. During the next few days the patient remained much the same but on January 30 Kernig's sign became very marked and the child was more fretful, vomiting had continued at intervals. Up to February 12 the child remained very much the same and when undisturbed seemed comfortable. The sight was unimpaired but the left ear had begun to discharge a copious watery fluid. On February 16 the right ear started to discharge freely. The patient was still conscious and took notice of things going on around her, speaking occasionally. During the next few days the child became worse the movements of the arms became tremulous and the hearing seemed to be impaired. On February 22 the knee jerks were absent and there were signs of congestion at the bases of the lungs. The following day she became quite unconscious and getting weaker, died early on February 25.

Temperature Charts.



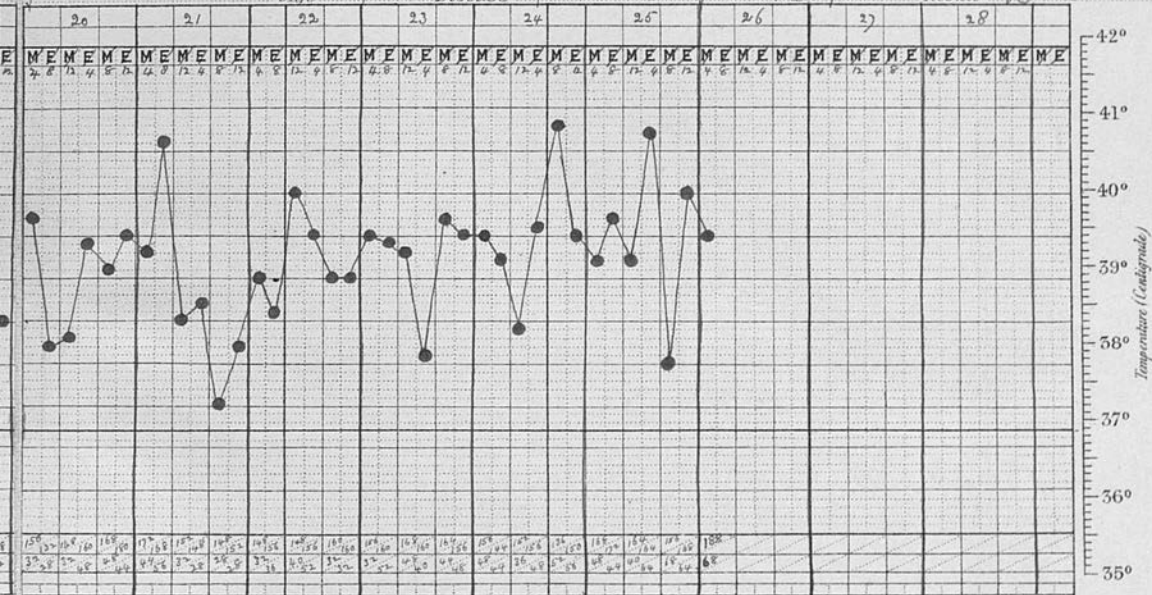


Case 5. Four hourly chart.

Pedro Mollan

Age 3 years Disease Epidemic Cerebro Spinal Meningitis

Result Death



Case No. 6. Elizabeth Kerr, Aged $2\frac{2}{12}$ years.

Admitted 22/1/07. Discharged 23/1/07. Result death.

Complaint. Vomiting, fits and feverishness associated with heavy breathing and slight cough.

Duration. Since the afternoon of January 20th.

Family History etc. The patient was the 7th of 8 children, one of whom had died from pneumonia. Both the parents were healthy. The house which consisted of two rooms were sunny, dry and well ventilated, the child however was seldom taken out.

Previous Health. The patient who had been breast fed, had thrived well and with the exception of measles when $1\frac{4}{12}$ and chicken pox 3 weeks before admission had been a healthy child. She had been bothered with thread worms for 5 months and had past some a few days before admission.

History of Present Illness. The child had been quite well until 1 p.m. on January 20th when she became drowsy so was put to bed. She awakened at 3 p.m. and was very irritable and cross and started to vomit. The vomiting continued for about one hour and associated with this there was a good deal of retching. Later on in the day she became very listless and feverish, and spent a very restless night. Early in the following morning she began to/

to vomit again and continued to do so all day. About 11-30 a.m. she had a fit which lasted for about ten minutes, and during the remainder of the day January 21 was alternately restless and quiet moaning occasionally, the eyes half shut, and the hands constantly moving. During the night she retched a good deal and was very restless. About noon the following day the head became retracted and the neck muscles were very stiff. Towards evening she became very drowsy but was constantly pulling at her mouth with her hands. Some strabismus was noticed by the parents who also noticed that the child was anxious to lie on the right side only.

State on Admission. The patient who was fairly well developed and nourished was lying on her right side in a very irritable but quite conscious condition. The lips were cyanosed but there was no herpes. The eyes were sunken and the limbs cold and of a purple colour. The skin was hot and dry but there were no purpuric spots. Although very drowsy the child resented any attempt to change her position, and lay with her head retracted, and with marked rigidity of neck.

The pulse was 140 per minute, regular but of small amplitude and tension.

The respirations were 30 and the temperature 98.2°F.

The/

The tongue was thickly coated posteriorly and around the teeth there was a marked muco-purulent secretion. The heart and lungs were normal, but the abdomen was markedly flattened. The eyes showed some injection of the cornea, but there was no squint and the pupils which were equal and of medium size reacted to light. The plantar reflex was normal as were also the knee jerks and both Kernig's sign and Babinsky were absent.

The blood showed haemoglobin 82%, the red corpuscles being 5450000 and the white 19000.

No specimen of urine was obtained for examination.

Progress. Throughout the early part of the night the child was very restless, had 2 attacks of vomiting and the head retraction became more evident. About 3-30 a.m. the following morning lumbar puncture was performed and 3c.c. of turbid fluid containing many polymorph cells and meningococci escaped, but not under tension. After this the breathing became easier, the child was less restless and the head retraction almost completely disappeared. Later on in the day about 12-30 p.m. as the child was becoming restless again 10 c.c. of fluid were obtained, after which the restlessness became less marked for a time. Throughout the day the child retched/

retched and vomited a good deal, the pupils varied much in size from time to time but remained equal. Death took place about 11 - 15 p.m.

Post Mortem Examination.

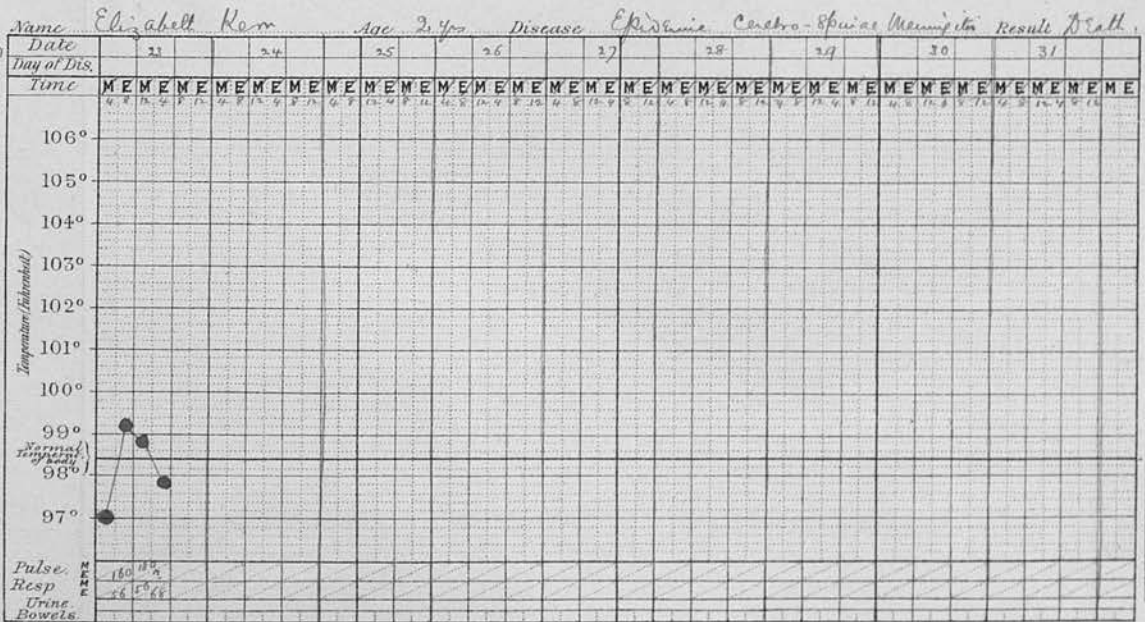
The brain showed a well marked lepto meningitis with dilatation of the superficial vessels and flattening of the convolutions.

The cord showed a diffuse leptomeningitis rather more marked over the cervical and lumbar regions.

The heart, liver & kidneys showed advanced cloudy swelling.

The lungs showed no pneumonic consolidation but there were patches of collapse and emphysema.

Both lungs showed great congestion.



Case 6. Four hourly chart.

Case No. 7. Mary Neale. Aged $\frac{8}{12}$ years.

Admitted 31/1/07. Discharged 19/2/07. Result death.

Complaint. Vomiting and pain in the head.

Duration of Illness. 12 days.

Family History. etc. Both parents were alive and healthy. The patient was the youngest of 4 children, 2 of whom had died in early infancy. The house consisted of 2 rooms and was well ventilated.

Previous Health. The child who was on the breast, had thrived well and there was no history of any illness.

History of Present Illness. On January 20th the child became restless and feverish and started to vomit. Latterly the vomiting had not been present.

State On Admission. The child who was very well nourished was very irritable if disturbed and cried out loudly when handled. There was no stiffness of the back and no head retraction. There was no eruption on the skin either herpetic or purpuric. The pulse was 128 per minute, the respiration 52 and the temperature 102.8°F . The heart was normal but the lungs showed signs of bronchitis.

The plantar reflex gave a flexor response but the abdominal reflex was absent. Both knee jerks were somewhat exaggerated. The pupils were equal, slightly/

slightly dilated and reacted normally. Kernig's sign was absent. A specimen of urine showed no abnormality. The blood showed a white corpuscle count of 29,500 and the glyco-genic reaction was present.

Progress. On February 2 the patient was still very irritable if handled and there seemed to be some stiffness of the neck and back with pain on movement. When left undisturbed the child lay quite quiet. There was no tension in the fontanelle and on being lumbar punctured a very small quantity of thick flaky pus was withdrawn. On examination of a film preparation large numbers of both intra-cellular and extra-cellular meningococci were seen. On the following day February 3 Kernig's sign was well marked, there was no head retraction but there was a tendency to tremor in the left arm. The child remained fairly quiet and was feverish especially at night. She was able to take nourishment by the mouth and was quite conscious. On the three following days the child seemed much the same but on February 5 some tendency to head retraction was noticed. On February 7 the knee jerks were absent and an ophthalmoscopic examination of the fundi by Dr. Berry showed nothing abnormal. Slight internal strabismus/

strabismus of the right eye was noticed on February 8th and on February 11th no organisms could be demonstrated in the cerebro-spinal fluid. The child grew gradually more apathetic and weaker, and on the evening of February 13 marked opisthotonus became present. Early on the following morning the arms and legs began to twitch and this continued at intervals. On February 16 the child became unconscious, the attitude of the limbs was one of flexion and she had difficulty in swallowing. On February 18 the head retraction became very marked and although great force was required to alter the position it did not seem to cause her pain. The hands were clenched and the knee jerks were now absent.

On February 19 the child seemed much worse and the position of the head etc. was more exaggerated. Death took place about 1-30 p.m.

Post Mortem Examination.

The brain showed a distinct lepto-meningitis of the base and also over the cortex. In the latter situation there were signs of a part of the exudate having been absorbed.

The cord showed a well marked lepto-meningitis over its whole extent with some signs of absorption.

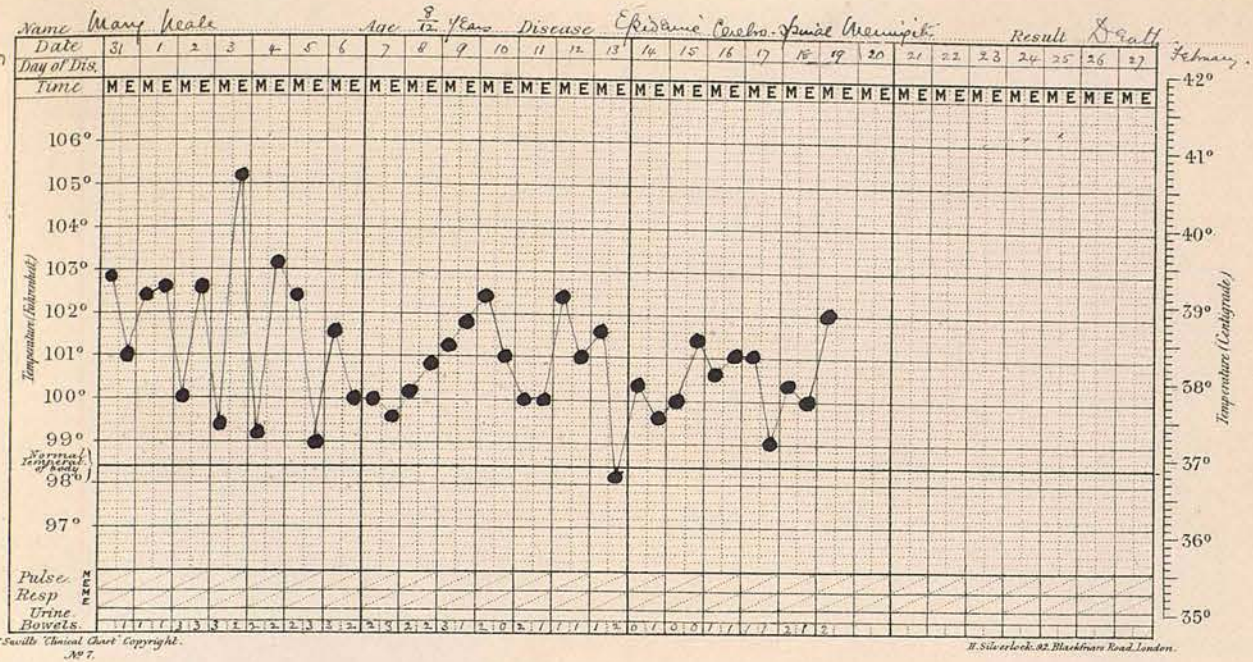
The/

The lungs showed patches of broncho pneumonia and marked congestion.

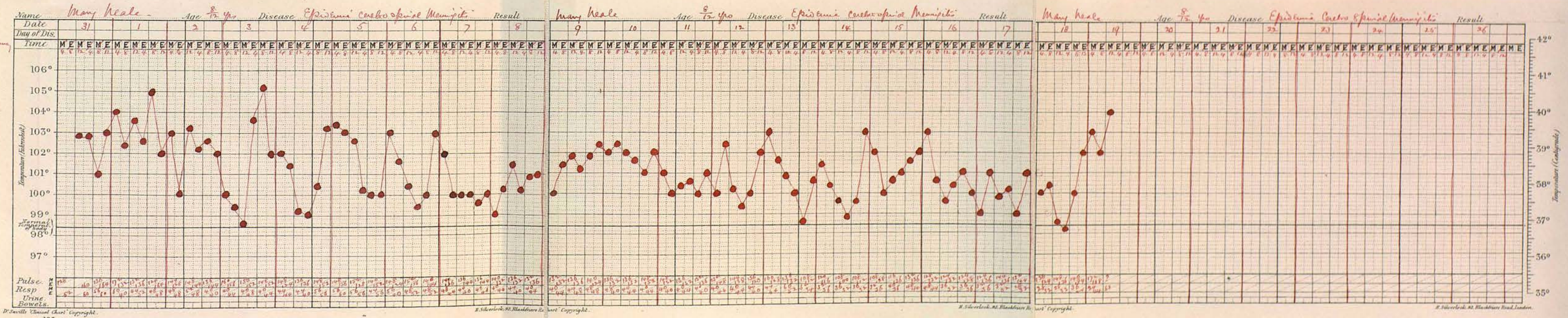
The other organs showed signs of acute toxæmia.

The alimentary tract showed little that was abnormal.

Temperature Charts.



Case 7.



Case 7. Four hourly chart.

Case No. 8. Norah Finnigan. Aged 10 months.

Admitted 2/2/07. Discharged 21/2/07. Result death.

Complaint. Bronchitis and fits.

Duration of Illness. 3 days.

Family History etc. The patient was the youngest of 10 children, 2 of whom had died from pneumonia following measles. The house was dry and well ventilated and the parents were both alive and healthy.

Previous Health. The child who was on the breast had thriven well but had had running ears when 3 months old. With the exception of this and a slight attack of bronchitis a month before the onset of the present illness, the child had been quite healthy.

History of Present Illness. Early on the morning of January 30 about 3 a.m. the patient was seized with a convulsion in which she became rigid, the eyes being turned upwards and inwards. The fits had recurred several times before her admission on February 2 and in the intervals between them a varying amount of rigidity had been maintained.

State on Admission. The patient who was a large and well nourished child was apathetic and semi-unconscious. There was a marked internal strabismus of both eyes, the pupils of which were equal and reacted to light. The fontanelle was slightly bulged, and a faint pulsation/

pulsation could be felt in it, a slight degree of cranio tubes was also present. The face was dusky and there was a crop of labial herpes but no purpuric spots could be seen. The head was not retracted, but while the arms were rigidly flexed at the elbow and finger joints, the legs were extended with the toes curling in towards the soles. The abdomen was slightly retracted, and the child although quite blind had nothing abnormal in the fundi on ophthalmoscopic examination. The pulse was 128 per minute, very poor in volume and tension. The respirations were 48 per minute and regular and the temperature was 98.6^oF. The heart appeared to be normal but the lungs showed signs of congestion especially at the base of the right. Both the plantar and abdominal reflexes were absent but the knee jerks were increased. A specimen of the urine contained no albumen. The blood showed a leucocytosis of 29500 but the glycogenic reaction in this case was absent.

Progress. Shortly after admission the child was lumbar punctured and 20 c.c. of comparatively clear fluid escaped under considerable tension. On standing however a slight deposit settled and on making film preparations of this, the fluid was found to/

The fluid showed some similarity between the fluid to contain many polymorph cells, with a few meningococci some of which were within the cells. Lumbar puncture was continued every day, indication for so doing being judged from the tension of the fontanelle. On February 4 as the result of 3 punctures 65 c.c. of fluid escaped and in each case the tension in the fontanelle, and the amount of rigid spasm of the limbs was lessened. On February 11 no organisms could be found in the fluid. The last lumbar puncture was done on February 19 and as in previous instances the head retraction etc. became lessened but the relief was only temporary and lasted only 3 or 4 hours. The child remained very irritable, head retraction became present on February 18 and increased, becoming very marked before death. The rigid extension of the legs and tetanic spasm of the arms and hands remained present until death, which took place on February 21.

Post Mortem Examination.

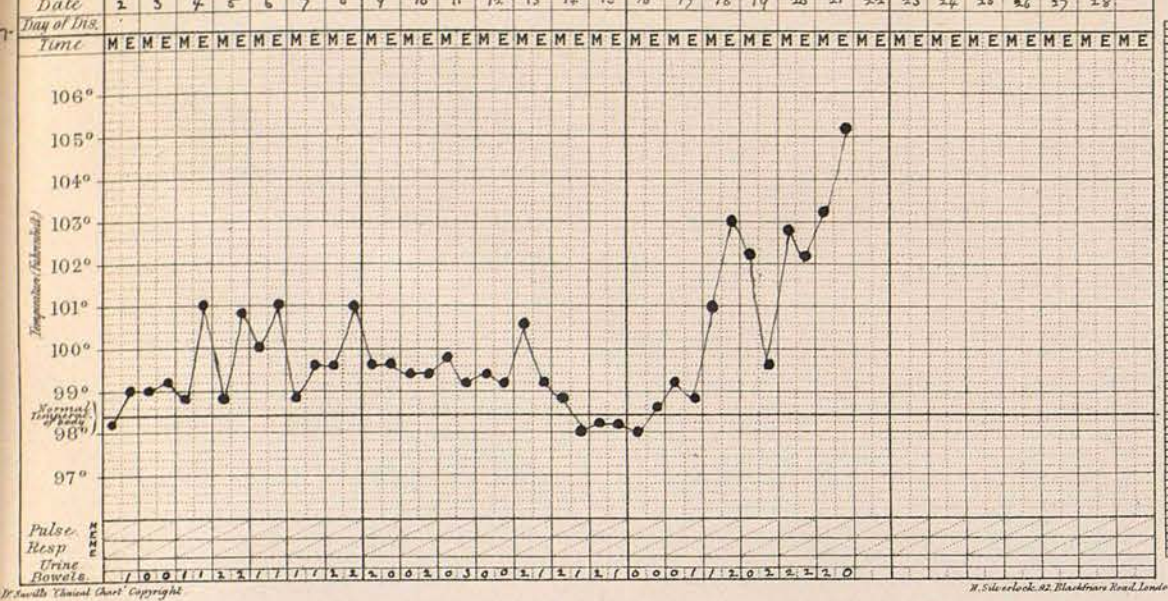
The brain showed a condition at the base of chronic lepto-meningitis, where there had been almost complete absorption of the exudate. The pia was thickened and the foramen of majendi was occluded causing a commencing internal hydrocephalous with dilatation of the ventricles.

The/

The cord showed some adhesion between the dura and the pia, and there was practically no exudate.

