Thesis for M.D. 1907

CEREBROSPINAL MENINGITIS

with special reference to

the

Epidemic Variety.

a study of 32 cases seen in

The Sick Children's Hospital, Glasgow.

June 1907.

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the Edinburgh Sick Children's Hospital the results were the same — of 23 patients 19 are dead, 4 are still alive, and no patient has yet recovered completely[1]. The great majority of the cases were chronic, and the tendency as the Epidemic went on, was for the cases to become more and more chronic, no acute case having occurred after January 21st. Including 1 case of 12 days the average duration for the acute cases was 4 2/3 days, for the chronic cases 50 days, and leaving out 4 cases who lived periods of 89, 68, 68, and 61 days the average duration was 35 2/3 days. In the American Journal of Medical Sciences Councilman states that the cases in which he performed post mortem Examinations, the duration of illness varied from 2 to 74 days. The average duration of the acute cases was 6½ days, while 28½ days was the average duration of the chronic cases leaving out the exceptional case of 74 days[2]

Of the Tubercular cases 1 was a male and 9 were females, and their ages ranged from 7 months to 7 years. As will be seen from the tables, whereas more

TABLE OF TUBERCULAR CASES

Case	Age		Sex	Date of Onset	Duration
	Y	M			
A	2	11	M	Oct 13th	10 days
B	2	–	F	" 23rd	16 days
C	7	–	F	" 24th	20 days
D	–	7	F	Nov 14th	Recovered Died Mch 28th from relapse
E	6	6	F	Jan 5th	40-50 days Recovery
F	1	9	F	" 20th	20 days
G	3	–	F	Feb 7th	20 days
H	2	4	F	Mch 4th	17 "
I	6	–	F	" 11th	22 "
J	2	10	F	" 12th	8 "

than half of the pyogenic cases were under 2 years of age, only 1/5 of the tubercular cases were under 2 years. 8 cases died, and 2 aged respectively 7 months and 6½ years recovered. (One of these cases relapsed later, and died of meningeal tubercle 4½ months after first being attacked by it. No case died in less than 8 days; 3/4 of those who died were ill for

about 3 weeks. This corresponds with a statement of Dr Cecil Walls who remarks that "a fatal termination almost always occurs in 23 days from the onset, generally on the 21st" (3)

The Epidemic cases fall into 2 main groups (1) The acute (2) The Chronic. (This classification is one employed by Dr Mya in the Lancet in 1900 (4)) a third class might be added — (3) the Subacute type.

As an instance of the acute type of case the following may be taken :—

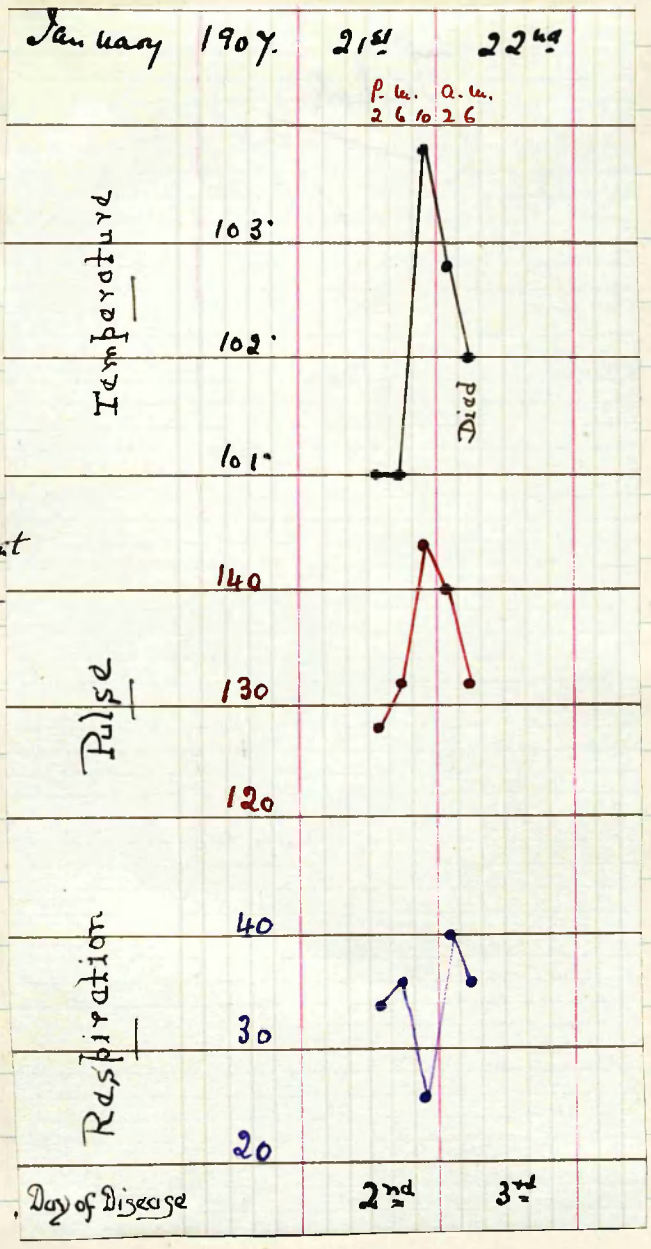
I Case 5, female, age 6 years. Temperature Chart I