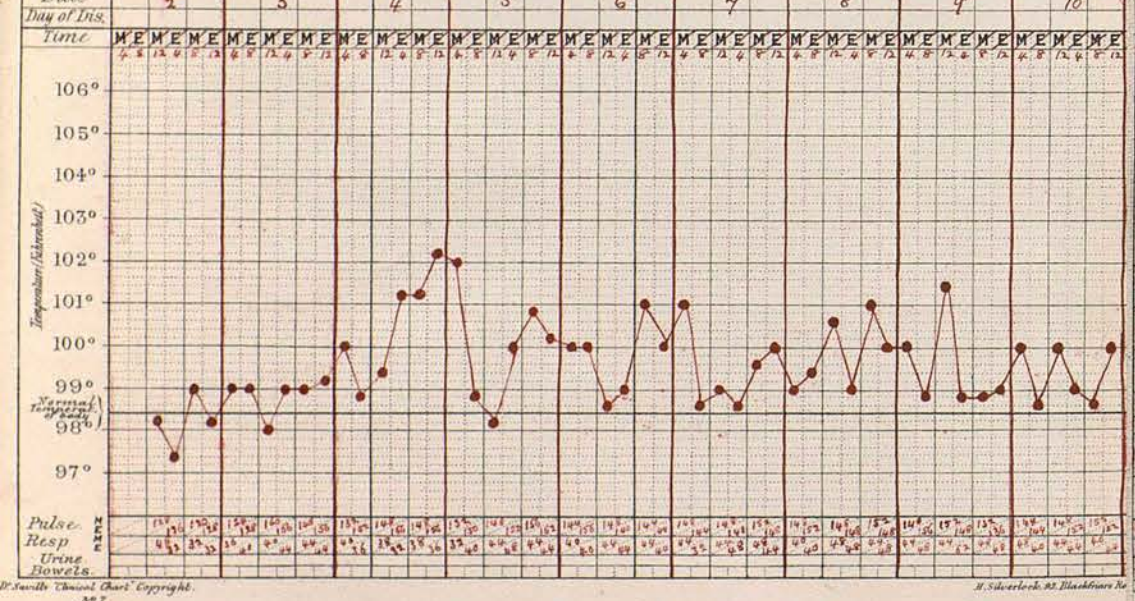
Permission for the examination of the brain and spinal cord only was given in this case.

Name *Norah Finigan* Age $\frac{10}{12}$ Years Disease *Epidemic Cerebro-spinal Meningitis* Result *Death*

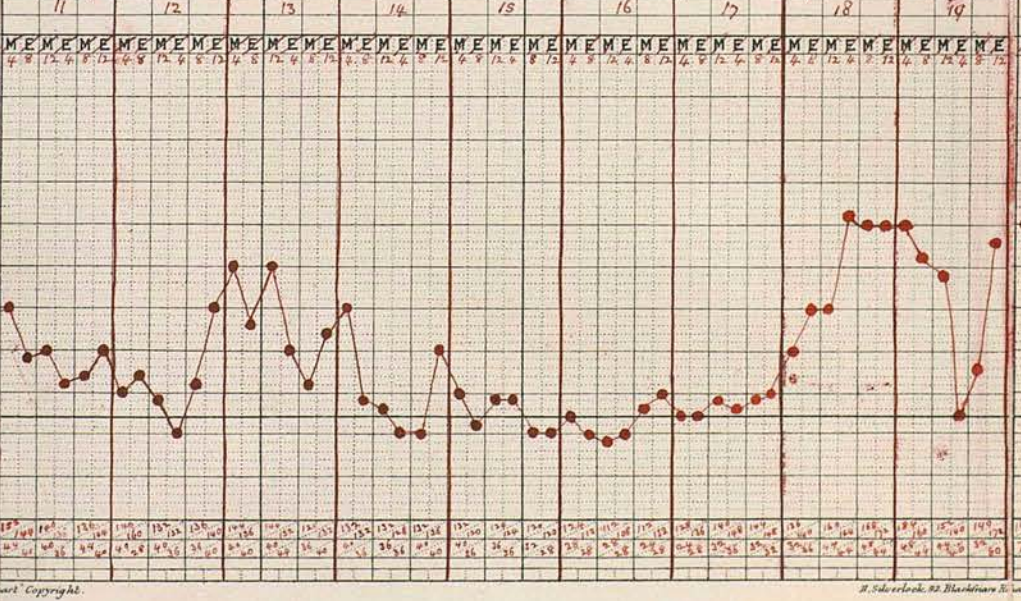


Case 8.

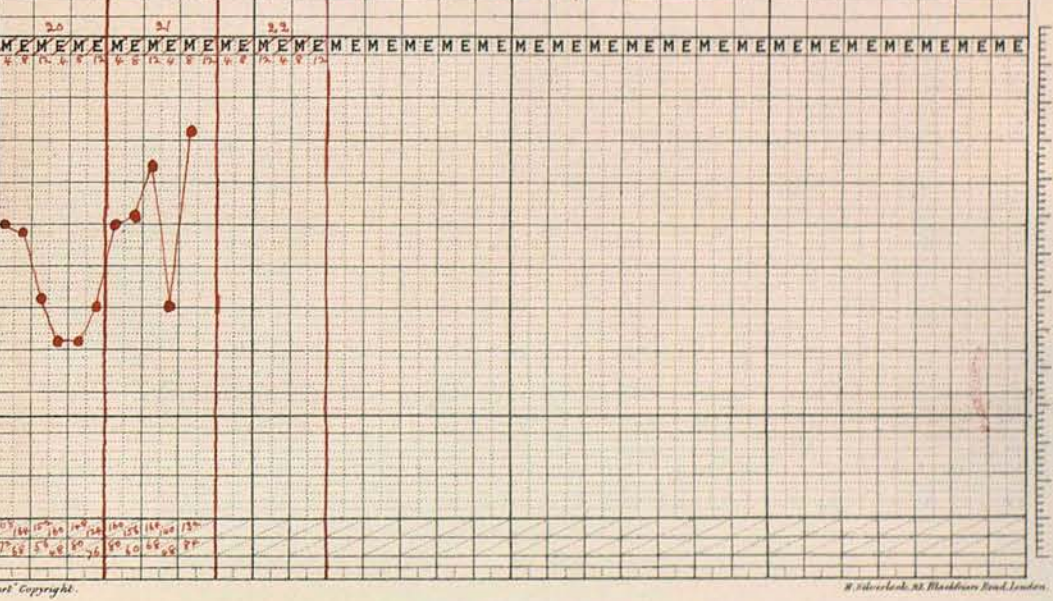
Name *Norah Finigan* Age $\frac{10}{12}$ Years Disease *Epidemic Cerebro-spinal Meningitis* Result *Death*



Name *Norah Finigan* Age $\frac{10}{12}$ Years Disease *Epidemic Cerebro-spinal Meningitis* Result *Death*



Name *Norah Finigan* Age $\frac{10}{12}$ Years Disease *Epidemic Cerebro-spinal Meningitis* Result *Death*



Case 8. Four hourly chart.

Case No. 9. Thomas Bingham. Aged $1\frac{5}{12}$ years.

Admitted. 2/2/07.

Complaint. Convulsions and irritability.

Duration of Illness. Since January 5th.

Family History. etc. The patient was the youngest of four children, the rest of whom were strong and healthy, as were the parents. The house consisting of 2 rooms was dry, sunny and well ventilated and the child had been getting out in fine weather.

Previous Health. The patient who had been breast fed had thriven well and had been a healthy child with the exception of measles when 11 months old. He had been a little drowsy for a week before ^{the} present illness commenced.

History of Present Illness. On the night of January 5 the child had an attack of vomiting and on the following morning seemed very drowsy, and had no appetite. He was kept in bed and that evening about 8 - 30 p.m. took a convulsion which lasted for several minutes. The next day January 7 he was very feverish, had a cough and slight diarrhoea. He was very drowsy and apathetic and at night became very feverish. He remained restless and feverish for a week and vomited frequently. The next week he was less feverish and had no vomiting but was still very restless and drowsy. Constipation was present from/

from the first, also a certain amount of head retraction. During the second week squinting had been frequently noticed.

State on Admission. The child who weighed 16 lbs, 14 oz. was fairly well developed but rather emaciated. He was very irritable, resented being disturbed and lay on his right side with his head markedly retracted. Although very restless and throwing his arms about he did not cry out unless disturbed. The face was slightly flushed and the skin which was warm and dry showed no eruptions, either herpetic or purpuric. The pulse which was 148 per minute and the temperature 99^o F. The abdomen was somewhat flattened and the skin was thrown into folds, the liver was slightly enlarged. The limbs showed no rigidity and no evidence of arthritis. The heart and lungs were normal. The fontanelle was bulging slightly and there was a slight rigidity of the neck and back. The eyes showed no strabismus and the pupils which were equal and of medium size reacted well to light; the child however was quite blind and took no notice of objects placed in front of the eyes. The plantar reflex gave a flexor response but both the cremasteric and abdominal were absent and the knee and achilles jerks were diminished. There was no hypertonicity of/

of the muscles of the limbs. The tongue was thickly coated and the patient was not swallowing readily.

The urine showed ^{no} abnormality.

The blood showed a red corpuscle count of 4330000, a white corpuscle count of 19800 and the glyco-genic reaction was present. The haemoglobin was 60%.

Progress. About 11 p.m. on the night of admission the child was lumbar punctured and from 15 to 20c.c. of turbid fluid escaped under considerably increased pressure. He remained very restless and irritable that night and an internal strabismus of the left eye was noticed occasionally, lasting for about 10 minutes at a time. He remained in much the same state for a few days, with head retraction and varying irritability. The swallowing was only accomplished with difficulty and a few days after admission champing movements of the jaw were noticed. There was no photophobia or Kernig's sign.

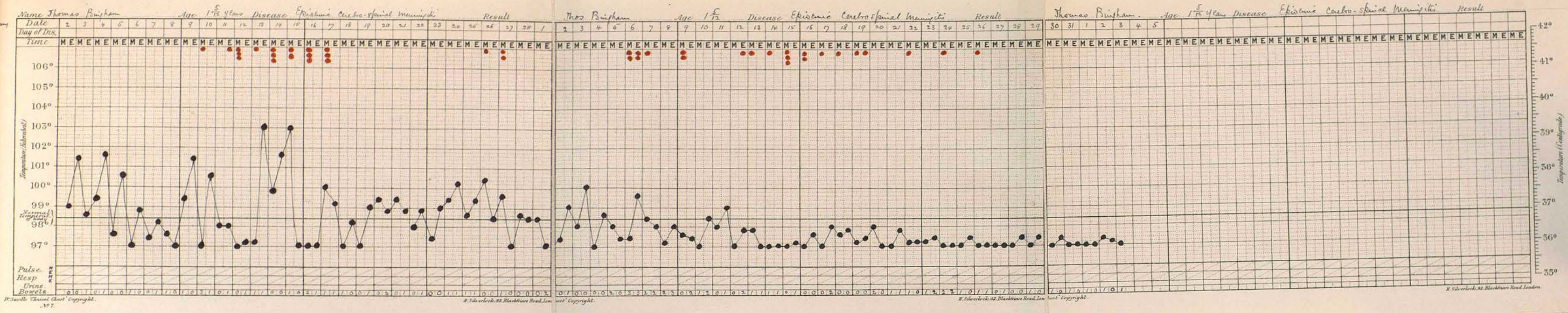
On February 10 the head retraction and the stiffness of the neck seemed less but as the child refused to swallow, feeding by means of the stomach tube was started. The patient was coughing a good deal but no signs of bronchitis were present.

On February 12 the patient could see again and the head was less retracted. During the next few days/

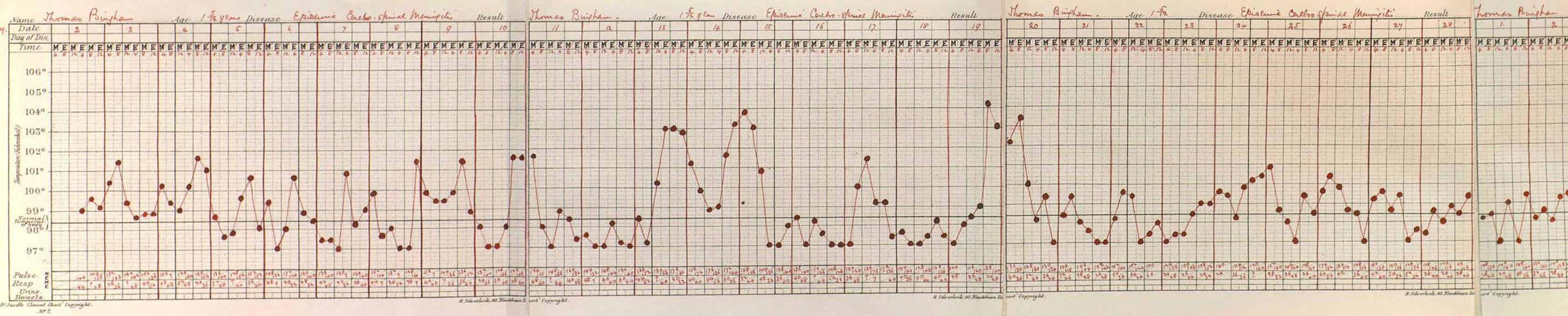
days he remained in much the same condition but the emaciation was now becoming very marked. He was quite conscious however and still refused to swallow. On February 19 a blotchy erythematous rash was noticed all over the trunk and this remained for about an hour and a half. During the next few days the child was swallowing well but was still irritable and quite deaf. He lay quite quiet for the most part with the eyes half closed but there was no photophobia. On the night of March 5th the child had a little diarrhoea with some blood streaked stools, vomiting was also present and continued occasionally for a few days.

On March 15 the abdominal reflex had returned but the knee jerks were absent. There was no Kernig's sign but the head was still retracted. The temperature was now keeping subnormal, and the pulse although small was quite regular. On March 31 the child appeared blind taking no notice of objects placed in front of the eye hearing however had returned. On two occasions the fundi were examined by Dr. Berry who found them to be quite normal.

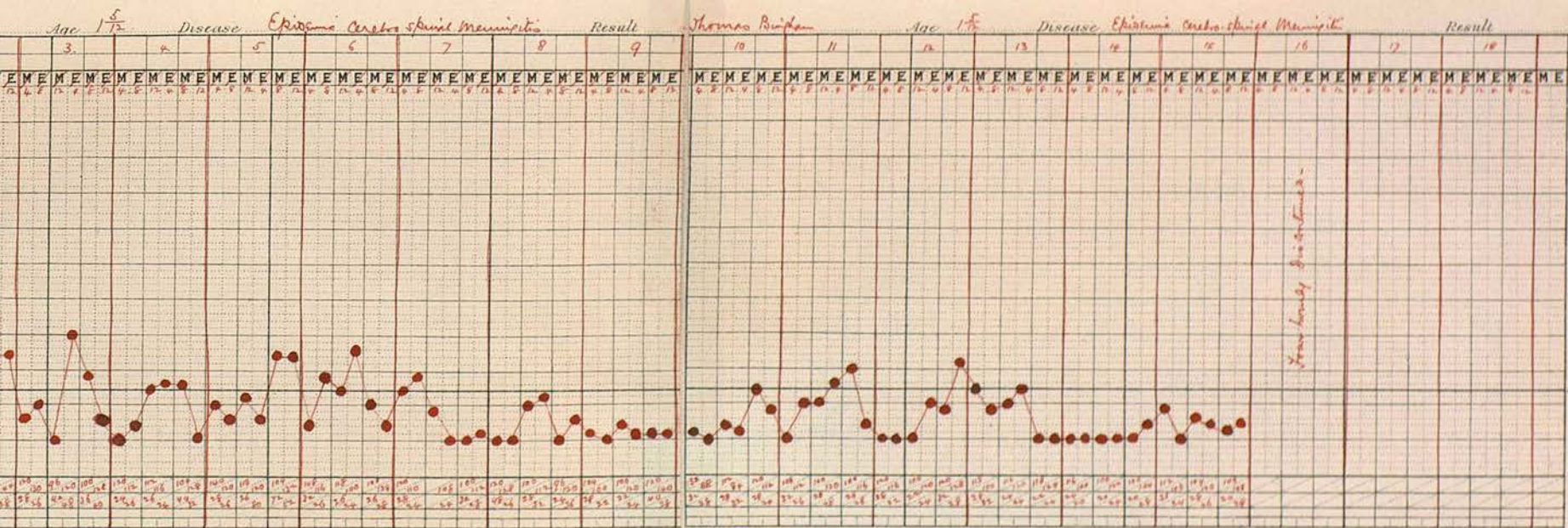
Temperature Charts.



Case 9.



Case 9. Four hourly chart.



Very lowly disturbance.

Case No. 10. James Curran. Aged 13 weeks.

Admitted 2/2/07. Discharged 5/2/07. Result Death.

Complaint. Screaming and convulsions.

Duration of Illness. Since January 25.

Family History etc. The patient was the last of 7 children, 5 of whom were stillborn. Both the parents were healthy but there was a strong history of consumption on the Mother's side. The house which consisted of one room, was well ventilated but the child had been seldom taken outside.

Previous Health. At birth the child was suffering from enlargement of the thyroid gland, and soon commenced to have snuffles. He was bottle fed and 3 weeks before present illness started had had an attack of diarrhoea lasting for 3 days. There was no history of bronchitis or otorrhoea.

Present Illness. On the morning of January 25 the patient cried a great deal and drew up his legs, apparently suffering from abdominal pain. There was no fever at this time and no diarrhoea. He remained thus until January 28 on which date convulsions accompanied by squinting commenced and recurred at frequent intervals until the night of February 1. On January 29 he became feverish and had some head retraction but there was no rigidity of the limbs, blindness/

blindness or constipation, the bowels being quite regular.

State on Admission. The child who was small but well nourished, was conscious but very irritable especially if handled, and lay with the head much retracted. There was considerable rigidity of the neck and back, and the limbs were in a state of complete flexion. The fontanelle was bulging slightly, the face flushed and the skin which was warm and moist showed no eruptions. The pulse was 188 per minute, regular in rythm but of small amplitude and low tension. The respirations were 60 per minute with moaning expiration. The temperature was 99.2°F. The abdomen was normal but the spleen and liver were both enlarged, the latter reaching the level of the umbilicus. The heart was normal but the lungs showed signs of congestion and there was a patch of pneumonic consolidation on the left side at the base. The plantar reflex gave a flexor response but the abdominal reflex was absent. Both knee jerks were elicited with difficulty the right being slightly more marked than the left. Kernig's sign was parkedly present and there was no paralysis. The pupils were equal, of medium size and/

and reacted to light. The child appeared to be quite deaf and made no response to noises produced close to the ear. The urine contained a trace of albumen. The blood showed red blood corpuscles to the number of 5000,000 and a leucocyte count of 12,600. The haemoglobin was 64%.

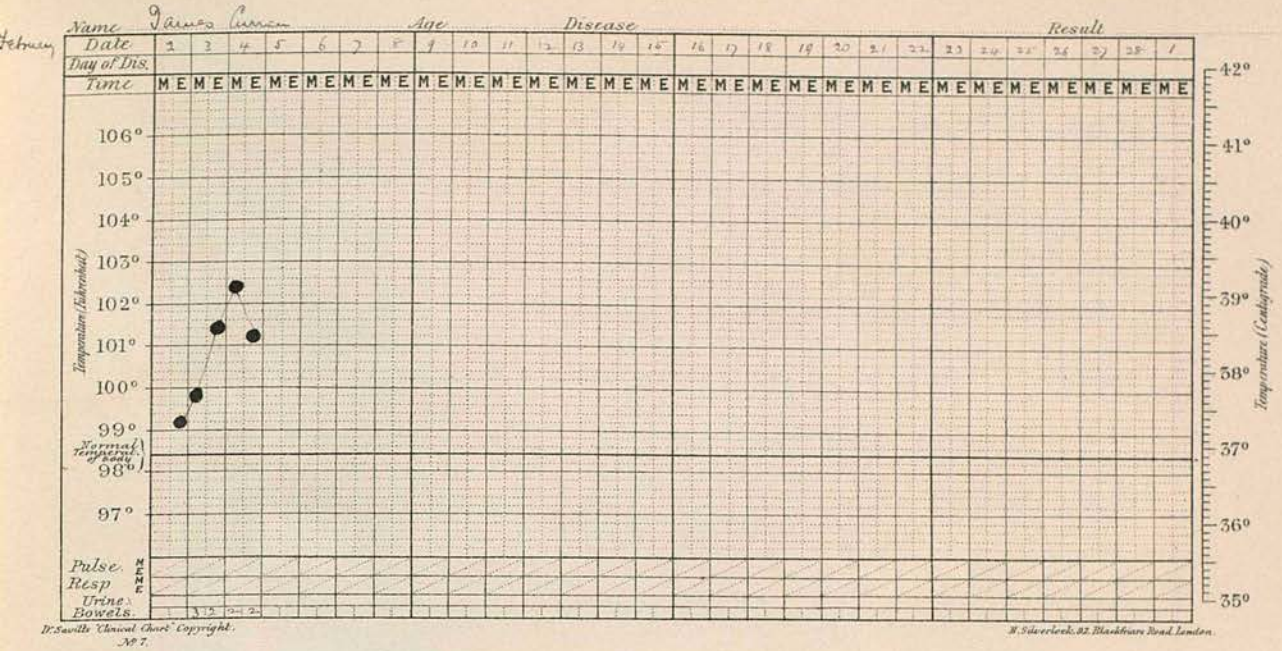
Progress. Shortly after admission the child had clonic contraction of the right extremities lasting about a minute. About 11 p.m. he was lumbar punctured and 4c.c. of slightly purulent fluid escaped, but not under tension. After this the child did not seem so restless and the tension in the fontanelle was lessened.

The following day February 3 after sleeping well through the night, the child seemed much the same, but towards evening had an attack of vomiting and the head retraction was more evident. During the following night he was very restless, the head retraction increased and the back became curved. The flexor spasm of the limbs was maintained. The eyes showed marked nystagmus but there was no squint. All through the following day February 4 was very restless, sweating copiously, the eyes staring and the head much retracted. Towards evening he had 2 convulsions of short duration. Death took place about 1-40 a.m. February 5th.

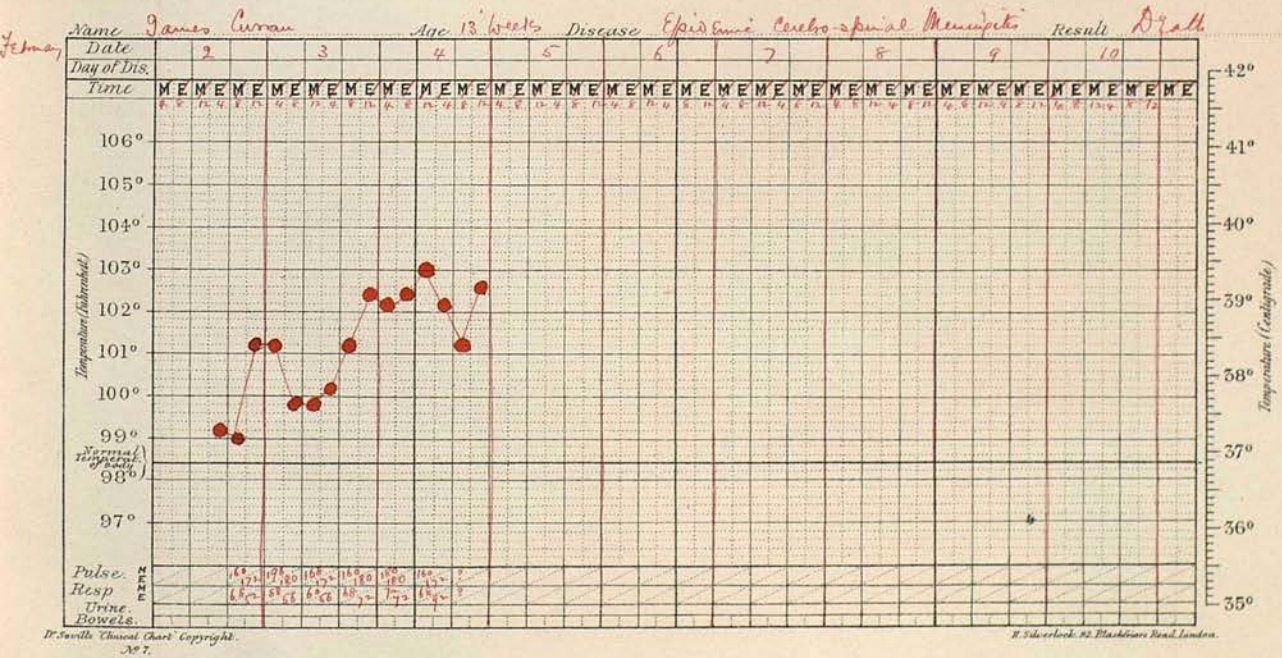
Post Mortem Examination.

The brain showed acute lepto-meningitis both basal and vertical. The convolutions were flattened, with dilation of the superficial veins. The purulent exudate was marked in the sulci. The cord showed pachymeningitis of its lower part, also a diffuse lepto-meningitis. The heart, liver and kidneys were pale on section and showed cloudy swelling. The lungs were congested and oedematous, with patches of lobular collapse and emphysema. There was an area of pneumonic consolidation at the base of the left lung. The bronchi were congested.

Temperature Charts.



Case 10.



Case 10.

Four hourly chart.

Case No. 11. Joseph Gilchrist. Aged 4 years.

Admitted 9/2/07. Discharged 11/2/07. Result death.

Complaint. Headaches and pain in the neck.

Duration of Illness. One day.

Family History. etc. The patient was the 5th of 6 children. Both the parents were healthy. The house which consisted of two rooms was well ventilated and the child has spent most of his time out of doors.

Previous Health. The child who had been breast fed, had thriven well and with the exception of an attack of measles a year ago had always been very healthy.

History of Present Illness. About 3 a.m. on

February 9 the patient who was suddenly taken ill with pain in the head and back, soon became fevered and delirious, raving all night and very restless. Later on in the morning as he was still feverish his mother brought him up to hospital. Previous to the onset of his illness the child had had a cough for about a week.

State on Admission. The child who was well

nourished and developed was perfectly conscious and sat up in bed complaining of severe frontal headache. There was no rigidity of the neck or any of the joints but the patient complained of pain all over the body and of great thirst. The skin all over the body was covered/

covered with small raised reddened spots slightly resembling measles but there was no herpetic eruption on the lips. The pulse was full, bounding and regular at the rate of 124 per minute, the volume being good but the tension poor. The respirations were 32 per minute and the temperature 102°F.

The abdomen was flat and scaphoid in shape and there was no enlargement of the liver or spleen. The heart and lungs were normal. As regards the superficial reflexes both abdominal and plantar were present and active. The knee jerks were also active but Kernig's sign was absent. The pupils were equal and dilated and reacted both to light and accommodation.

The blood showed a white corpuscle count of 36000 with a fairly well marked glycogenic reaction.

A specimen of urine obtained for examination showed nothing abnormal.

Progress. The patient passed a fairly quiet night and slept well, but had to be sponged as the temperature rose to 105°. The following morning February 10 the child presented quite a different appearance. The lips and cheeks were blue and the extremities were of a mottled purplish colour. A few of the spots noted on admission remained. Rigidity of the neck was slightly present but the head retraction remained absent/

absent. Kernig's sign was now markedly present. Both the knee jerks and plantar reflexes were now absent and there seemed to be some hyperaesthesia. Lumbar puncture was performed and 2 fluid ounces of cloudy cerebro-spinal fluid escaped under considerable pressure. Film preparations showed the presence of large numbers of intracellular and extracellular meningococci. After this the child's condition improved, but although still conscious he was very irritable, the tongue was heavily coated and the breath had a strong smell of acetone. He lay with his legs flexed on the abdomen and resented any attempt to change his position. Towards evening he became worse and the pulse became irregular and feeble. At 8 p.m. lumbar puncture was repeated and one ounce of fluid escaped after which the child seemed a little easier but was still restless and cried out occasionally.

During the night and early the next morning the child remained restless with quiet intervals. Lumbar puncture was repeated on three occasions and up to 9-15 a.m. on February 3 ounces of fluid had escaped, sufficient being removed on each occasion to allow the tension become normal. Towards noon the child became more restless, the breathing more laboured and the pupils contracted. Death took place about 12 p.m.

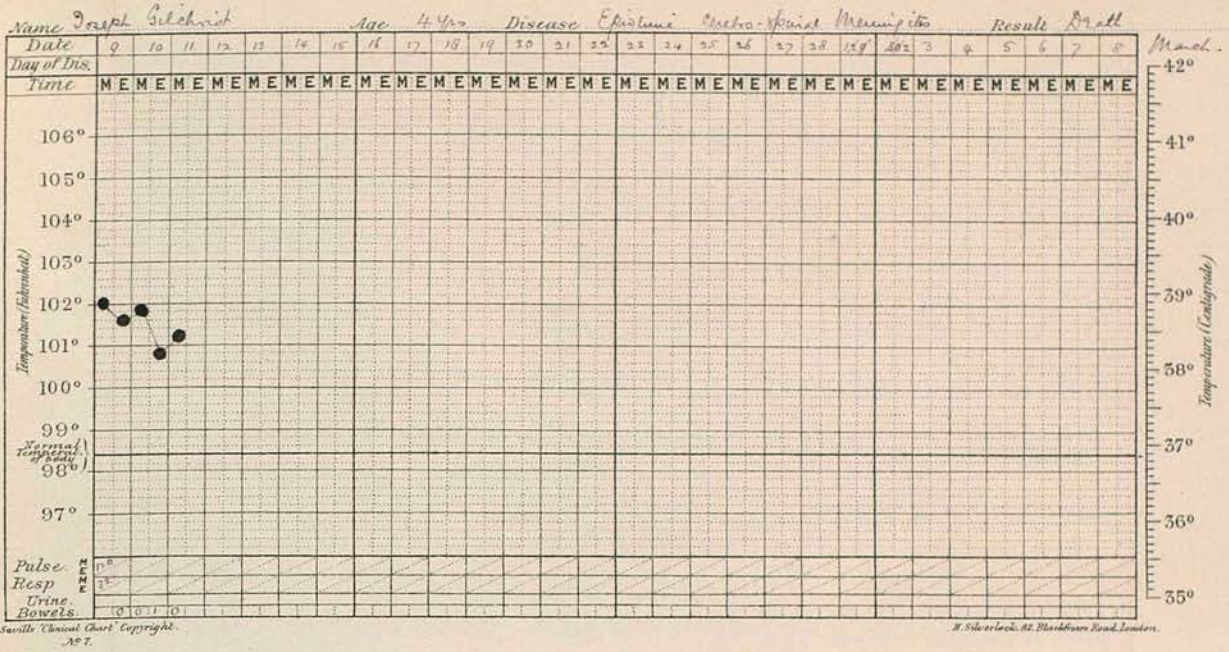
Post Mortem Examination.

The brain showed a well marked basal and vertical meningitis with marked hyperaemia. The exudate was irregularly distributed.

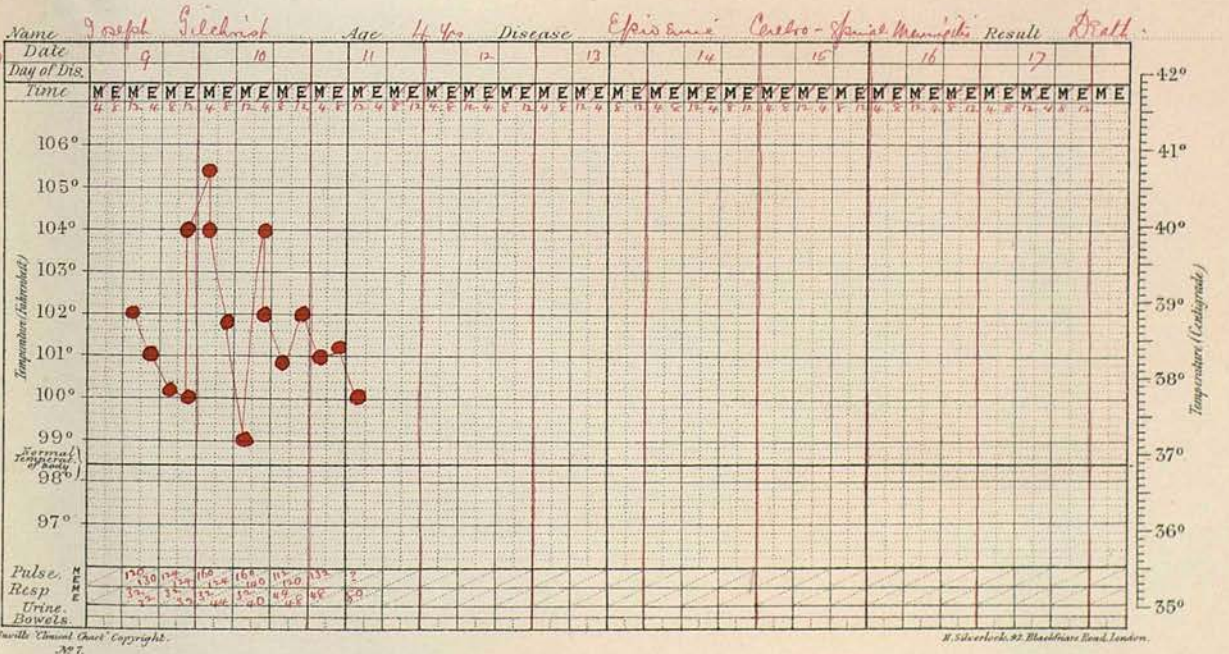
The cord showed an acute lepto-meningitis, the exudate was fairly generally distributed but there was little over the cervical and lumbar enlargements. The lungs showed marked broncho-pneumonia of the left lower lobe.

The other organs showed signs of acute toxaemia.

Temperature charts.



Case 11.



Case 11. Four hourly chart.

Case No. 12. Thaddeus Gaffney. Aged $2\frac{10}{12}$ years.

Admitted 20/2/07. Died in City Hospital

Complaint. Fever and unconsciousness.

Duration of Illness. 2 days.

Family History etc. The patient was the 3rd of 4 children, the rest of whom were healthy as were both the parents. The house which consisted of 2 rooms was well ventilated but the child had been getting out seldom.

Previous Health. The patient who had been breast fed had always been quite healthy except for slight alimentary trouble when cutting his teeth and an attack of diarrhoea lasting for a week, a month ago.

History of Present Illness. Up till the morning of February 17 the child had been quite bright but on this date he became very drowsy and dull. Early the following morning February 18 about 2 - 30 a.m. he vomited and retched for about five minutes. After this he slept well but on awakening later in the morning he appeared worse. About 10.30 a.m. he became unconscious and remained so until about 8 p.m. when he appeared to be quite blind but understood when spoken to. That night he slept well and on the following morning February 19 appeared to be a little better. He was conscious and could see quite well. Later on head retraction became present and towards evening/

evening he became very restless and noisy. That night he slept very little but on February 20 was quite conscious although still very restless. There was no constipation but the patient had a slight cough.

State on Admission. The child who was well developed and nourished lay on his right side with his legs flexed at the hip and knee. He resented very strongly any attempt to move him and seemed quite conscious of what was going on around him. The cheeks were slightly flushed and the skin generally was hot and dry but there was no eruption either purpuric or herpetic. There were a few petechiae like flea bites on the abdomen and inner aspect of the thighs. The pulse which was 124 per minute was of small amplitude and low tension. The respirations were 24 per minute and regular. The temperature was 100°F. The abdomen was healthy but the liver and spleen were slightly enlarged. The neck was rigid and the head retraction was well marked. As regards the limbs, the arms showed no rigidity or involuntary movements, the legs showed some hypertonicity in the attitude of flexion. There was evidence of slight rachitic change at the epiphyses of the long bones and some beading of the ribs. The heart and lungs appeared to be normal. The tongue was thickly coated posteriorly/

posteriorly and around the teeth was a copious mucopurulent secretion. Pain was caused when the head was flexed on the chest, otherwise, the child did not seem to experience it. As regards the superficial reflexes, both the plantar and cremasteric were healthy but the abdominal reflex was absent. The knee jerks were present but not increased. The pupils were equal, of moderate size and reacted to both light and accommodation. The urine contained a trace of albumen.

On the neck and behind the ears and the patient had a slight cough.

On March 13 the child looked a good deal worse and the rash had become general. The lungs showed signs of some asthma. Early in the afternoon the

child was transferred to the City Hospital suffering Progress.

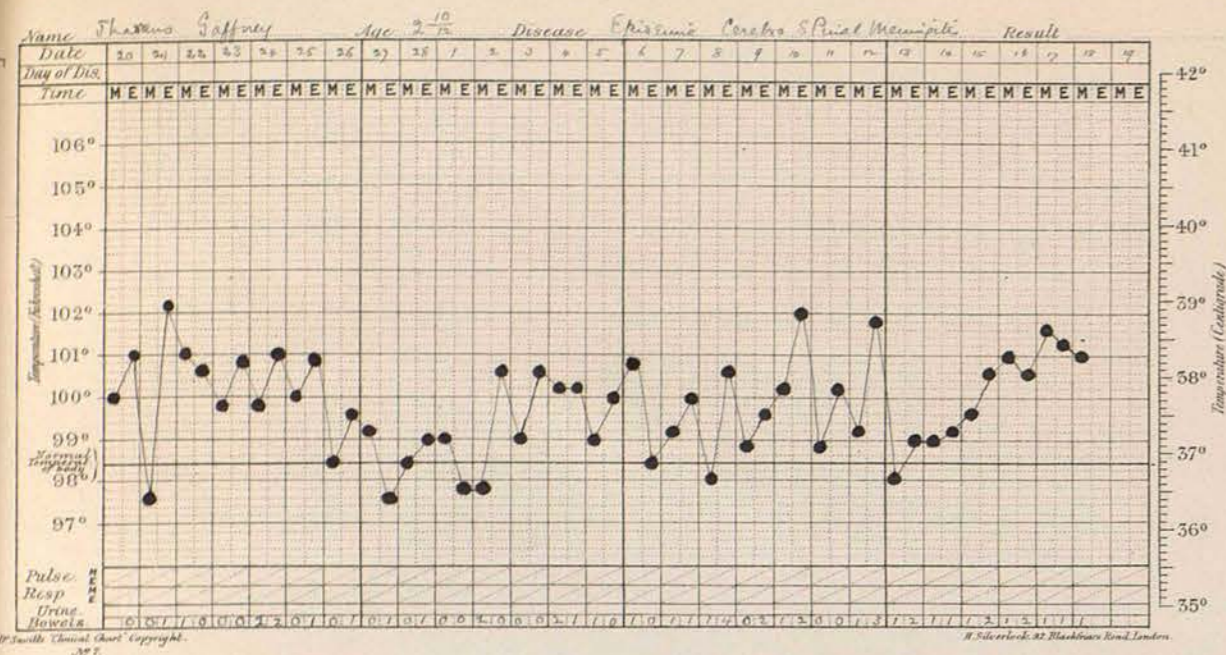
On the evening of the day of admission the patient was lumbar punctured and 10 c.c. of turbid cerebro-spinal fluid escaped under great pressure. On the following day after a very restless night during which he got very little sleep, the child seemed much the same and remained so for several days during which he was quite conscious with a varying amount of head retraction and irritability. He spoke occasionally and slept fairly well at night, taking his milk well and occasionally smiling. Kernig's sign varied slightly from day to day and by degrees/

degrees the child grew a good deal thinner. On March 15 the abdominal reflex had returned and although the child had become much thinner he was quite conscious and bright with no impairment of vision or hearing. Kernig's sign was marked but the head retraction, was only slightly present.

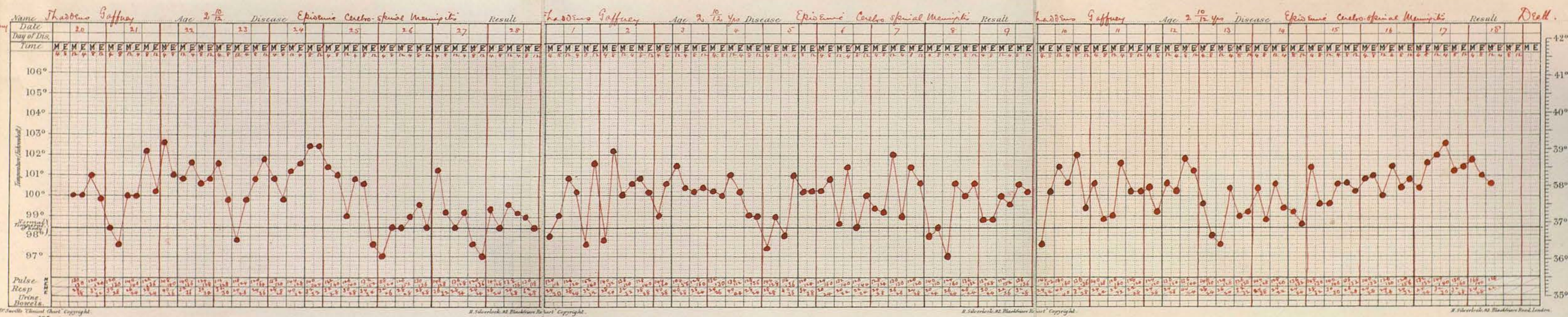
On March 17 the child seemed more irritable than he had been, the temperature was showing a marked gradual rise and about mid-day a discrete macular eruption was noticed on the neck and behind the ears and the patient had a slight cough.

On March 18 the child looked a good deal worse and the rash had become general. The lungs showed signs of some catarrh. Early in the afternoon the child was transferred to the City Hospital suffering from Measles in addition to his original complaint and died about 11-30 that night.

Temperature Charts.



Case 12.



Case 12. Four hourly chart.

Case No. 13. John Thomson, aged $2\frac{1}{2}$ years.

Admitted. 25/2/07.

Complaint. Vomiting, feverishness, thirst, heavy breathing and cough.

Duration of Illness. 3 days.

Family History, etc. There were two other children who were quite healthy. Both parents were also quite healthy, and there was no history of any hereditary disease. The house which consisted of 2 rooms was well ventilated but was on the ground floor and rather damp. The child had been out for the greater part of the day.

Previous Health. The patient who had been breast fed for six months and subsequently on a chiefly milk diet had thriven well and apart from an attack of measles when 13 months old during which he took several convulsions, had been very healthy.

History of Present Illness. On February 22nd the child was quite well when he went to bed and slept quietly until 10-15 p.m. when he awoke crying and vomited shortly afterwards. Subsequently he was very restless and thirsty and his hands were constantly moving even in sleep. On the following morning February 23 he was very drowsy and commenced to cough. He did not seem feverish until the evening when he became very restless and hot and the cough which/

which had become more severe prevented him from sleeping. About 9-30 p.m. head retraction was noticed but there was no rigidity of the limbs. All that night he was very restless and continued to be so all the next day, February 24. The cough was not present on this date but the child remained very thirsty and was constantly putting his hands down his throat. The breathing had become more rapid and there appeared to be some tenderness at the back of the neck on pressure in addition to the rigidity and head retraction. There was no history of any rash or convulsions.

State on Admission.

The patient who was well developed and nourished was quite conscious and lay on his right side with the lower limbs in an attitude of flexion. The thighs were flexed on the abdomen the legs on the thighs and the toes flexed on the soles of the feet. There was no cyanosis about the face and the skin which was warm and dry showed no eruption. When disturbed the child was very irritable and complained of pain in the back of the neck when the head, which was retracted was flexed on the chest. There was some rigidity of the neck and the back. The pulse which was 150 per minute was quite regular but of poor amplitude and tension.

The /

The respirations were 50 per minute and the temperature 99.2^o F. The abdomen was healthy and there was no enlargement of liver or spleen. The tongue was moist and irregularly coated posteriorly but there was no catarrh of the buccal cavity. The limbs showed no rigidity. The head of the ulnar on the right side there was a marked swelling over which the skin was glazed but there was no redness or fluctuation, pressure however ^{over it} caused the patient pain.

There were similar swellings over the dorsum of the right foot and at the junction of the lower and middle thirds of the tibia on the same side. The heart and lungs were normal. As regards the reflexes, the plantar gave a flexor response on both sides. The abdominal reflex was absent. Both knee jerks were absent. The pupils were equal, of medium size and reacted to both light and accommodation. The child was quite deaf but sight was unimpaired. A specimen of urine obtained for examination showed nothing abnormal.