This patient was admitted to the Sick Childrens Hospital on January 21st 1907 with a history of convulsions of one days duration. Patient had enjoyed excellent health till the preceding afternoon when she became heavy looking. (She had never suffered from otorrhoea.) About 5 o'clock on the evening of first day of illness she began to take general convulsions, and these were repeated every hour or two until her admission at mid-day on the 21st. She quickly became unconscious, but screamed out from time to time as if in great pain. From the time of her admission on the 21st until her death at 9.30 a.m. on the 22nd she was almost continually rigid — her arms were stiff, her fingers strongly flexed with the thumbs turned into the palms, her legs straight and rigid with her toes pointed; her neck was stiff, and her head and eyes were deviated to the right. This condition became more pronounced from time to time during exacerbations of the rigidity, and then too her head became markedly retracted. No herpes or rash appeared. Her pulse was rapid and feeble, but was not irregular. Her breathing was noisy and rapid, and her temperature ranged between 102 and 103° F. Nothing abnormal was made out in either heart or lungs. Lumbar puncture was done shortly after admission, and

Temperature Chart I

Acute Case

Case B f.
age 6 yrs



Showing elevation of temperature, pulse, and respiration throughout the whole short course of the illness.

turbid fluid spurted out at so greatly increased pressure that no accurate measurement of this could be made. It was at least 5 times as great as normal. The deposit was markedly polymorpho-nuclear, and showed the characteristic Diplococcus Meningitidis Intracellularis. At the post mortem examination the dura was found tense with its veins engorged. The veins of the cerebrum were dilated, and the whole surface of the cerebrum was oedematous, but pus was only distinct in a few of the Sulci in the Rolandic area. There was no pus at the base of the brain, or on the cord. The cerebral cortex, when cut into, was found markedly congested, and the ventricles were slightly dilated and contained turbid fluid.