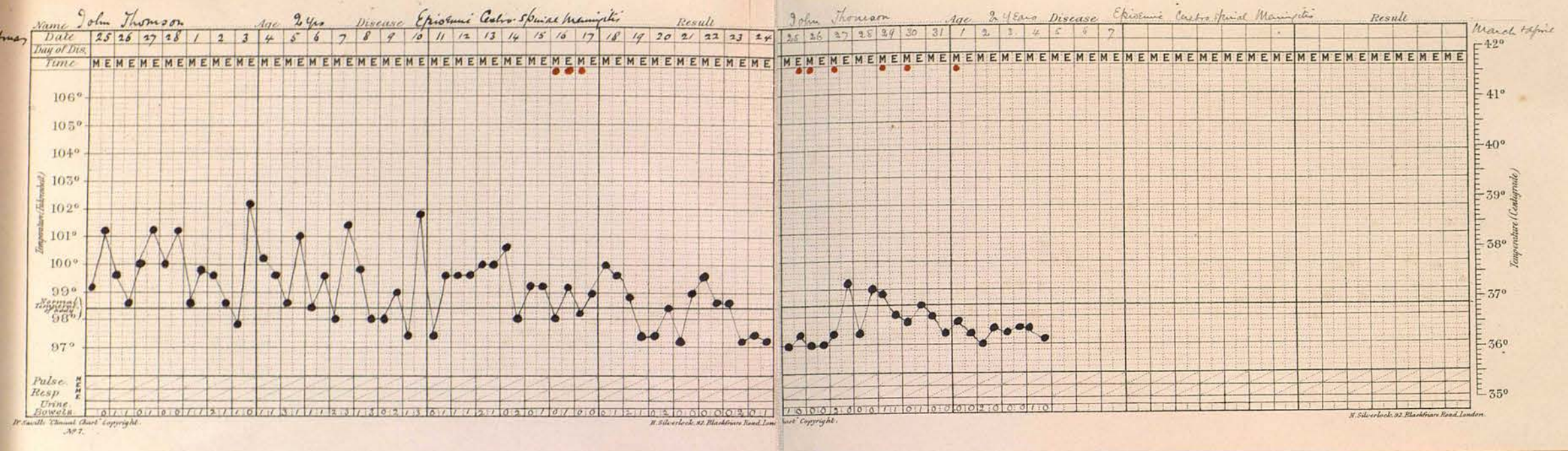
Progress. About 5-30 p.m. on the day of admission the patient was lumbar punctured. But no fluid could/

could be obtained. A film preparation, however, made from a small flake of exudate blacking the lumen of the needle showed large numbers of meningococci many of which were intracellular. On careful examination of the joints definite swelling with some glazing of the skin over it was found, behind the right **external** malleolus, over the distal interphalangeal joint of the right fore finger, and both knees especially the left had an excess of fluid within the joint cavity. On the following day there was some swelling around the right elbow joint, the patient's condition otherwise very much the same. On the following day February 27 a patch of herpes had broken out on the chin, the joints were more swollen and at the right wrist joint the swelling now involving the whole joint had become more marked on the dorsal aspect. The child was conscious, asked for anything he wanted, and recognised his parents. The fundi examined by Dr. Berry showed nothing abnormal. On February 28 the left knee joint was explored with an hypodermic syringe and a few drops of pus were obtained.

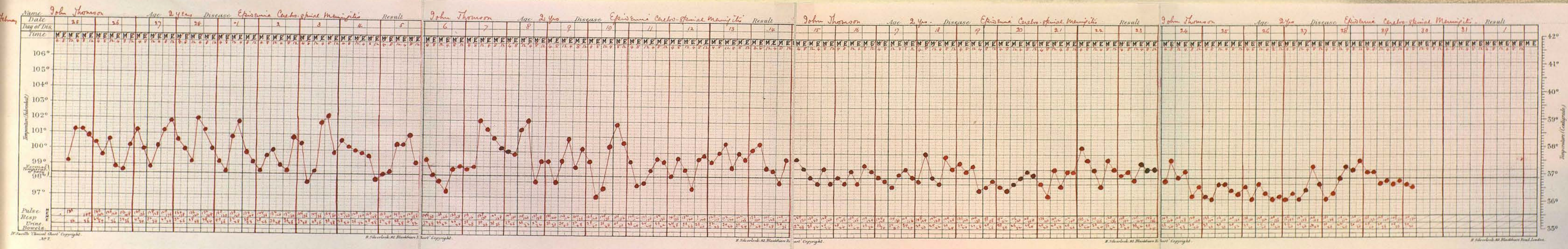
On March 2 the child was much the same but although the neck was stiff flexion of it did not seem to pain him and there was no head retraction. Kernig's/

Kernig's sign was well marked on both sides. The joint conditions seemed much the same. On March 5 the swelling in the joints was less marked, Von Graefe's symptom was present at times and both the knee jerks and abdominal reflexes were absent. On March 7 the joint swellings etc. had almost entirely disappeared and the moving of the limbs seemed to cause the patient less discomfort. The child was not restless, took food well and sight was unimpaired. On March 12 the patient was not seeing so well and was rather apathetic. The neck was still stiff but there was no head retraction.

On March 14 the conjunctiva was visible all round the cornea, the child was now quite blind and Kernig's sign was slightly present. The swellings had completely disappeared and the pulse was of low tension and showed some irregularity. On March 16 the epigastric reflex had returned and until the end of the month the child's condition remained much the same. He had grown steadily more emaciated and was now very much wasted. Was swallowing well but remained quite blind and deaf. There was no increase in the size of the head.



Case 13.



Case 13. Four hourly chart.

Case No. 14. John Lister. Aged $3\frac{1}{2}$ years.

Admitted 25/2/07. Died City Hospital 26/2/07.

Complaint. Delirium and vomiting.

Duration of Illness. 3 days.

Family History etc. Both the parents were alive and healthy. The house was dry and well ventilated but sunless. The child had been getting out every day.

Previous Health. Having been brought up on the breast the boy had thriven well and with the exception of chicken pox when $1\frac{1}{2}$ and measles when $2\frac{1}{2}$ years old had always been quite healthy. There was no history of otorrhoea but the child had been wetting the bed at night occasionally and this condition had been more marked since the present illness started.

History of Present Illness. About 6 p.m. on February 22 the child became very drowsy and went early to bed. Previously to this the child had been rather thirsty for a day or two and easily tired. After being asleep for a couple of hours he awakened, and started to vomit complaining at the same time of severe frontal headache. He was very irritable if disturbed and continued to vomit at intervals all through the night. The vomiting continued all/

all the next day February 23 and during the evening the child became unconscious and wildly delirious. All that night he was very noisy and lay tossing about with flushed cheeks, occasionally grinding his teeth and seemed thirsty. On February 24 he remained very restless and delirious, vomiting occasionally, until 6 a.m. on day of admission.

State on Admission. The child was well developed and nourished, and when admitted lay in a state of wild delirium, constantly crying out and grinding his teeth with great force every few minutes. The face was flushed, the eyes sunken, and the nose filled with sordes. There was no sign of herpes nor was there any rash purpuric or otherwise on the skin which was hot and dry. The breath was foul and the tongue was dry and thickly coated with fur, the papillae being prominent. The respirations was 33 per minute and regular. The pulse 103 regular but of poor volume and tension. The temperature was 99.4°F. The abdomen was not retracted and there was no enlargement of liver or spleen. Head retraction was absent. There was a marked rigidity of the muscles of the neck, but no paralysis or hyperbonicity of the limbs. The heart was normal but the child had a slight cough and the lungs showed a slight degree of bronchitis/

bronchitis. The plantar reflex was normal but the abdominal reflex was absent. Both knee jerks were active and Kernig's sign was well marked. The blood showed red corpuscles to the number of 5620000 and a leucocyte count of 24500 with a fairly well marked glycogenic reaction. A specimen of urine obtained shortly after admission showed no trace of albumen.

Progress. Shortly after admission patient was lumbar punctured and a small quantity of turbid cerebro-spinal fluid was withdrawn by means of a syringe. On examination the fluid was found to contain a great many polymorph leucocytes and a few meningococci. The child continued to be very irritable, screaming out occasionally especially if disturbed and rubbing his nose and mouth with the back of his hands, the fingers of which he sometimes bit. After being removed to the City Hospital in the afternoon the child seemed to get rapidly worse. 25 c.c. Burroughs, Wellcome & Co.'s serum was injected about 9-30 p.m. but no improvement was noticed and child died on the following morning February 26 about 11 a.m.

Post Mortem Examination.

Brain/

Brain showed a well marked basal meningitis. There was some purulent lymph in the arachnoid cistern, well marked over the optic chiasma and on the under surface of the cerebellum and frontal lobes. The convolutions were much flattened and the superficial veins distended.

The cord showed a well marked and very uniform purulent meningitis over its whole extent.

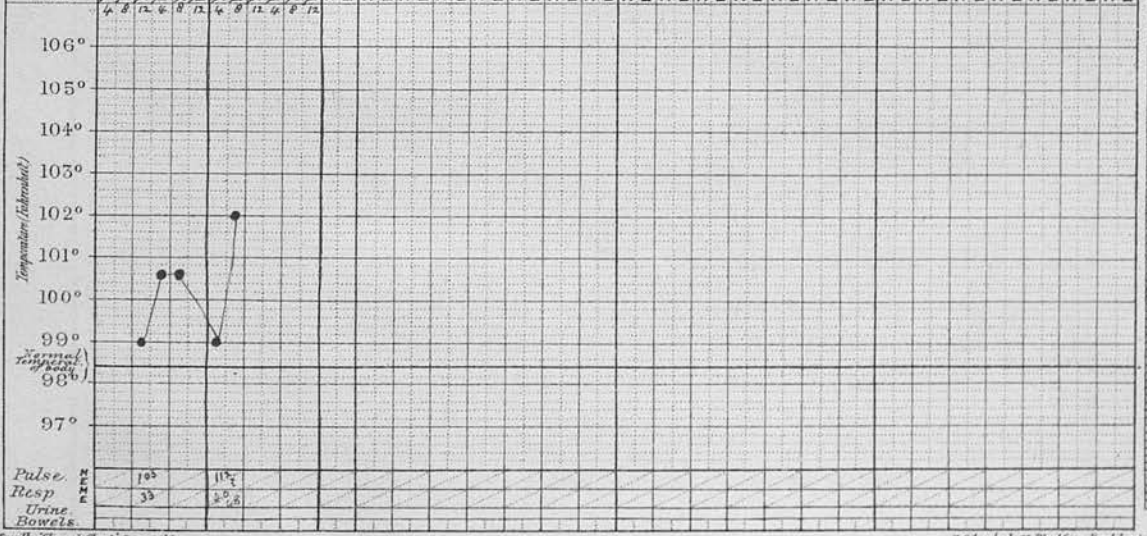
The heart showed no petechiae on the surface, the muscle was pale and showed cloudy swelling.

The lungs showed great venous congestion and oedema but no distinct pneumonic consolidation.

All the other organs showed signs of acute congestion and toxic change.

Name *John Lister* Age *3 1/2* Disease *Epidemic Cerebro-spinal Meningitis* Result *Death*

Date *25* *26*
Day of Ills.



Case 14. Four hourly chart.

Case No. 15 Allan Gordon, Aged 4 years.

Admitted 27/2/07. Died City Hospital 28/2/07.

Complaint. Feverishness and Shaking.

Duration of Illness. 2 days.

Family History etc. The patient was the 11th of 13 children, 3 of whom had died of pneumonia and one of abdominal tuberculosis. Both the parents were healthy and the house which consisted of two large rooms was dry and well ventilated.

Previous Health. The child had been breast fed and had thriven well. When about 2 years of age he had had measles followed by otorrhoea and was also slightly rickety at this time.

History of Present Illness. After breakfast on the morning of February 25 the child was drowsy and dull, and remained so all day; he was also very thirsty. He slept well that night and the following morning he had a severe shivering and trembled a great deal when handled. During the afternoon February 26 he had two attacks of vomiting and later on in the evening became delirious and cried out constantly that he was falling, at other times that he wanted a drink. All through the night he remained very restless and endeavoured to get out of bed but did not seem to see where he was going.

State on Admission. The Patient who was well developed/

developed and nourished lay in a delirious and very restless condition, crying out when handled and grinding his teeth forcibly every few minutes. There was very marked stiffness of the neck and to a less extent of the back, while the head was slightly retracted. The arms and legs were flexed and slightly rigid, the former showing the clasp knife phenomenon. The eyes were wide open and staring, the pupils equal and of moderate size and reacted sluggishly to light. The face was dusky and slightly cyanosed especially about the lips but there were no purpuric spots of herpes. The pulse was 148 per minute, irregular in rhythm and of poor volume and tension. The temperature was 98.6°F. The heart and lungs were apparently normal. The plantar reflex gave a flexor response with jerking of the whole limb, the abdominal reflex was absent. Both knee jerks were elicited with difficulty and Kernig's sign was absent. The blood showed a white corpuscle count of 32,000 with a well marked glyco-genic reaction. No specimen of urine was obtained for examination.

Progress. About 4 p.m. on the day of admission the child was lumbar punctured and 20 c.c. of turbid cerebro-spinal fluid escaped under considerable tension/

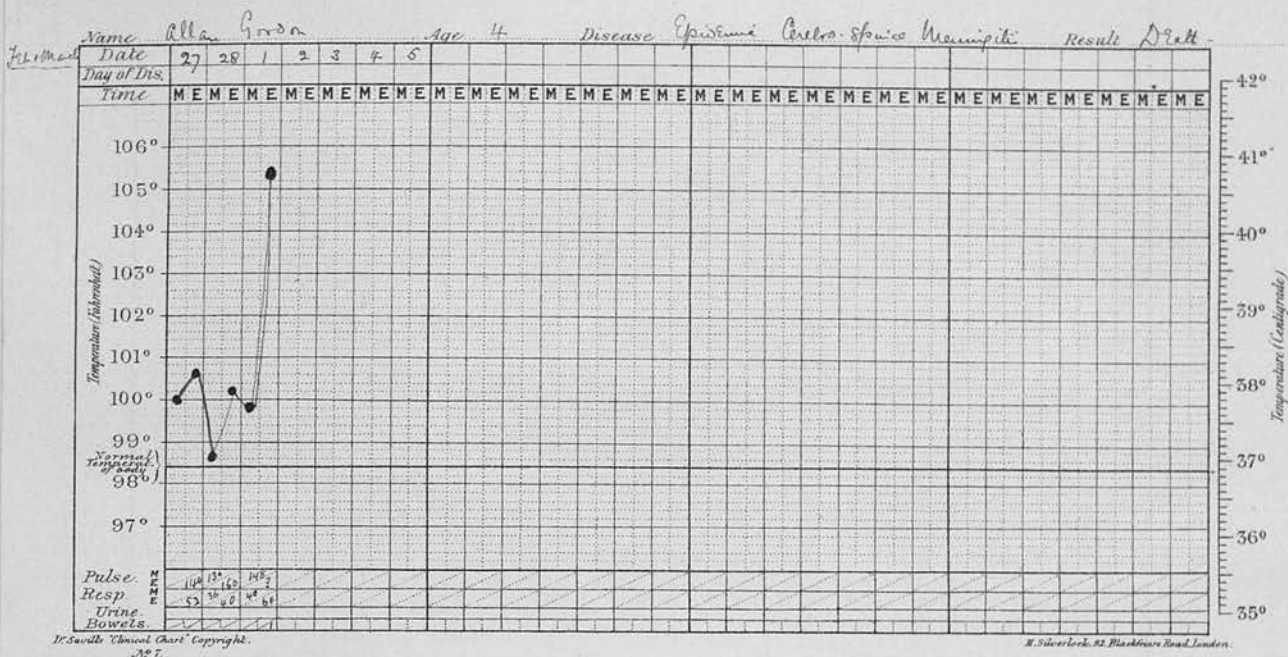
15
tension. Film preparations of the fluid showed many cells mainly polymorphs and great numbers of meningococci many of which were intracellular. Later on the child was sent to the City Hospital where 10 c.c. Kolle's serum was injected subcutaneously every 2 hours. The following day the patient was weaker but there was no increase in the amount of head retraction. During the afternoon the breathing became more rapid and laboured and death took place about 8 p.m. February 28th.

Post Mortem Examination.

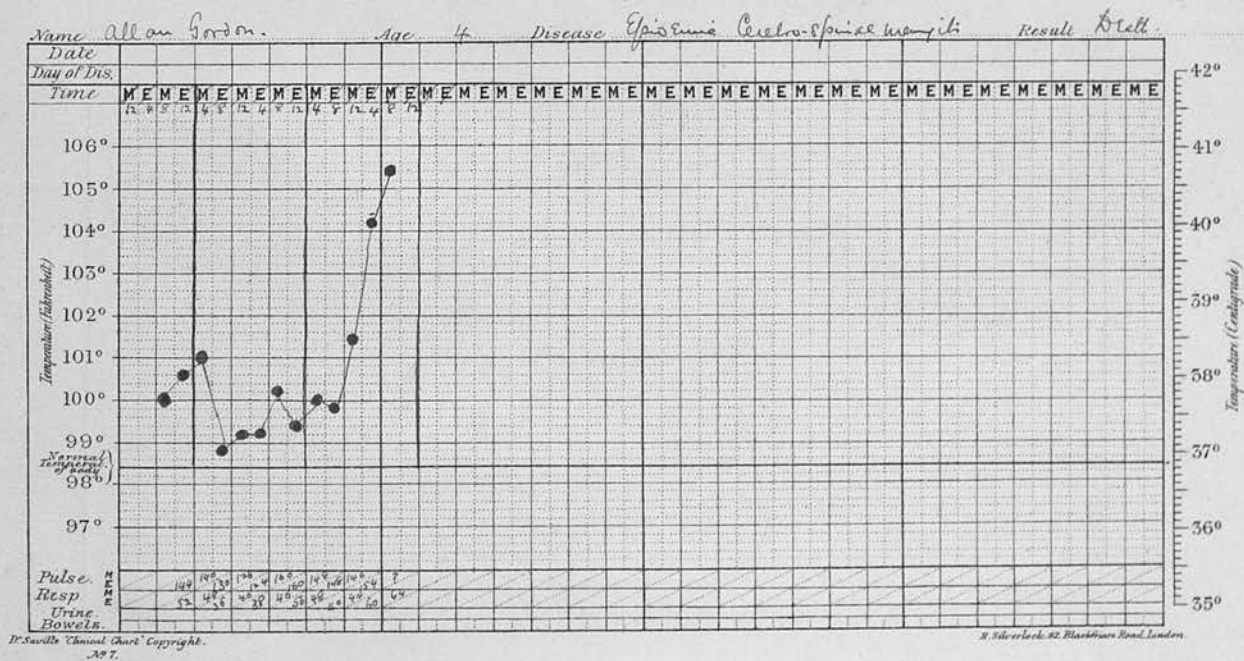
The brain showed a well marked basal meningitis with delitiation of the superficial veins. The cord was uniformly covered with a thick yellow gelatinous exudate within the pia arachnoid throughout its whole extent.

The heart, liver and kidneys showed signs of acute toxic poisoning.

Temperature Charts.



Case 15.



Case 15. Four hourly chart.

Case No. 16. Alfred McLeod. Aged 6 years.

Admitted 28/2/07. Died in City Hospital 2/3/07.

Complaint. Pains in the head, vomiting and of a purple rash all over the body.

Duration of Illness. 24 hours.

Family History etc. Patient was the 10th of 11 children, 2 of whom has died of measles and 1 of pneumonia. Both parents were alive and healthy. The house was dry and well ventilated and the child had been out every day.

Previous Health. After being brought up on the bottle the child had thriven well and with the exception of measles and whooping cough when about 3 years old had always been healthy.

History of Present Illness. On February 27, he awakened, complained of severe headache and had no appetite. The mother said he seemed dull and strange looking. He was thirsty and very drowsy, sleeping at intervals all day. In the evening he became very restless and commenced to vomit about 7 p.m. and continued to do so for about 2 hours. When the vomiting ceased the child became quieter for a time but became very restless and delirious about 1 a.m. the following morning. The spots which started on the buttocks made their appearance about/

about 11 p.m. on the night of February 27.

State on Admission. The patient who was a well developed and well nourished boy was unconscious and delirious, screaming out occasionally and very irritable if disturbed. The face was flushed, dusky and had a slightly cyanotic tint. The skin which was hot and dry had a well marked purple purpuric rash all over the body but most marked on the inner side of the thighs and on the front of the chest and abdomen. The spots varied greatly in size and shape being irregular and up to $\frac{1}{2}$ inch in diameter. Over the left knee there was a large bruise like mark about the size of a crown piece. The pulse was 130 per minute of fairly good volume but of very poor tension. The respirations were 47 per minute and regular. The Temperature was 99° . The tongue was heavily coated with a thick white fur and the breath was very foul. No herpes were present on the lips or elsewhere and the abdomen seemed natural in shape. The neck was slightly rigid but there was no head retraction nor was there any sign of paralysis or squint. The pupils which were equal in size and moderately dilated, reacted slightly to light.

The/

The child was quite blind. The heart was normal, but the lungs showed signs of slight bronchitis. As regards the superficial reflexes the abdominal was absent and stimulation of the plantar reflex gave marked Babinsky. Both knee jerks were active but the ankle jerks were very dull. Kernig's sign was markedly present. Examination of the blood showed a leucocytosis of 24,900 per cubic millimetre with a fairly well marked glycogenic reaction. There was no trace of albumen in the urine.

Progress. Shortly after his admission about 10-30 a.m. the child was lumbar punctured and 10cc. of turbid cerebro-spinal fluid escaped under increased tension. Film preparations of the fluid showed chiefly polymorph cells, and a few typical meningococci, some of which were within the cells. In the early part of the afternoon he was removed to the City Hospital and became very restless with a slight degree of head retraction. At 5-15 p.m. $12\frac{1}{2}$ c.c. Burroughs, Wellcome & Co.'s antimeningococci serum was injected subcutaneously and an hour later the same procedure was carried out. After this the pulse seemed stronger, and there appeared to be some improvement.

During the night he slept fairly well at intervals, at other times he was working with his arms//

arms, and wailed occasionally, the face being flushed but there was no increase in the amount of head retraction. On the following day March 1 no fresh haemorrhages could be seen the pulse seemed fuller and bounding, but the breathing was more laboured. During the evening 25c.c. of the serum was injected. Next morning the patient was a good deal worse, the pulse could not be felt and there was a good deal of tremor associated with the working of the arms which still continued. Patient got gradually weaker and death took place about 5 p.m.

Post Mortem Examination.

Brain showed a marked degree of basal meningitis the optic chiasma and under surface of the cerebellum were especially involved. There was also some purulent lymph in the sulci and to a less extent on the under surface of the temporal and frontal lobes.

The superficial veins were greatly congested.

The spinal cord was uniformly covered with a thick yellow purulent exudate.

The heart showed some minute petechiae on the surface.

The liver and kidneys showed cloudy swelling and toxic change.

The lungs showed an extreme degree of congestion and there/

there were small areas of capillary bronchitis and broncho pneumonia. Over the surface of the left lung there was a small amount of purulent lymph.

Case No. 17. Charles McKenzie. Aged $2\frac{5}{12}$ years.

Admitted 28/2/07. Died in City Hospital 2/3/07.

Complaint. Fits, feverishness and slight cough.

Duration of Illness. 4 days. very restless condition

Family History etc. The patient was the youngest of 4 children. Both parents were quite healthy. The house which consisted of 2 rooms was sunny, dry and well ventilated and the child had been getting out every day. The patient was a very well

Previous Health. He had been fed on the breast and with the exception of scarlet fever a year ago had always been a very healthy child. In a marked cyanotic

History of Present Illness. Early on the morning of February 25 about 12-30 a.m. the child started to vomit, became restless and feverish and complained of pain in the forehead. The vomiting which was hot, accompanied with a good deal of retching continued at intervals until the following morning. All through the day he remained very restless and feverish with a slight cough and marked constipation. On the morning of February 26 the child commenced to take fits of about one minute duration and which continued at varying intervals until admission. Next day February 27 the child was still very restless and irritable, complaining of great thirst, and grinding the/

the teeth loudly at intervals of a few minutes. The mouth became very foul, and the tongue thickly coated. Herpes broke out over the lips and left nostril and the child lay in a very restless condition crying out every now and then especially if handled. All that night and the next morning the symptoms remained much the same until about 2 p.m. on February 28, when he became quite unconscious.

State on Admission. The patient, ^{who} was a very well developed child was in a semi-comatose condition but very irritable and crying out loudly when handled. The face was flushed and dusky, with a marked cyanotic tint. The lips were swollen and raw looking, and covered with dried blood and herpes. There was also a crop of herpes around left nostril but there were no purpuric spots on the skin which was dry and hot. The pulse was 170 per minute, very feeble and rapid, but regular and of low volume and tension. The respirations were 52 per minute and rather laboured, with marked rattling in the throat owing to the mucous which had accumulated in the trachea. The temperature was 101.4°. The abdomen seemed healthy and there was no enlargement of liver or spleen. The breath was very foul and the buccal cavity was covered with a muco-purulent secretion. Head retraction was absent/

absent but there was considerable rigidity of the neck and back. The limbs showed no rigidity or paralysis but Kernig's sign was very marked. The heart was healthy, the lungs however showed marked signs of bronchitis but no area of consolidation could be made out. The plantar reflex gave very definite Babinsky on both sides and the abdominal reflex was absent. Both knee jerks were active, the achilles jerks could not be elicited. The pupils were equal, dilated and reacted slightly to light, no blindness or strabismus was present.

On examination the urine was found to contain a distinct trace of albumen. The blood showed a leucocytosis of 21266 and a red corpuscle count of 4320,000. The glycogenic reaction was fairly well marked.

Progress. About 6-30 p.m. on the day of admission the patient was lumbar punctured and a small quantity of yellowish turbid fluid was obtained by means of a syringe attached to the needle. A film preparation of the fluid showed many polymorph cells and a few typical meningococci, Several of which were within the cells. On the following day after remaining much the same during the night, the child seemed more comatose/

comatose and a slight degree of head retraction was present in addition to the other symptoms all of which remained well marked. On being removed to the City Hospital later in the day the patient's condition got gradually worse and death took place about 11-30 a.m. on the following morning.

Post Mortem Examination. A well marked exudation was present at the base of the brain especially around the optic chiasma and posterior arachnoid system. The cord showed a very uniform thick yellow exudate from the base of the cervical enlargement downwards.

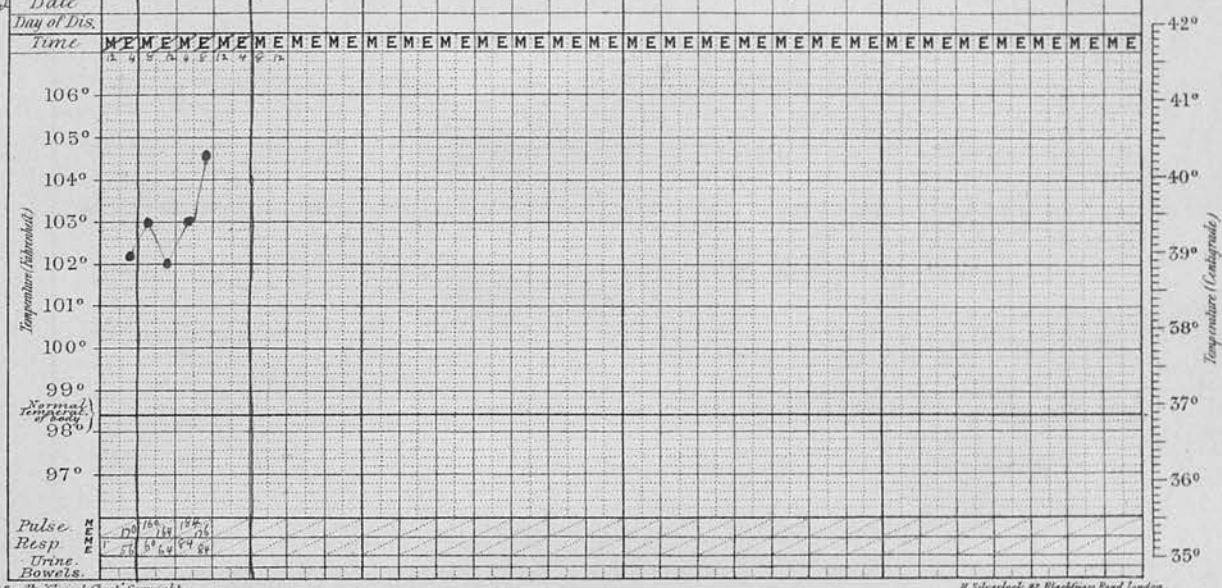
The lungs showed areas of broncho-pneumonia congestion and oedema, with marked congestion of the bronchi. The heart, liver and kidneys showed marked cloudy swelling and toxic change.

The mesenteric glands were increased in size and hyperaemic, while the intestine showed some catarrh.

Temperature Chart.

Case No. 17. Epidemic cerebro-spinal meningitis. 1894-5 years.
Admitted 7/4/07.

Name Charles W. Kuzie - Age 2 ⁵/₁₂ Disease Epidemic Cerebro-spinal Meningitis Result Death



D. Saville Clinical Chart Copyright No. 7.

H. Silverlock 82, Blackfriars Road, London.

Case 17. Four hourly chart.

... to her home by ... there was ... of this ... had been ... since the ...

The patient was very well developed and well nourished ... quite conscious ... on her right side with her knees drawn up and ... was slightly pointed. The face was pale but

Case No. 18. Elizabeth Carlotti. Aged $\frac{7}{12}$ years.

Admitted 4/3/07. Died in City Hospital 7/4/07.

Complaint. Restlessness and cough.

Duration. 7 days.

Family History, etc. The parents were healthy as were the other children two in number. The house which consisted of one room was dry and well ventilated but the child had been getting outside very seldom.

Previous Health. The patient had been bottle fed and had thriven well until she was 5 months old when she had an attack of pneumonia. Since that time she had had a slight cough.

History of Present Illness. On February 26 the child began to scream whenever she was handled and became very constipated. She remained in a very fretful condition for a day or two and became very restless. She slept very little for the four days previous to her admission to hospital. There was no history of fits or vomiting but the cough had been more troublesome since the illness commenced.

State on Admission. The patient who was very well developed and well nourished seemed quite conscious and lay on her right side with her knees drawn up and the toes slightly pointed. The face was pale but not/

not cyanosed. The skin was dry and over the upper part of the chest especially on the right side there was ^amarked petechial rash resembling very large flea bites without any surrounding zone of discolouration. To a less extent the same kind of spots were present all over the skin including the scalp. There was no herpes. She was extremely irritable and cried out loudly when handled. The neck and back showed a good deal of rigidity and there was definite head retraction and the fontanelle was bulging slightly. The pulse was 170 per minute regular and of moderate volume but poor tension. The respirations were 40 fairly regular and the temperature was 100.4° F. The abdomen was prominent and both the liver and spleen were slightly enlarged. The heart and lungs were normal. The tongue was coated with a white fur. As regards the reflexes the plantar reflex was very active and gave a flexor response the whole limb being jerked at the same time but the abdominal reflex was absent.

Both the knee jerks were brisk. Kernig's sign was present to a slight degree, especially on the left side.

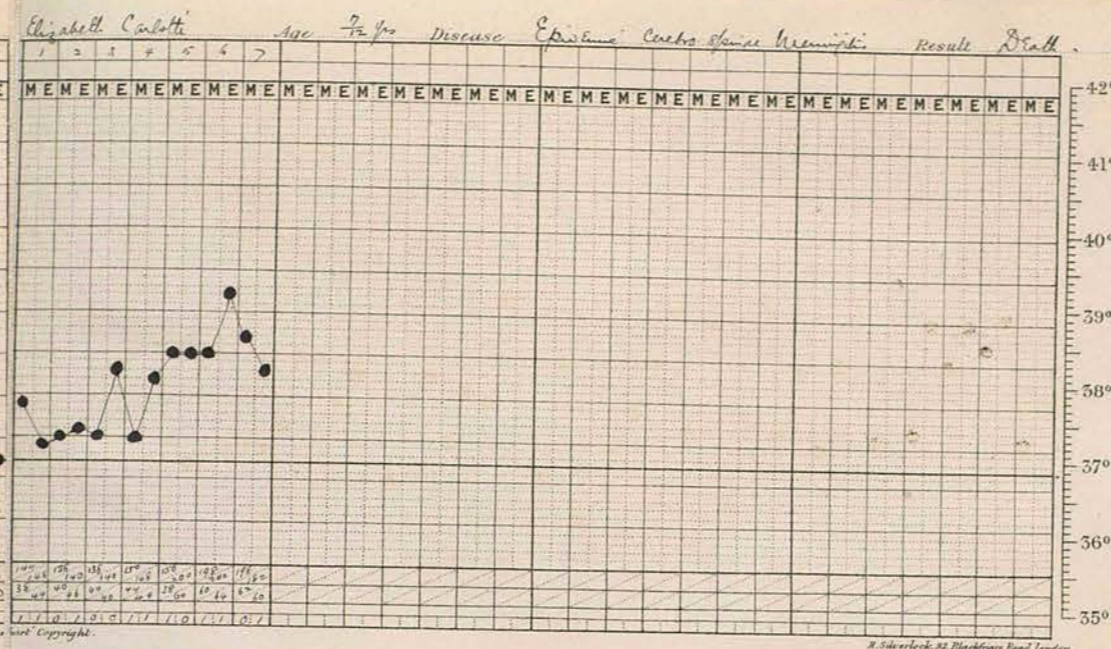
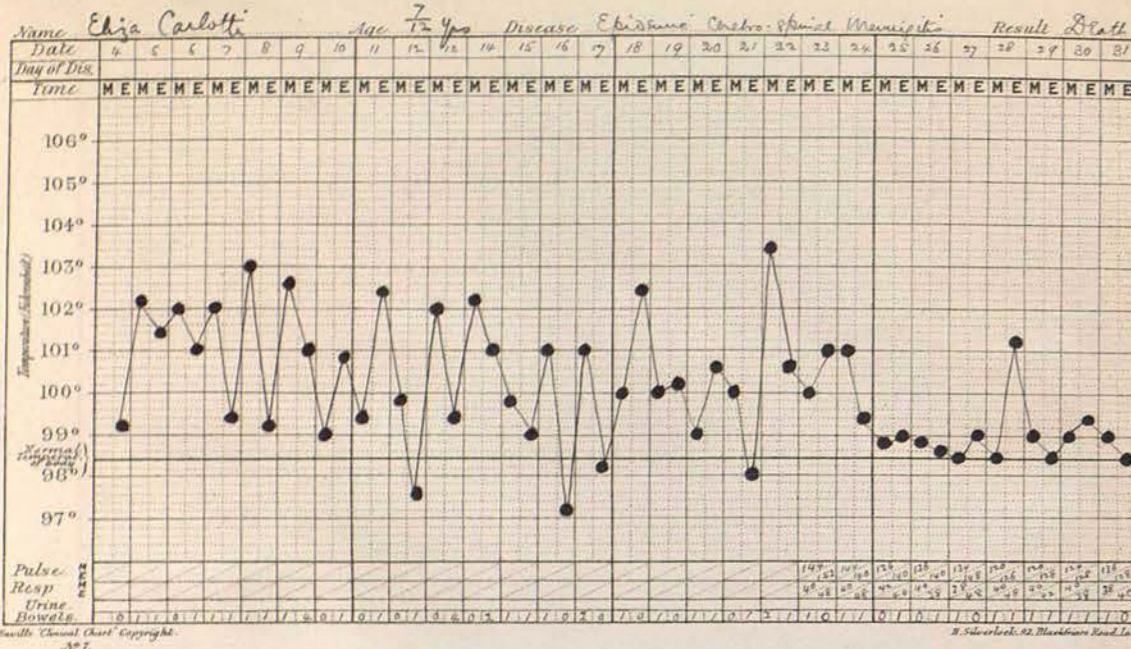
The pupils were equal of medium size, reacted to light and there was no sign of blindness. The urine contained no trace of albumen and the blood gave a white corpuscle count of 15300.

Progress. The child remained very fretful especially if disturbed but took milk well. The general condition remained much the same until March 7 when the head retraction was not so marked nor was the Kernig's sign so definite. There seemed to be great uneasiness about the mouth and child had her hand constantly in it. On March 11 the head retraction had disappeared and on March 14 the child seemed a little better, she was less irritable, liked being nursed and was looking about her more, her condition otherwise being much the same.

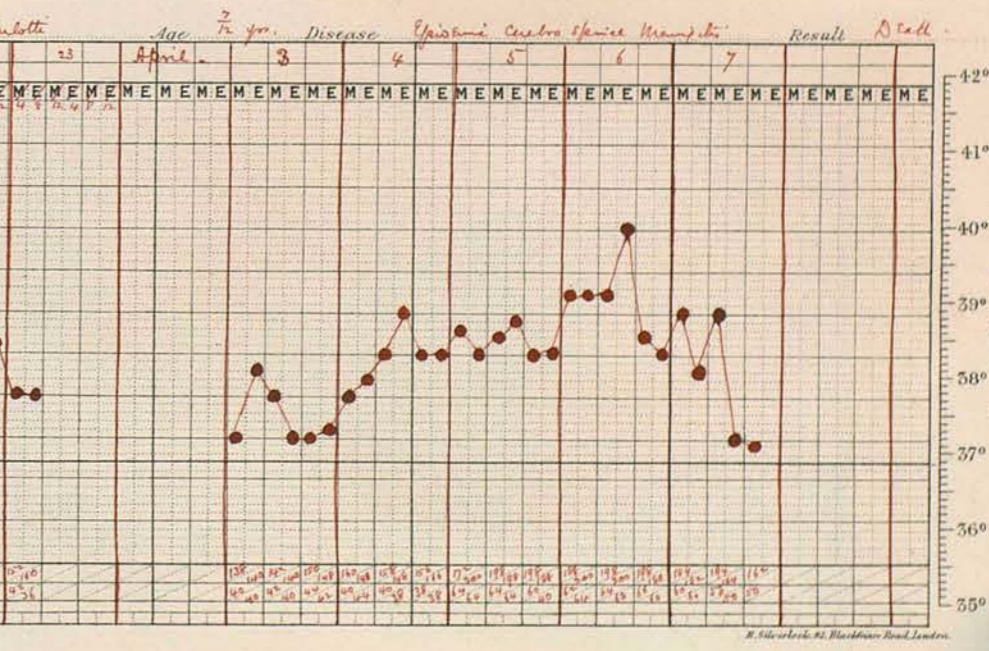
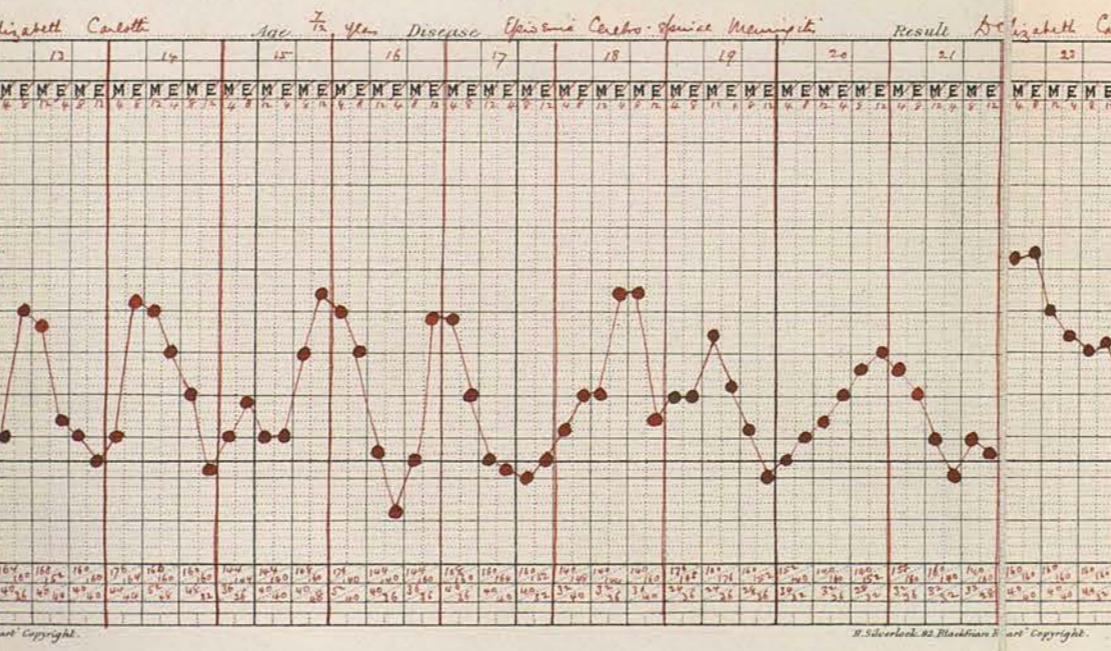
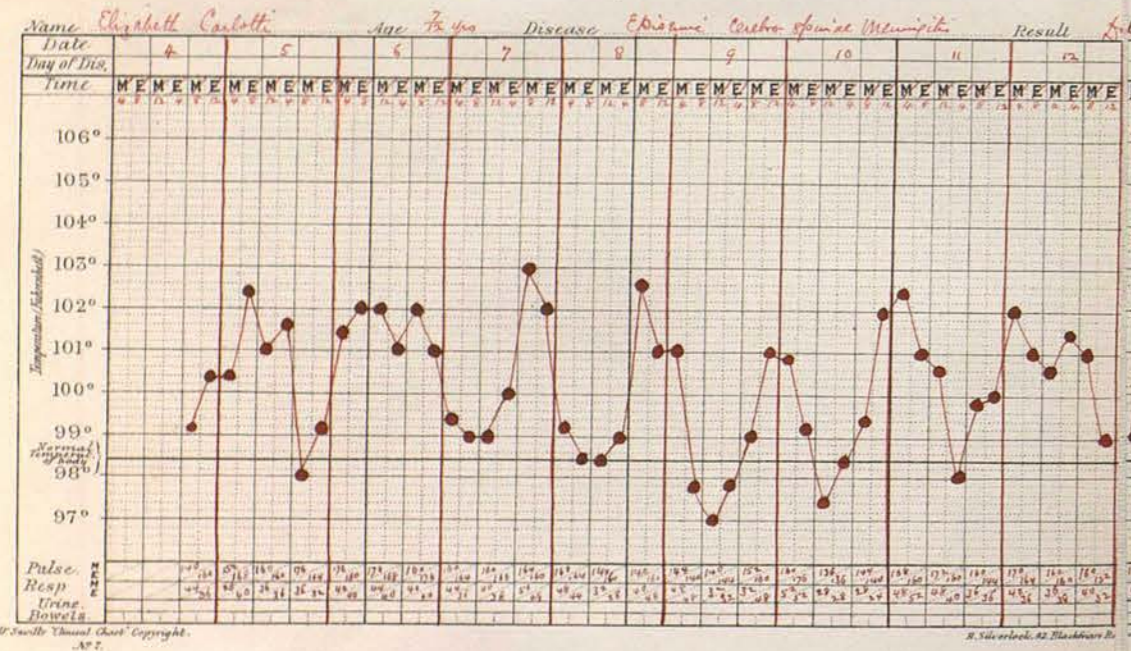
On March 19 the child was more irritable again and on March 22 had developed measles. The head retraction and Kernig's sign had reappeared and although still conscious the child looked a good deal worse. She was transferred to the City Hospital.

By April 2 the head had become more retracted, the child was quite unconscious and the pupils which were very small reacted only very slightly to light. Rigidity and head retraction became steadily more marked, the eyes staring and the abdomen retracted. Death took place on April 7th.

Temperature Charts.



Case 18.



Case 18. Four hourly chart.

Case No. 19. Joseph Donald. Aged $2\frac{11}{12}$ years.

Admitted 8/3/07.

Complaint. Restlessness and vomiting.

Duration of Illness. 3 days.

Family History etc. The patient was the youngest of 4 children. Both the parents were quite healthy and the house which consisted of 2 rooms was dry, sunny and well ventilated. The child had been getting out for the greater part of the day.

Previous Health. The patient had been breast fed, had thriven well and with the exception of having had measles when 2 years of age, had always been very healthy.

History of Present Illness. On March 4 the child was quite well and running about as usual. About 3-30 a.m. on March 5 he started to moan in his sleep, became very restless and feverish and his breathing became heavy. He did not complain of any pain at the time and was quite sensible. A little later in the morning he started to vomit and continued to do so until the morning of March 7. On the last mentioned date, ^{head} retraction was first noticed and late in the day the child became unconscious. There was no history of constipation, convulsions or eruptions.

State on Admission. The child who was a fairly well developed and well nourished boy was conscious and very irritable, resenting strongly any attempt to change his position in bed. He lay on his right side with the limbs flexed and the head slightly retracted. The cheeks were pinched and slightly flushed, the eyes hollow surrounded by dark areolae and the conjunctivae suffused. There were no eruptions, either herpetic or purpuric. The pulse was 144 per minute of moderate amplitude but poor tension. The respirations were 30 per minute and regular, the temperature was 99°F. The abdomen was normal and the liver and spleen were not enlarged. The neck showed marked rigidity and the lower limbs were slightly rigid in the attitude of flexion. The extremities of both upper and lower limbs were cold and presented a livid mottling. The heart and lungs were normal. As regards the superficial reflexes, both plantar and cremasteric were present, but the abdominal reflex was absent. Both the knee jerks were present and not increased, the left being elicited with difficulty. The pupils were equal of moderate size and reacted to light.

On March 26 the child had two attacks of vomiting and continued to vomit occasionally and continued/

Progress. About an hour after admission the child was lumbar punctured and 12 c.c. of turbid fluid escaped under considerable tension. Examination of film preparations showed many cells mainly polymorphs and numerous meningococci many of which were intracellular. Later in the day he was removed to the City Hospital, where 10 c.c. of Kolle's serum was injected subcutaneously. The following morning March 9 he was fairly quiet and was quite conscious. The blood showed a white corpuscle count of 51600, with a fairly well marked glycogenic reaction. He became restless and noisy that night, when other 10 c.c. of Kolle's serum was injected.

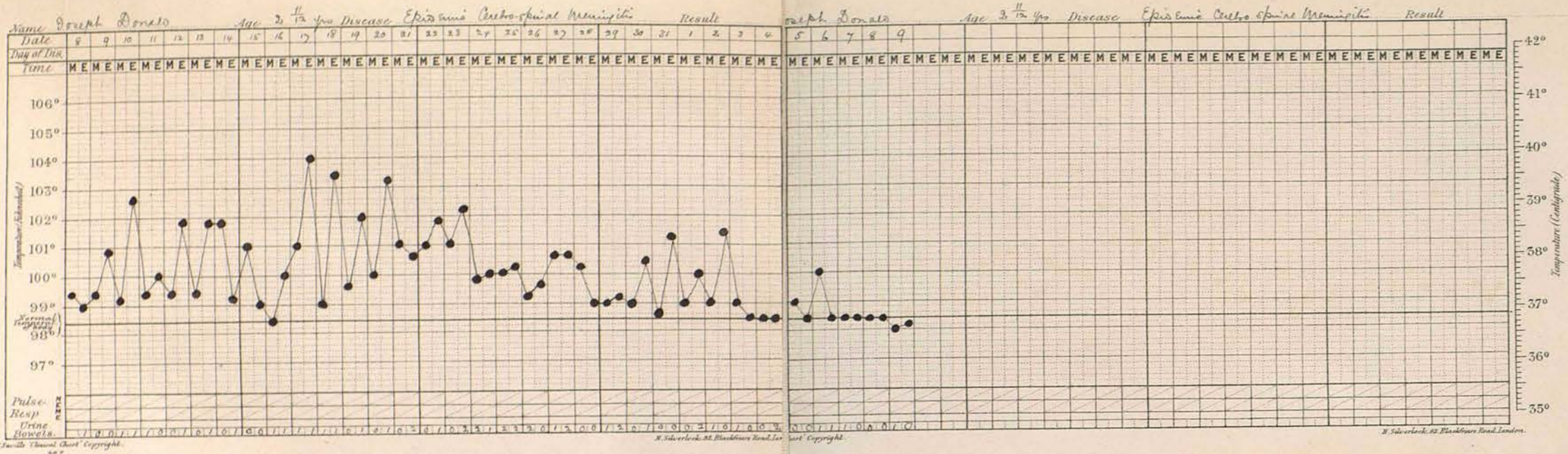
During the next few days he seemed to get slightly better, benefiting by the hot baths of which he had three in the 24 hours. On March 14 the neck was still rigid but there was no head retraction and the child was talking coherently. On March 15 a crop of herpes broke out over the thumb of the right hand.

During the next few days his condition remained much the same, he seemed soothed by the baths but was very hyperaesthetic when touched.

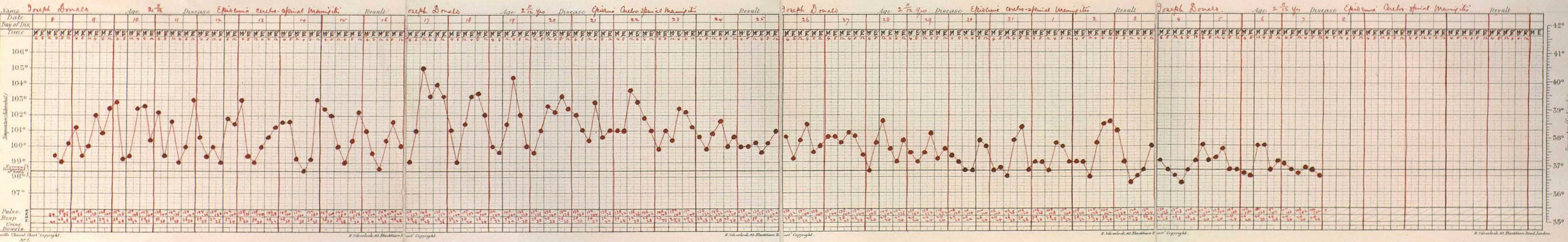
On March 20 he was quite deaf but vision was unimpaired. On March 26 the child had two attacks of vomiting and continued to vomit occasionally and continued/

continued to do until these notes terminated at the end of the first week of April. Gradually the head retraction had become less and the child seemed to have improved slightly.

Temperature charts.



Case 19.



Case 19. Four hourly chart.

Case No. 20. George Finnie. Aged $7\frac{1}{2}$ years.

Admitted 14/3/07.

Complaint. Headache, stiffness of the neck and vomiting.

Duration of Illness. 7 days.

Family History. etc. The patient had a brother and sister who were quite healthy as were both the parents. The house which consisted of 3 rooms was sunny, dry and well ventilated. The child had as a rule been out for the greater part of the day.

Previous Health. The patient had been brought up on the breast. He had had German measles, measles, and chicken pox, but with the exception of these illnesses had always been very healthy.

History of Present Illness. On March 8 the child was quite well about mid-day and at dinner time had a good appetite. On coming home from school that afternoon he complained of severe headache and shivering. During the night he slept well but nocturnal enuresis was present. The following day March 9 the headache was not quite so severe but he was drowsy and had no appetite. The headache was worse again next day and was chiefly vertical. In the evening he went to bed early and slept well until 6 a.m. on March 11 when he commenced to vomit and the headache was very severe. The vomiting continued at intervals/

intervals, the face became flushed and he commenced to grind his teeth. Later in the day the tongue became very furred and the breath very foul. He was very constipated and herpes broke out on the lower lip. On March 12 he vomited about 1 a.m. and continued to do so all day. He was very thirsty and the drowsiness and headache were still very marked. The child had an attack of vomiting on each of the succeeding days and the other symptoms remained about the same.

State on Admission. The child who was a well developed and well nourished boy was quite conscious and complained of thirst and of intense headache over the vertex. He was flushed, extremely restless and objected to being handled in any way. On being put to bed he lay on his back and constantly rubbed his hands over the lower part of his face picking at his lips and nose every few minutes and occasionally grinding his teeth. The skin was hot and dry and there was a small patch of herpes on the lower jaw between the lip and the chin. There were no purpuric spots. The abdomen was not flattened and seemed quite normal in shape and there was no enlargement of the liver or spleen. The tongue was thickly coated especially posteriorly and anteriorly the papillae/

papillae were prominent. The neck was rigid with tenderness on pressure over the muscles and the head was slightly retracted. The limbs showed no paralysis but there was marked hyperaesthesia on handling the child. The heart was normal but the lungs showed signs of bronchitis and the patient had a slight cough. As regards the reflexes; the plantar, cremasteric and abdominal were all quite healthy but the knee and ankle jerks were absent. The pupils were of medium size equal and reacted to light and accommodation. There was marked photophobia. The urine showed a specific gravity of 1018 and there was no trace of albumen.

The blood showed a white corpuscle count of 24200 and there was a fairly definite glycogenic reaction.

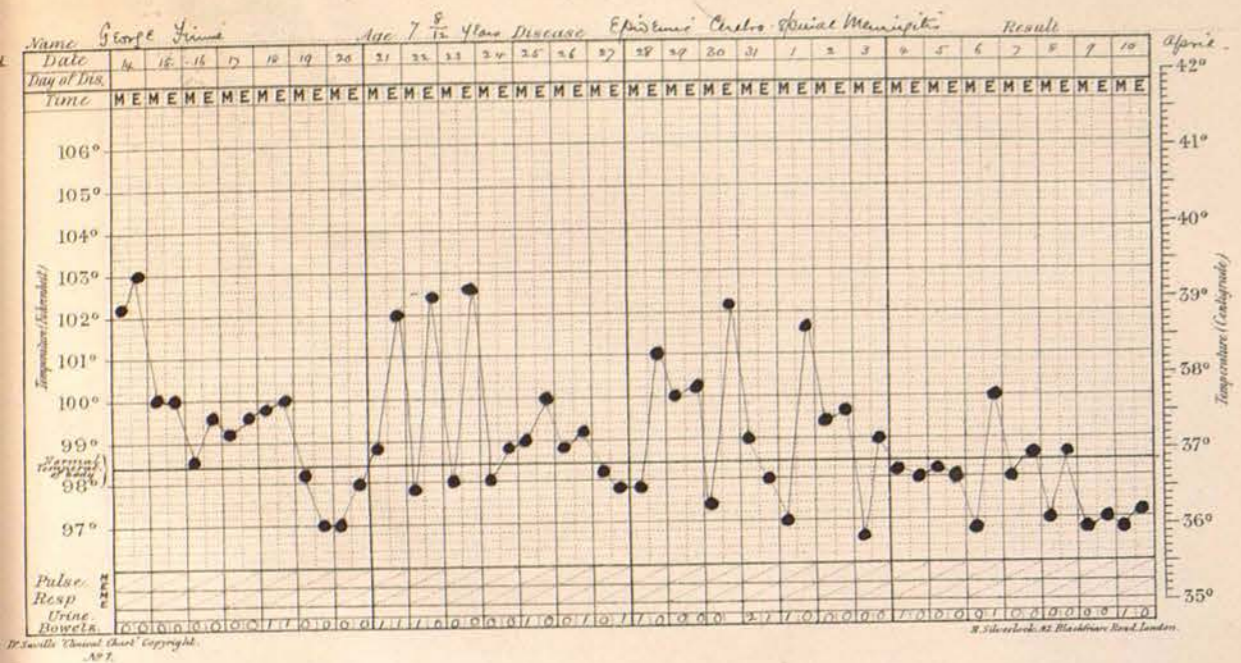
Progress. About 4 p.m. on the day of admission the patient was lumbar punctured and 15 c.c. of turbid cerebro-spinal fluid escaped under increased tension. On examination of film preparations of the fluid many polymorph cells were seen with a few typical meningococci, one or two of which were within the cells. For the rest of the day the child remained quiet at intervals but at other times he was very restless, crying out and complaining of extreme headache. He slept at intervals during the night but became very restless/

restless towards morning. On March 15 the patient was transferred to the Leith Fever Hospital. On this date the plantar reflex gave a well marked Babinsky on both sides and hyperaesthesia of the skin was still well marked. On March 19 the white blood corpuscles numbered 38,750 and towards evening a discrete papular rash was present over the body which became more marked on the following day, March 20.

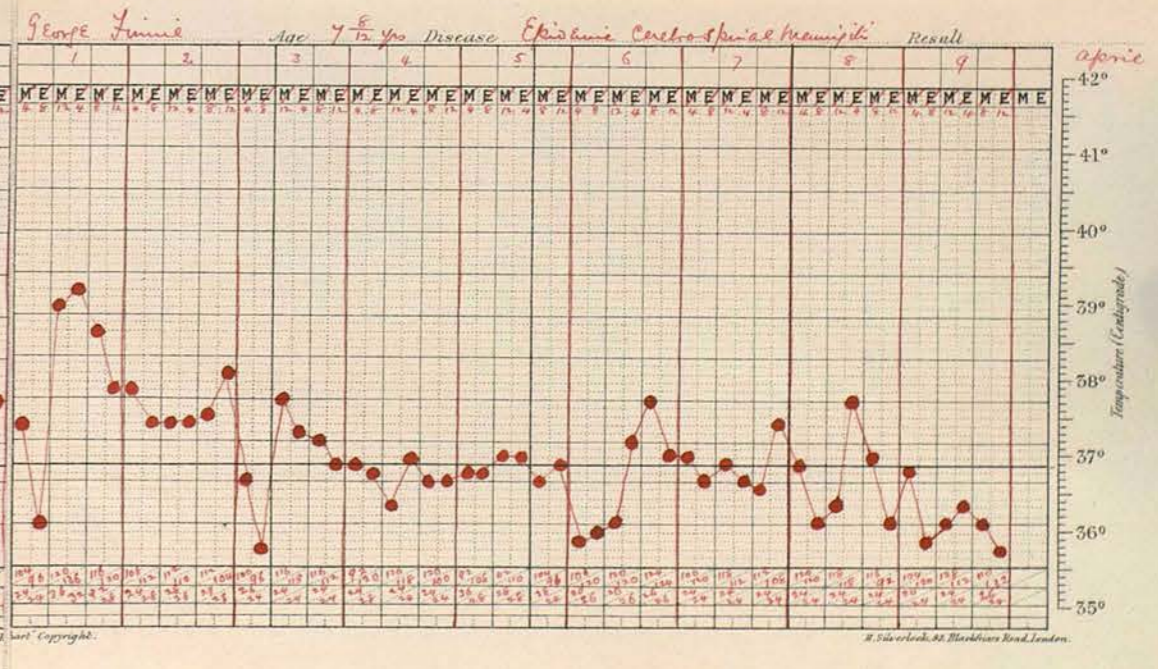
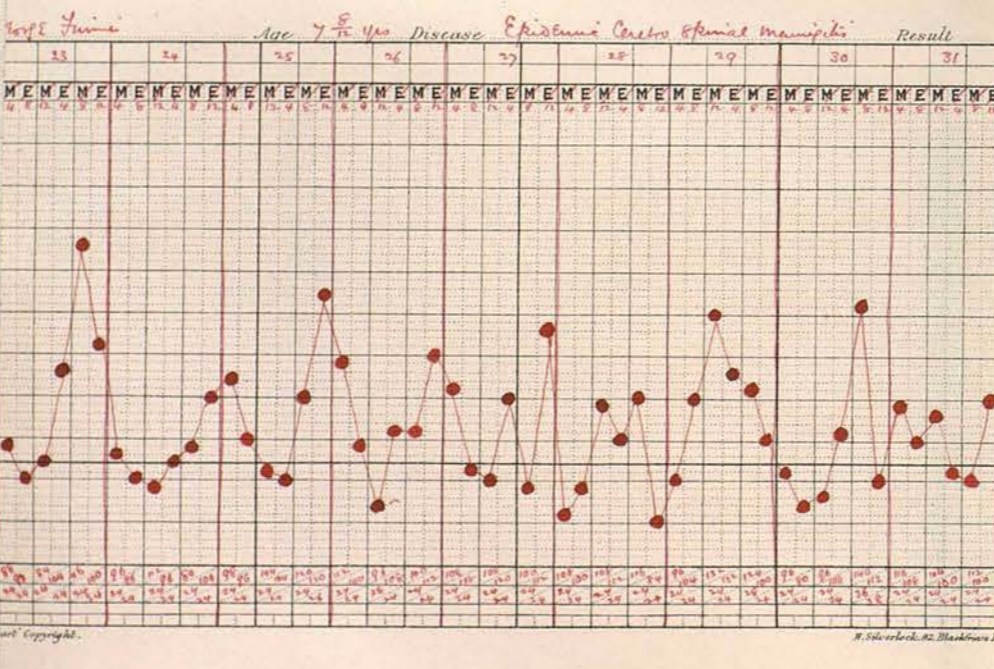
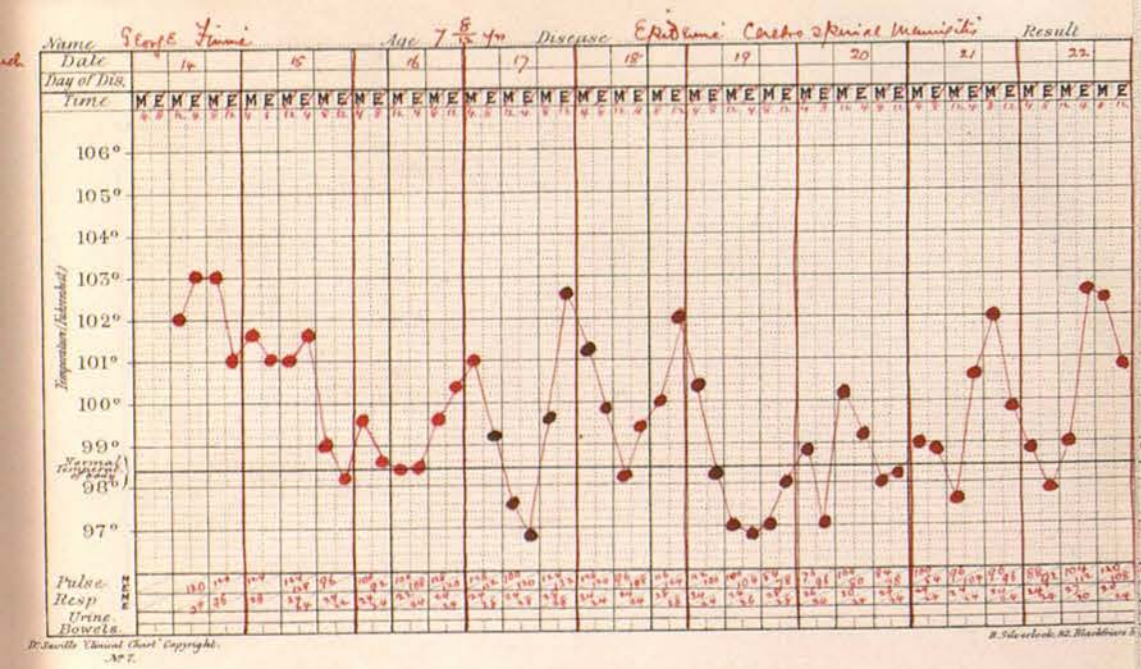
On this date the child commenced to pass everything in the bed. The papular rash remained present until March 27 and during that time the patient had complained constantly of the pain in his head and neck. The abdominal reflex still remained well marked and the stiffness of the neck and head retraction were much the same as at the commencement.

On April 7th the abdominal reflex and knee jerks were still active and Kernig's sign was more marked, the child was swallowing well but was not so inclined for food and had started to vomit occasionally.

Temperature Charts.



Case 20.



Case 20 Four hourly chart.

Case No. 21. Georgina Stanfield. Aged $1\frac{8}{12}$ years.

Admitted 19/3/07.

Complaint. Irritability, loss of appetite and constipation.

Duration of Illness. 14 days.

Family History. etc. Both the parents were quite healthy, and the house consisting of three rooms was dry and well ventilated. The child had been getting out every day until the commencement of her illness.

Previous Health. The patient had been bottle fed and had thriven well until the age of $1\frac{5}{12}$ when she had an attack of chicken pox, since when she had not been very strong.

History of Present Illness. Three weeks ago the child developed a croupy cough which lasted for about a week. At the end of this time she seemed very irritable and did not want to be lifted. She had a few attacks of vomiting, had no appetite and was very constipated. During the week before admission the drowsiness and irritability had been more marked.

State on Admission. The patient who was well developed and nourished, was semi-conscious and lay quite quiet if undisturbed. When handled however she became extremely irritable, her whole body trembled, and she raised her hands to the back of her neck/

neck as if she felt pain in it. The face was pale but there was no trace of cyanosis. There was no peripetic eruption but there were a few dull bluish spots on the thighs and legs.

The pulse was 112 per minute and of poor volume and tension. The respirations were 30 per minute and rather irregular, and the temperature was 98.6°F.

The tongue was coated with a white fur posteriorly and the child had some difficulty in swallowing. The abdomen was of natural shape and there was no enlargement of liver or spleen. There was marked rigidity of the neck but no head retraction, the limbs showed no paralysis or rigidity. Both the heart and lungs were apparently normal. The plantar reflex gave well marked Babinsky on both sides and the abdominal reflex was absent. The knee jerks were present and the right was a little more marked than the left.

Kernig's sign was slightly present on both sides.

The pupils were equal moderately dilated and reacted sluggishly to light.

The urine contained no albumen.

The blood showed a red corpuscle count of 5730,000, a white corpuscle count of 37600 and haemoglobin 70%.

In this case the glyco-genic reaction was absent.

Progress. After admission the child who seemed to

be/

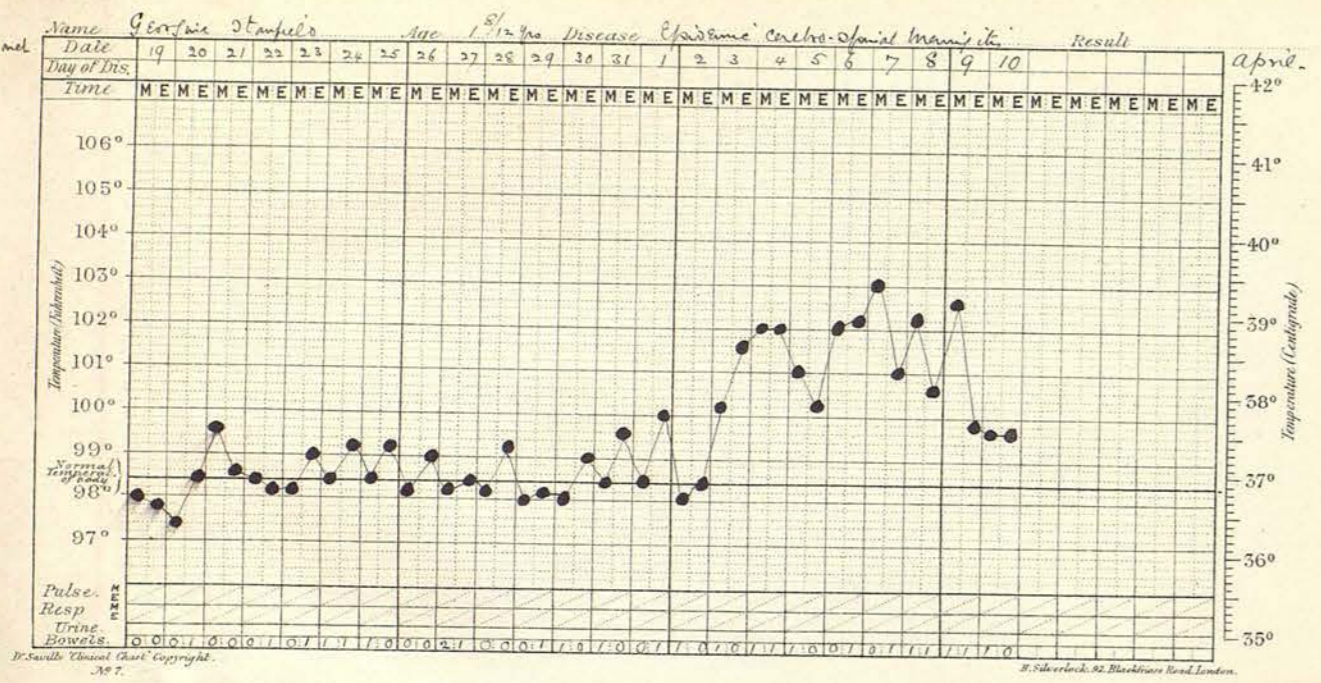
be seeing alright lay fairly quiet for the rest of the day, but was swallowing with difficulty.

The following day March 20 she was quite blind and made no response to noises made close to the ears.

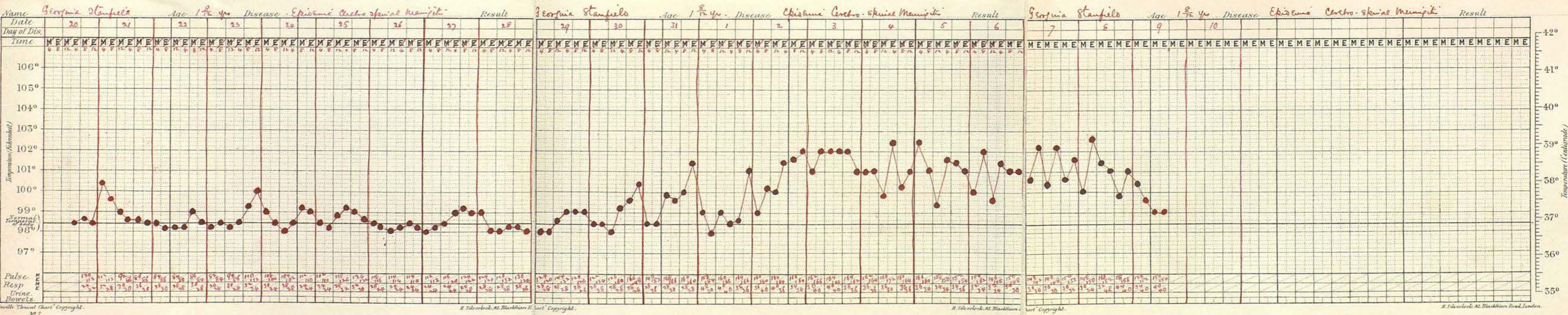
During the day lumbar puncture was done and a few drops of turbid fluid containing many polymorph cells and a few meningococci escaped under slightly increased tension. The child who remained quite quiet, apparently unconscious and with slight internal strabismus of left eye was removed to the City Hospital the following day March 21.

On the following day March 22 the strabismus of the left eye had become external and the child vomited occasionally without effort. On March 23 the strabismus of the left eye was again internal and the child's head was rigidly flexed on the chest. On March 25 the internal strabismus of the left eye was very marked and the head seemed quite straight but became retracted on the following day, March 26. She had an attack of vomiting on this date and by March 28 the head retraction had become very marked. During the next day or two the child lay with staring eyes and on March 29 had a tonic convulsion, relieved however by hot baths. By April 3 the child's head had become still more retracted with marked opisthotonus of the body while the arms were strongly pronated/

pronated and the hands flexed at the wrist. On April 10 the child's condition was much the same but she was more cyanosed.



Case 21.



Case 21. Four hourly chart.

Case No. 22. Rose Millar. Aged $\frac{9}{12}$ years.

Admitted 25/3/07.

Complaint. Feverishness, quick breathing and that she was pained when sitting up.

Duration of Illness. Since 10 a.m. March 24.

Family History etc. The child was the youngest of 11 children, 3 of whom had died. One of Diphtheria, one of scarlet fever and one of some form of meningitis.

There were three miscarriages. The father had consumption and there was a strong history of the disease in his family. The mother was quite healthy. The house which consisted of three rooms was well ventilated and dry and the child had been getting out every day.

Previous Health. The patient who was on the breast had thriven well and with the exception of a slight cough for three weeks previous to the onset of the present illness.

History of Present Illness. On the morning of March 24 the child seemed quite well and was playing as usual until 9 a.m. when she fell asleep. About an hour later she awoke and was very cross, feverish and drowsy. She remained in this condition all day but took her food well. During the afternoon the mother noticed a few spots on the legs like flea bites which/

which grew darker in the evening and had disappeared by the following morning. She slept fairly well during the night and on the following day was breathing rapidly and was very wheezy. About 9 a.m. she vomited and was very quiet, seeming not to take notice of anything but screamed loudly when raised to a sitting posture.

State on Admission. The child who was well developed and nourished was quite conscious, noticing what was going on around her but seemed drowsy. She lay on her back with the lower limbs flexed on the abdomen, and was very irritable when handled or disturbed in any way. The face was pale but not cyanosed and the extremities were warm and showed no mottling. The skin generally was warm and dry and showed no eruptions. The pulse was 180 per minute regular but of small amplitude and tension. The respiration were 68 per minute and the temperature was 102.4 F. The abdomen was of natural shape but the liver showed slight enlargement. The fontanelle was markedly bulging but there was no definite stiffness in the neck or head retraction. Pain was evidently present in the neck on flexing the head on the chest. The heart was normal but the lungs showed distinct signs of bronchitis.

The child occasionally uttered a sharp cry but lay/

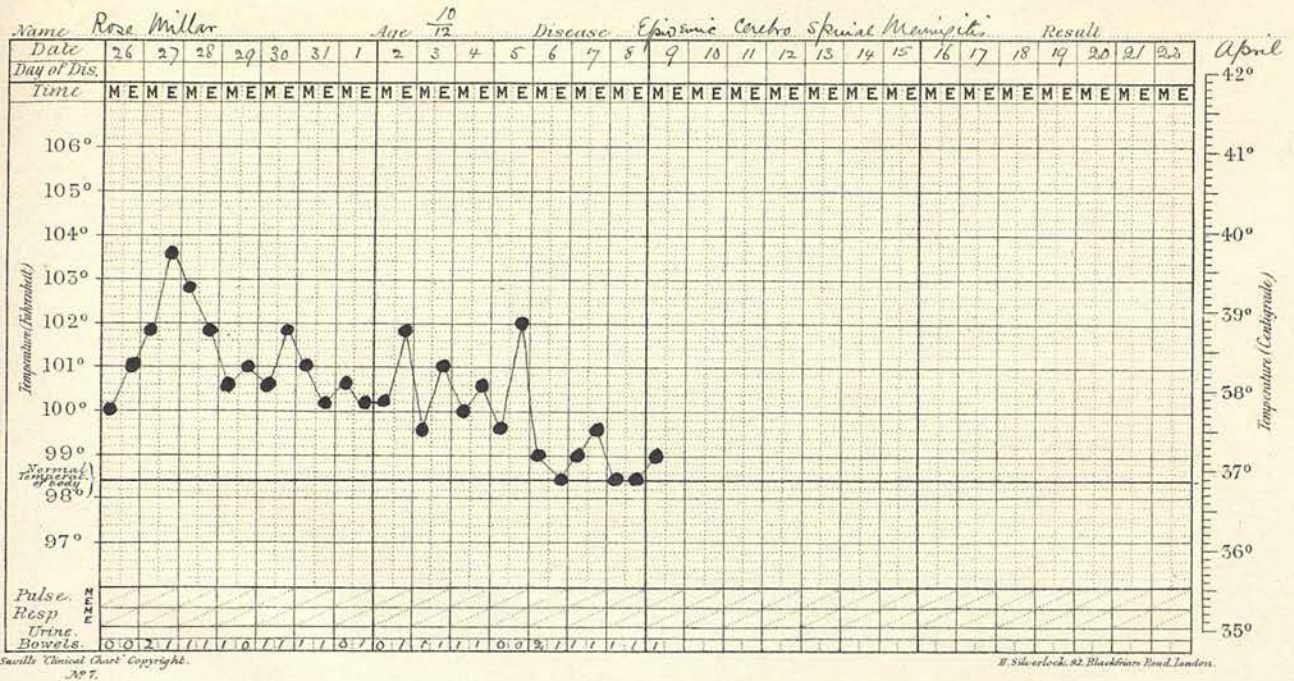
lay fairly quiet. The abdominal reflex was absent but the plantar gave a flexor response. The knee jerks were brisk. The pupils were equal, small and reacted to light and both sight and hearing were unimpaired. The urine showed nothing abnormal. The ^{red} blood corpuscles numbered 4420000, the white 12600 and haemoglobin was 75%.

Progress. Shortly after admission the patient was lumbar punctured and about 12 c.c. of slightly turbid fluid escaped. The fluid contained a few meningococci some of which were within the polymorph cells of which there were great numbers. She remained fairly quiet occasionally screaming out, but early the following morning became very restless. She remained conscious and was transferred to the City Hospital on March 26.

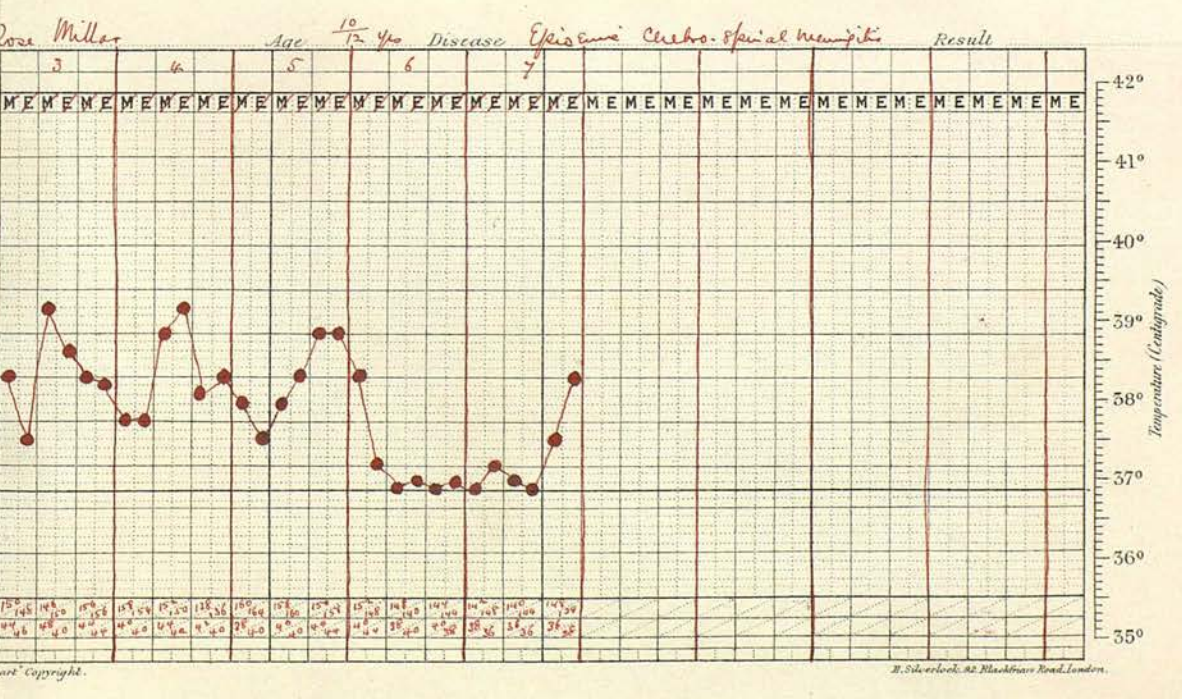
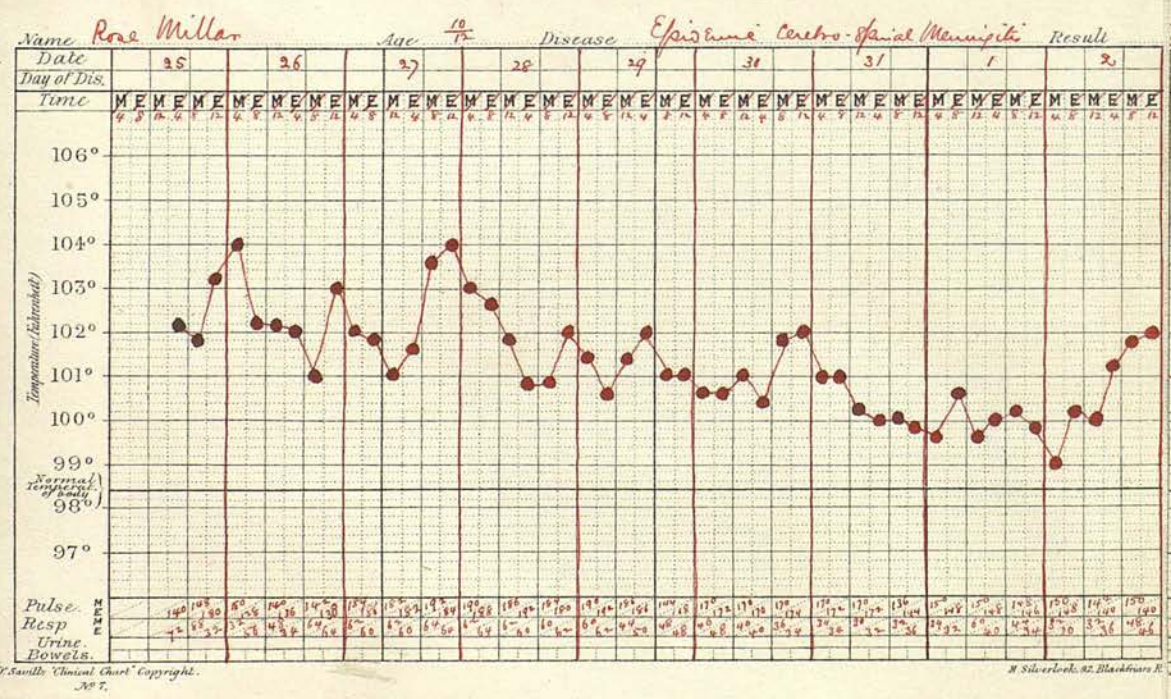
On the following day March 27 the child seemed unconscious and there was some rigidity of the arms at the elbow joints. The patient was given 10 c.c. of Kolle's antimeningococcic serum. On March 29 the child was not so irritable, Kernig and head retraction were still absent. 25 c.c. of Burroughs, Wellcome & Co.'s serum were injected and this dose was repeated on the following day. There was now definite head retraction which became more marked on April 2 but was less on April 6 and on this date the child seemed conscious/

conscious and took notice of what was going on.

Kernig's sign remained absent.



Case 22.



Case 22. Four hourly chart.

Analysis of Symptoms.

Sex. Of the twenty-two cases forming the basis of this study thirteen were males, nine females, showing a slight preponderance of the former.

Age at Onset.

| | |
|--------------------------------|-----------|
| Under six months. | One case |
| Over six and under nine months | two cases |
| Over nine and under twelve | two " |

| | | |
|------------------------|----------|-------|
| During the first year. | 5 cases. | 22.7% |
| " " second year | 3 " | 13.6% |
| " " third " | 6 " | 27.7% |
| " " fourth " | 2 " | 9% |
| " " fifth " | 4 " | 18% |
| " " sixth " | | |
| " " seventh " | 1 case | 4.5% |
| " " eighth " | 1 " | 4.5% |
| | 22 | |

Average age at onset of the 22 cases = 2 years, 8 months.
 " " " " " " 5 " in first year = 7 months
 " " " " " " 17 " older than one year
 = 3 years, 3 months.

From the above statistics it will be seen that
 the/

the greatest number of cases i.e. 27.7% occurred within the third year, and that in the series there were only two cases older than five years.

The youngest child was three months and the oldest seven years, six months old.

Month of Onset.

| | |
|----------|-------------|
| October | One case |
| November | One case |
| December | One case |
| January | Seven cases |
| February | Eight cases |
| March | Four cases |

The diminution in the number of cases admitted in March bears no accurate relation to the number of cases occurring in the District in that month as several of them were sent direct to the City Fever Hospital. The disease was present in epidemic form early in January and has continued since this date without showing any sign of abatement. The fact that the weather during the months of January and February was of an exceptionally severe character lends support to the theory that cold is one of the predisposing factors of the disease. The month of March was milder than usual, we see however no diminution in the number of cases which are still occurring/

occurring.

Distribution and General Surroundings.

As will be seen from the map, the cases occurred in widely separated parts of the City, and were not confined entirely to the poorest localities. In only one instance was there a history of two individuals being attacked in the same house, and as both cases occurred during the same week the infection was probably simultaneous. With only two exceptions the houses were dry and well ventilated and in a great many instances the rooms were situated on the top storey. The occupations of the parents were very diverse and do not seem to have any bearing on the source of infection. There was a history of tuberculosis in two of the families and in one of these a history of syphilis was also present.

Previous Health.

About 75% of the children had been breast fed and in almost every case the nutrition and development was very good. The majority of the patients had suffered from one or more of the infectious diseases of childhood, but apart from this had been healthy up to the onset of the disease. Slight rickets/



Stewart's College
Recreation Ground

Cricket Ground

Comely Bank
Nursery

Royal Victoria Hospital

Deanpark
Nursery

Donaldson's Hospital

North Merchiston
Cemetery

Nursery

ARBORETUM

Inverleith
Public Park

Grange Cricket
Ground

Dean Ch.
Nursery

Belgrave Cr.
Gardens

Calton Hill

Warriston Ho.

Warriston
Parks

Leith Ath.
Parks

Leith
Nursery

Leith
Nursery

Leith
Nursery

Leith
Nursery

Warriston Ho.

Warriston
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ricketts was noted in three instances.

a. Signs of catarrh immediately preceding onset.

In one case the child had suffered from thread worms for five months. In another there were signs of intestinal irritability and pain for a week. In four of the cases there was a history of cough which had been present for a week or more.

b. Influence of Dentition.

In only one case was there definite signs of the child cutting teeth but in three instances the child was constantly putting the hand into the mouth throughout the course of the disease.

c. Blows on Head.

A history of a fall on the head three days before the appearance of meningeal symptoms was noted in one case.

Mode of Onset and first sign of the disease.

The suddenness of the onset was very characteristic in almost every case. In one child, however, there was a history of languor and thirst for a few days, before the more acute symptoms manifested themselves.

Of the twenty-two cases, the first sign was.

| | |
|-------------|----------|
| Vomiting. | 9 cases. |
| Drowsiness. | 5 " |

| | |
|-----------------------------|----------|
| Convulsions. | 3 cases. |
| Headache. | 3 " |
| Screaming and irritability. | 1 " |
| Restlessness. | 1 " |

Usually any one of these signs was accompanied by one or more of the others. Thus fever was almost constantly present at the onset and restlessness in the majority of cases closely followed the initial symptom. In one case the onset was accompanied by severe rigors and in another diarrhoea was present in addition to the vomiting.

Bulging of the fontanelle.

This was present to some extent in five out of six cases. In one the condition was very marked but the tension was relieved by lumbar puncture. In one of the cases the tension varied from day to day.

Rigidity of the neck.

This sign was present in every case at one period of the illness and was usually one of the earliest to be noted. The amount of rigidity varied very much but in some it was very marked. In six of the cases the rigidity spread down to the muscles of the back. Pain on pressure over the affected muscles/

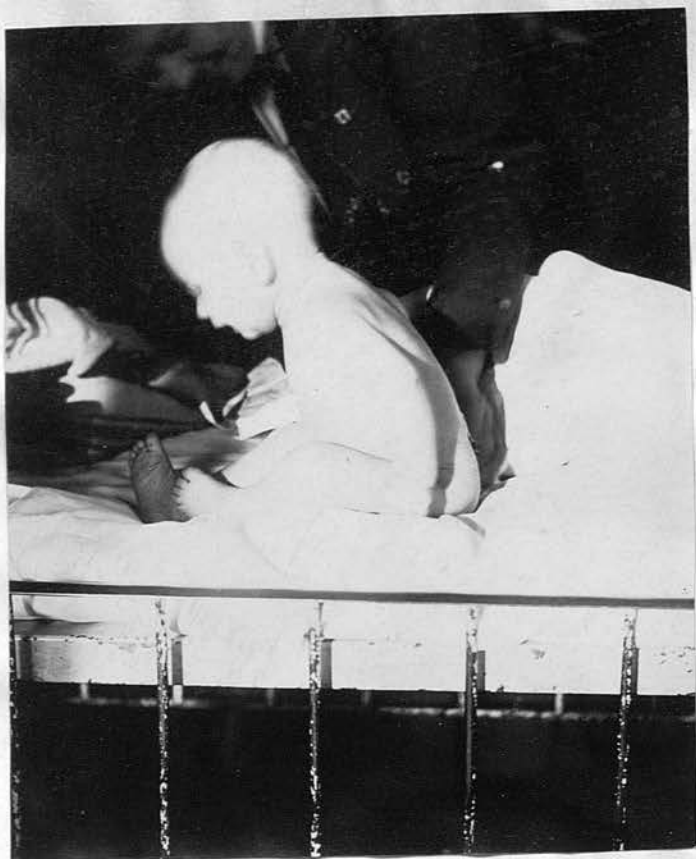


Fig. 1. Case 7.
11 days after onset.

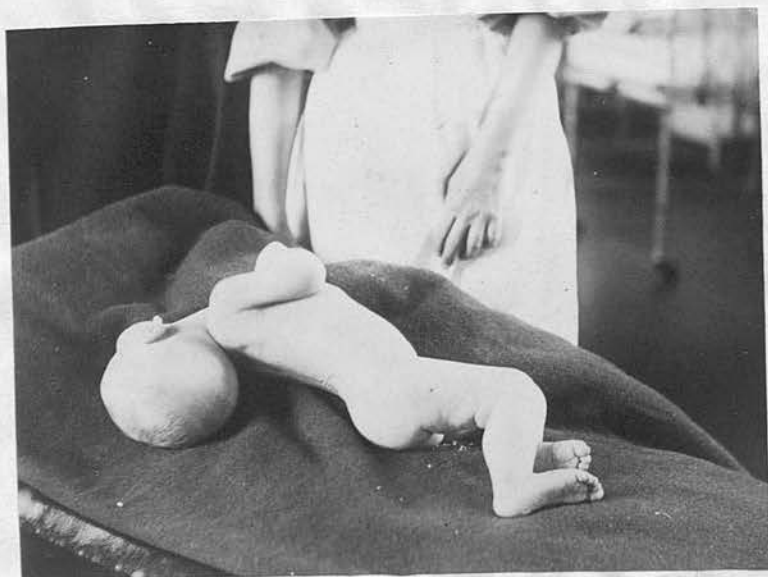


Fig. 2. Case 7.
2 days before death.

muscles was present in several cases.

Head retraction.

This sign was noted in 19 of the 22 cases. In several instances where the head retraction was absent on admission, it became very marked as the disease progressed. Figs. 1 and 2 illustrate this point, the latter photograph was taken two days before death. As regards the onset of this sign: of the twelve cases in which the date of onset was noted one finds.

| | |
|--|----------|
| Appearance on first day. | 2 cases. |
| " " second " | 2 " |
| " " third " | 1 case |
| " " fourth " | 2 cases. |
| " " fifth " | |
| " " sixth " | 1 case |
| within the first week but day not noted. | 2 cases |
| Appearance on nineteenth day | 1 case |
| " " twenty first day | 1 " |

In some cases the head retraction varied from day to day and appeared to be absent at times. In other cases it became progressively more marked. In one case rigid flexion of the head on the chest was noted for one day to be followed two days later by retraction/



Fig. 3. Case 8.
3 days before death.



Fig. 4. Case 8.
3 days before death.

retraction which became very marked. In three of the cases the head retraction became so exaggerated that swallowing was impeded.

Opisthotonos.

Definite arching of the back combined with head retraction was very marked in several instances. It became permanent in one case on the 8th day of the disease and in other two cases on the 22nd and 23rd day respectively. This condition is well illustrated by Fig. 3, 4 and 5.

Headache.

This symptom was present as far as could be ascertained in seven cases and in two of these it was the first symptom. In one it commenced twelve hours after the onset of the illness. In two instances the pain was situated in the frontal region and in another it was present chiefly over the vertex. One child complained that the head felt heavy.

Cutaneous hyperaesthesia.

Although this sign was only definitely noted in five instances, great irritability was present in every case when the child was disturbed or handled. In one case the child cried out loudly when the patelle/



Fig. 5: Case 8.
3 days before death.



Fig. 6. Case 5.
One month after onset.

patella tendon was tapped to elicit the knee reflex. The hyperaesthesia was present on both sides and there was no joint complication in this case.

Vertigo: was recorded as being present in 2 cases in one of which it was very marked and the child cried out constantly that he was falling.

Reflexes.

Organic. In two cases there was a history of nocturnal enuresis before the onset of the disease and this symptom was exaggerated during the first few nights of the illness.

As a rule the reflexes were lost in severe cases at an early date although in a child of $7\frac{1}{2}$ years this did not occur until the 14th day.

Knee Jerks.

Plantar.

In twenty-one cases the condition of this reflex was noted on admission.

Normal in 14 cases

Babinsky's sign was present in 3 "

Increased with jerking of the whole limb in 2 "

Absent. in 2 "

In/

In two cases where the reflex was present on admission it became absent at a later date and in one Babinsky's sign developed on the 7th day.

In three of the cases in which Babinsky's sign was present the child was over two years of age.

Abdominal.

Of the 18 cases in which this reflex was noted on admission it was

| | |
|------------|----------|
| absent in | 14 cases |
| present in | 4 " |

Of the latter the reflex was lost in two cases at a later date, e.g. on the 8th and 11th day respectively.

Of the cases in which the reflex was absent on admission it returned in two instances on the 22nd and 69th days.

Knee Jerks.

Of the 22 cases the condition was recorded on admission as being

| | |
|-------------|----------|
| Active in | 10 cases |
| Absent in | 5 " |
| Normal in | 4 " |
| Sluggish in | 3 " |

Of the cases in which the reflex was present on admission it became lost in four cases at a later date/



Fig. 7. Case 16.
2^d Days of disease.



Fig. 8. Case 8.
One week after admission.

date. In one it was absent on the 8th day and in another on the 29th day.

Kernig's Sign.

In 20 of the cases in which this sign was recorded it was

| | |
|------------|----------|
| Present in | 11 cases |
| Absent in | 9 " |

Of the latter the sign became present at a later date in three of the cases. In some instances it became permanent and very marked, Fig. 6. In others it varied in degree from day to day.

Ocular Symptoms.

In three cases a pinkish suffusion of the conjunctiva was noted and staring of the eyes at some period of the disease was noticed in several of the cases.

Strabismus. This symptom was present in six of the cases at some period of the disease. As a rule it was unilateral and affected the left eye more commonly than the right. The strabismus was usually internal

Fig. 7. In one case it occurred on the 16th day but varied in this instance and was sometimes external. In one the strabismus was transient and lasted for about/

about ten minutes at a time. In another it was very marked and bilateral Fig.8.

Nystagmus. was only noted in one instance.

Pupils. Of 20 cases the size and reaction were noted on admission.

| | |
|------------------|----|
| Medium size. | 11 |
| Slightly dilated | 4 |
| Much dilated | 4 |
| Contracted | 1 |

In only one case was there inequality of the pupils. As regards the reaction to light.

| | |
|--------------------|----------|
| Normal reaction in | 12 cases |
| Sluggish " " | 7 " |
| Absent " " | 1 case. |

In many instances the pupils varied in size during the progress of the disease and in some became pin point. The pupils remained equal.

Optic Discs. In no case was any abnormality found in the optic discs.

Photophobia: was noted in three cases but as a rule this symptom passed off in a day or two.

Otorrhoea: was only present in one instance and occurred/



Fig. 9. Case 8.

On admission.



Fig. 10 Case 8.

7 days before death.

occurred on the left side on the 33rd day and on the right side on the 37th day.

Champing Movements of the jaw: was present in three cases and occurred both early and late in the disease.

Grinding of the teeth: was present in six cases. As a rule it occurred in the acute stages of the disease and was often accompanied by uneasiness about the mouth.

Tonic Spasm.

Besides the head retraction and opisthotonos already mentioned, rigid spasms of the limbs also occurred. In several of the children the spasm of the lower extremities was flexor in character and varied slightly in intensity from time to time, Figs. 11 and 12. In one case rigid extension of the legs occurred early and was permanent, Figs. 9 and 10.

Fig. 5 shows very well the position of the fingers and toes which was present in some instances, namely a tetanic clenching of the fingers which were flexed over the thumbs in the former and rigid palmar flexion of the latter. According to Lees and/



Fig. 11. Case 4.
3 days before death.



Fig. 12. Case 4.
3 days before death.

and Barlow the cause of these rigid spasms is due to irritation of the cerebellum, so that its normal tonic action on the muscles becomes exaggerated. Superpronation of the arms was present in one or two instances and is illustrated to a certain extent by Fig. 11 and 13. Tonic convulsions occurred in one case on the 24th day.

Clonic Spasm.

Convulsions occurred at some period of the disease in eight cases. In two of these it was the first symptom. As a rule they ^{occurred} early in the disease. In one case the convulsions continued at intervals throughout the disease and in another where convulsions had ushered in the illness, they ^{also} recurred a few hours before death. In one the convulsion was limited to the right side and in another the limbs on each side were alternately affected with the clonic spasm every few minutes.

Tremor of the limbs was noted in four cases, and in one of these the head was also implicated. Usually this was a terminal symptom and in one or two cases became very marked before death.

Paralyses.

Of the limbs were not recorded in any case, those/

those affecting the muscles of the eye have already been described.

Mental Condition.

Almost without exception the patients were irritable and restless if disturbed but many of them remained quiet if left alone. A sharp and constant crying out was present in six cases and was sometimes very marked.

Drowsiness was a feature at the onset, and has already been noted as one of the first symptoms.

Active delirium was present in six cases and in five of these it occurred within the first three days.

Coma was present in several of the cases and occurred early in rapidly fatal cases.

Consciousness was often lost for a time during the early part of the disease but returned after some hours or days and in many instances the intelligence was well preserved notwithstanding the grave lesions which existed at the base of the brain as seen on post mortem examination. In one case the child could sit up and talk intelligently 18 hours before death, and several of the other children took an interest in their surroundings and smiled/

smiled when spoken to and appeared to be quite free from any pain.

A few were quite apathetic and lay on one side particularly with the eyes half shut illustrated well by Fig. 7.

Digestive Symptoms.

Vomiting.

This has already been noted as the commonest of the initial signs. In many cases where vomiting was not the first symptom it was present within a few hours of the onset. At some period of the disease this symptom was noted in 17 of the 22 cases. Although occurring as a rule at the onset, in a few it continued at intervals throughout the course of the illness. In others where this symptom had been present early, it returned towards the latter end of the illness. Usually the vomiting was without effort but in three cases it was accompanied by a good deal of retching and in these cases the retching was present at times without actual vomiting.

Thirst.

This symptom was present in 50% of the cases and was often very marked during the first day or two.

Tongue.

This was recorded as being coated in twelve cases. In the majority of these the plastering of the tongue posteriorly was very marked but often the anterior part was comparatively clean and the papillae were raised and prominent. As a rule the breath was very foul in these cases and the smell of acetone was present in one. Catarrh of the buccal cavity was present in three cases and in these there was a copious mucopurulent secretion about the teeth.

Abdomen.

The shape of the abdomen as noted in twenty cases on admission was

| | |
|-------------------------------|-----|
| Normal in 11 cases | 55% |
| Retracted " 7 " | 35% |
| Slightly distended in 2 cases | 10% |

In one of the last instances it became retracted during the course of the disease and the flattening of the abdominal wall became very marked in chronic cases. Fig. 18.

Bowels.

Constipation was present in a good many instances especially during the early part of the illness.

Diarrhoea/

Diarrhoea occurred for a day or two in three cases and of these fresh blood was present in the motions of two.

Urine.

Of the 18 cases in which an examination could be made a trace of albumen was present in three.

Respiratory Symptoms.

Cough.

This was present in eight cases at some period of the disease but as a rule was of a slight nature.

Definite signs of bronchitis were found in seven cases and in three others there was a considerable amount of congestion at the base of the lungs amounting in two cases to actual pneumonia.

Respirations.

Were regular as a rule but irregularity was noted in two instances. Sometimes the breathing was very laboured at the onset and moaning expiration was frequently present.

Fairly wide fluctuation in the rate of the respirations during the 24 hours was present in many instances.

Circulatory Symptoms./



Fig. 13. Case 17.
3 days after onset.



Fig. 14. Case 18.
6 days after onset.

Circulatory Symptoms.

In no case could any involvement of the endocardium be discovered.

The pulse was regular as a rule but irregularity was present in some cases towards the close of the disease. In the older children it was often full and bounding in the early stage, but in all the cases it was soon of poor volume and low tension and became very rapid and feeble in the more acute cases. Like the respiration the pulse varied widely from time to time during the 24 hours.

Integumentary Symptoms.

Complexion.

In many of the more acute cases there was a marked dusky appearance of the face accompanied by distinct cyanosis of the cheeks and lips.

Herpes.

Was present on the lips in five cases or 22% and in three of these it occurred on the 3rd, 4th and 5th days respectively. Fig. 13.

In one of the cases where herpes occurred on the lips it also broke out on the thumb of the right hand a week later.

Rash.

Rash.

In this series of cases a well marked purpuric rash was present in only one case but in this instance it was very marked. The spots were of a purplish black colour and were very irregular in size and shape but fairly equally distributed over the surface of the body. Petechial spots not unlike large flea bites were present in about five cases Fig. 14. Transient blotchy erythemas were occasionally noted and occurred in one case on the 45th day and lasted for about $1\frac{1}{2}$ hours. A measly papular rash occurred in two cases, in one of which it was present on the 11th day and remained for a week.

Livid mottling of the extremities was present in six instances and was usually present in the acute stages.

The 'tache cerebrale' was present in almost every case.

Complications and Sequelae.Blindness.

This was noted as being present in six cases. In two it occurred on the second day of the disease and of these it was present for about 12 hours in one and in the other case was permanent.

In/



Fig. 15. Case 13.
3 days after onset.



Fig. 16. Case 13.
3 days after onset.

In two cases blindness was noted on admission and of these one case remained blind until death occurred two days later, in the other it returned after ten days and was lost once more about six weeks later.

Deafness.

Was noted in five cases. In one case hearing was apparently absent ^{after} seven weeks illness but had returned about four weeks later.

In two instances hearing was lost on the 15th and 17th days respectively and remained permanently absent.

Joints.

Affecting of the joints was only present in one case and in this instance several joints were affected simultaneously. It was first noted on the 3rd day of the disease. The knee joints were chiefly affected and showed a considerable amount of swelling, and although no redness or sign of active inflammation was present the skin over the joints was glazed and there was some stiffness and pain on movement. The condition gradually subsided and was absent by the 14th day. Figs. 15 and 16.

Internal hydrocephalus.

In one case Fig. 17 this condition was evidently present/



Fig. 17. Case 13.

Late in the disease.



Fig. 18. Case 12.

3 weeks after onset.

present, and the protrusion of the eyes and downward displacement of the eye is well seen in the illustration.

Wasting.

Was very marked in some of the chronic cases and Fig. 18, shows the marked and rapid degree of emaciation which may take place. This illustration also shows the flattening of the abdominal wall which is very marked in chronic cases. I photographed this case about six weeks after the onset of the disease.

Blood.

The blood in every case showed a leucocytosis and of 18 cases where the number of these cells was estimated the lowest count was 12600 and the highest 51600. The average count was 25,436 per cubic millimetre. In 14 cases the glycogenic reaction was noted and was found to be present in twelve or 85% of the cases.

As regards the types of white corpuscles present I made differential counts in nine instances and found that the polymorpho-nuclear leucocytes were increased in almost every case. The percentage of these cells varied from 67% to 89% with an average in eight cases of 80.9%. In the ninth case the leucocytes had fallen/

fallen to 32% but the lymphocytes were in this case increased to 55.3%. In other cases the lymphocytes varied from 4.6% to 19%. The large mono-nuclear forms varied from .3% to 5.3% but were absent in two cases. The stimulation cells of Turck varied from 3.2% to 13% and the myelocytes from .3% to 4%.

The red blood corpuscles, exhibited no peculiarity and varied from 4320,000 to 5,450,000 while the haemoglobin varied from 60% to 82%.

In one case the meningococcus was obtained in culture from the blood.

Temperature.

This did not conform in any case to any particular type, but was very irregular, and occasionally made wide excursions. In some cases it was remittent in form for a day or two, in other mainly intermittent.

The highest temperature during the illness varied from 99.2^o F. to 105.6^o F. In seven cases the temperature reached 105^o F. and in other four it reached 104. Thus in 50% of cases it reached 104^o F. or over.

In some of the chronic cases the temperature became normal or remained sub-normal and the lowest temperature/

temperature recorded was 96.6° F.

Duration.

Of the 22 cases four were still living.

Of the cases that had died the illness had terminated,

| | |
|---------------------|------------|
| within 48 hours | 2 cases. |
| " 72 " | 2 " |
| " 4 days | 3 " |
| " 1 week | 2 " |
| " 2 weeks | 1 case |
| " 5 " | 4 cases |
| Longer than 5 weeks | <u>4 "</u> |
| | 18 cases. |

In those cases which had died within the first week the shortest duration was 36 hours.

Of the cases that lived over 5 weeks the longest duration was 100 days or $3\frac{1}{2}$ months. The average duration in the latter cases was 2 months.

Of the cases that were still living the average duration was 27 days.

Diagnosis.

When the disease is present in epidemic form the diagnosis is often comparatively easy. The severe/

severe form of the disease is not unlike typhus fever but the temperature does not remain constant at a high level but is very irregular.

Severe forms of influenza may also simulate the onset of the disease but as a rule the nervous symptoms are less marked and are of shorter duration. As regards other forms of meningitis; in the tuberculous form the onset is more insidious, the symptoms are mainly cerebral, and consciousness is lost as a rule at an earlier date. The cerebro-spinal fluid in the latter case is usually quite clear while in the epidemic form it varies from a yellowish purulent opacity to opalescence. The tubercle bacillus is sometimes obtainable in the former and the meningococcus is usually very evident in the latter.

With regard to the pneumococcus and pyogenic form of meningitis, spinal symptoms are rare and there is often distinct evidence of spread from the ear or nose, or in the latter disease from a general pyemic condition.

Prognosis.

The mortality of the disease according to Hirsch averaged from 20.75% in a collection of 41 epidemics.

The/

The mortality appears to be higher in children and up to April 16, the mortality in this series of cases was 81.8%

The onset of delirium and coma is an unfavourable sign and occurs early in rapidly fatal cases. The extent of the meningitis as evidenced by local and general signs such as opisthotonus and severe convulsions is some guide to the probable duration of the illness.

Vomiting and convulsions occurring late in the disease usually signifies the onset of internal hydrocephalous, from which recovery is extremely rare.

Treatment.

As regards drugs the treatment in this series of cases was mainly symptomatic. The bromides, chloral and in some cases opium was used to quieten the delirium and restlessness. Stimulation seemed to have little effect on the strength of the patient or the character of the pulse.

Lumbar Puncture.

In several cases the removal of cerebro-spinal fluid by this method was certainly beneficial and in five cases the symptoms were alleviated for a time but as a rule the benefit derived was not permanent and/

and only lasted a few hours.

This method of procedure accompanied by injection of one of the silver salts or a solution of lysol was tried in two or three instances, but with no beneficial result, and caused in one case a marked degree of restlessness and collapse.

Treatment by injection of various forms of anti-meningococcal serum was adopted in those cases sent to the City Fever Hospital but as a rule little improvement followed.

According to Flexner⁷, some of his experiments with injection of normal serum proved that it reduced appreciably the toxic effect of given doses of the meningococcus. As regards the same observer's results with injections of anti-meningococcal serum he states that several monkeys were saved from death due to experimental inoculation.

Hydrotherapy.

In the form of hot baths at a temperature of 98 - 100^oF. three times a day undoubtedly soothed many of the patients thus treated and some cried out loudly for this procedure often^{it} than was systematically carried out.

Pathology.

In those cases where the post mortem examination was/

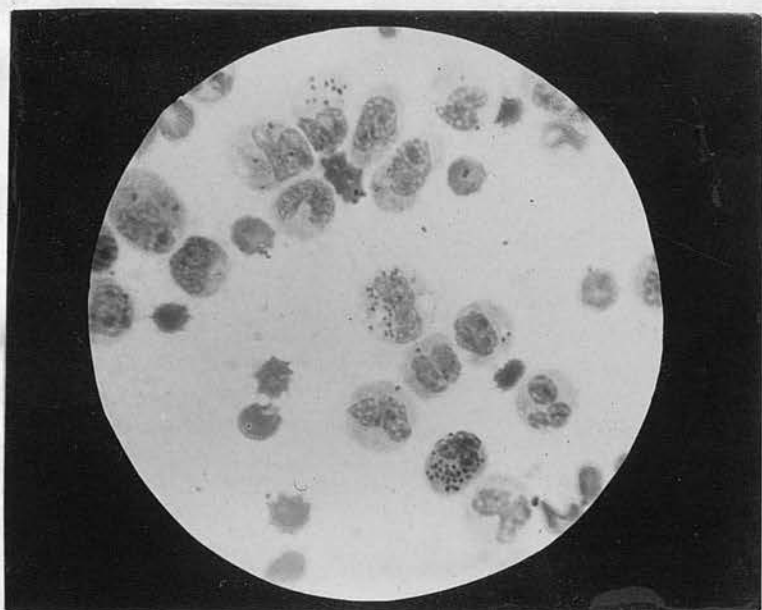


Fig. 19. Case 11.

was carried out there was usually a well marked basal and spinal meningitis except in chronic cases where the exudate had been largely absorbed. The spinal cord was more uniformly affected and pointed to earlier involvement.

As a rule the lungs showed great congestion amounting in some cases to actual pneumonia.

The other organs showed an extreme degree of toxic change and in some instances there was recent enlargement and hyperaemia of the mesenteric glands without much change in the alimentary canal.

Cerebro-spinal fluid derived from lumbar puncture showed great numbers of both intracellular and extracellular diplococci with the bacteriological characteristics of the meningococcus of Weichselbaum but the number present did not coincide with the severity of the disease. Fig. 19.

The fluid varied from a yellowish semipurulent turbidity to a slight opalescence due mainly to the presence of large numbers of polymorphonuclear cells.

In the majority of cases it escaped from the needle under considerable tension but in several it had to be withdrawn by means of a syringe.

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