The following case is an example of the "Subacute" type of case:-

Case 7 Age 11 years, female. Temperature Chart II

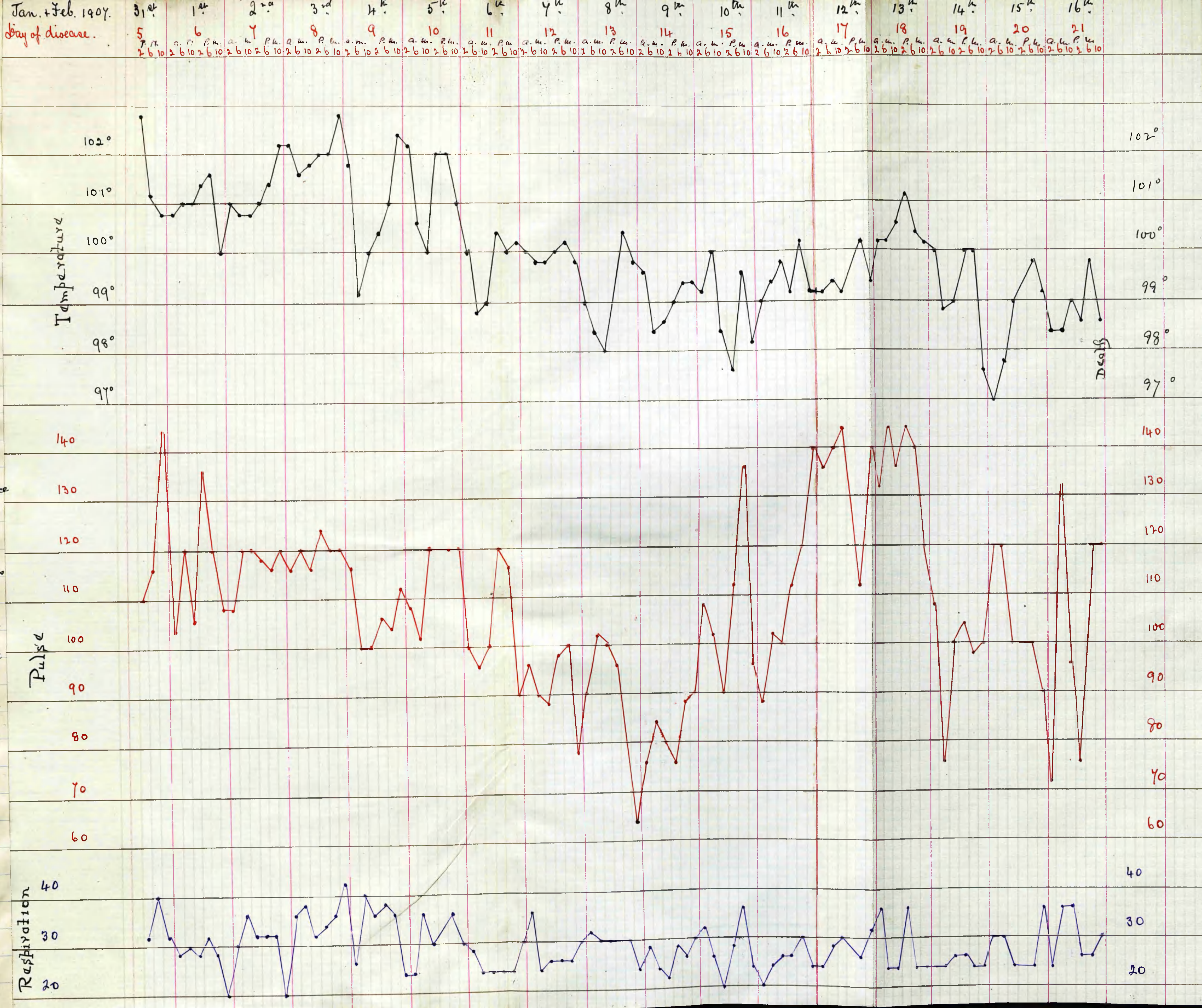
On the evening of January 27th patient began to complain of severe headache. — Prior to this her health had been excellent. — During the night of the 27th patient was twice sick and vomited. On the following day she complained of pain in the epigastrium and right chest. She was examined by a doctor, but the cause of her illness was not discovered. On the 29th she was again sick and vomited twice. On the 30th she again complained of pain in the chest this time on the left side. When admitted to Hospital on the 31st she was rigid from head to foot, and could be lifted up like a board. There was a profuse herpetic eruption on both lips, and at the side of the nose. She was fevered, her temperature being 102.8° F. Her tongue was coated with a white fur. Her head was only slightly retracted, but her neck was stiff, and her head could not be pulled forwards. Kernig's sign

Temperature Chart II

Case 7, f. age 11 yrs

Subacute case

Showing gradual fall of the temperature with slight recrudescence towards the end, and great variations and at times slow character of the pulse during the latter part of the illness



was well developed. Neither the knee nor the plantar reflexes could be elicited, and no ankle clonus was present. Patient was extremely hyperaesthetic, and could not bear being touched. Her urine contained a faint haze of albumen. Nothing abnormal was found in the thoracic organs. For the next 2 or 3 days patient remained in much the same condition muttering away in a delirious fashion, but answering rationally when addressed. She was very sleepless, and never slept without a sedative. Within the next few days the rigidity became much less marked, and the temperature began to remit somewhat. By about the 15th day of illness the temperature touched normal (see chart II). She still however objected to being disturbed, and was extremely quiet. Throughout her whole illness she was obstinately constipated. From the 12th day of illness patients pulse had a tendency to be very irregular, and often became very slow. From about the 16th day of illness she began to be sick once or twice daily, and though her temperature only rose a degree or two above normal, and her rigidity became progressively less marked, she was apparently not improving as well as one would have liked. She died suddenly during the night on the 21st day of illness, and unfortunately no post mortem examination was granted. Lumbar puncture, done on the 5th day of illness, showed the pressure to be 4 or 5 times normal; the cerebro-spinal fluid was turbid, and deposited a heavy sediment in a few minutes; the cells were polymorphonuclear, and numerous Diplococci Meningitidis were present. Repeated on the 13th day the pressure was found less — 2 to 3 times normal, the fluid was less turbid, and the cellular element and organisms were as before.

The following is an instance of the "Chronic" type of case:—

Case 2 Age 4 months, male.

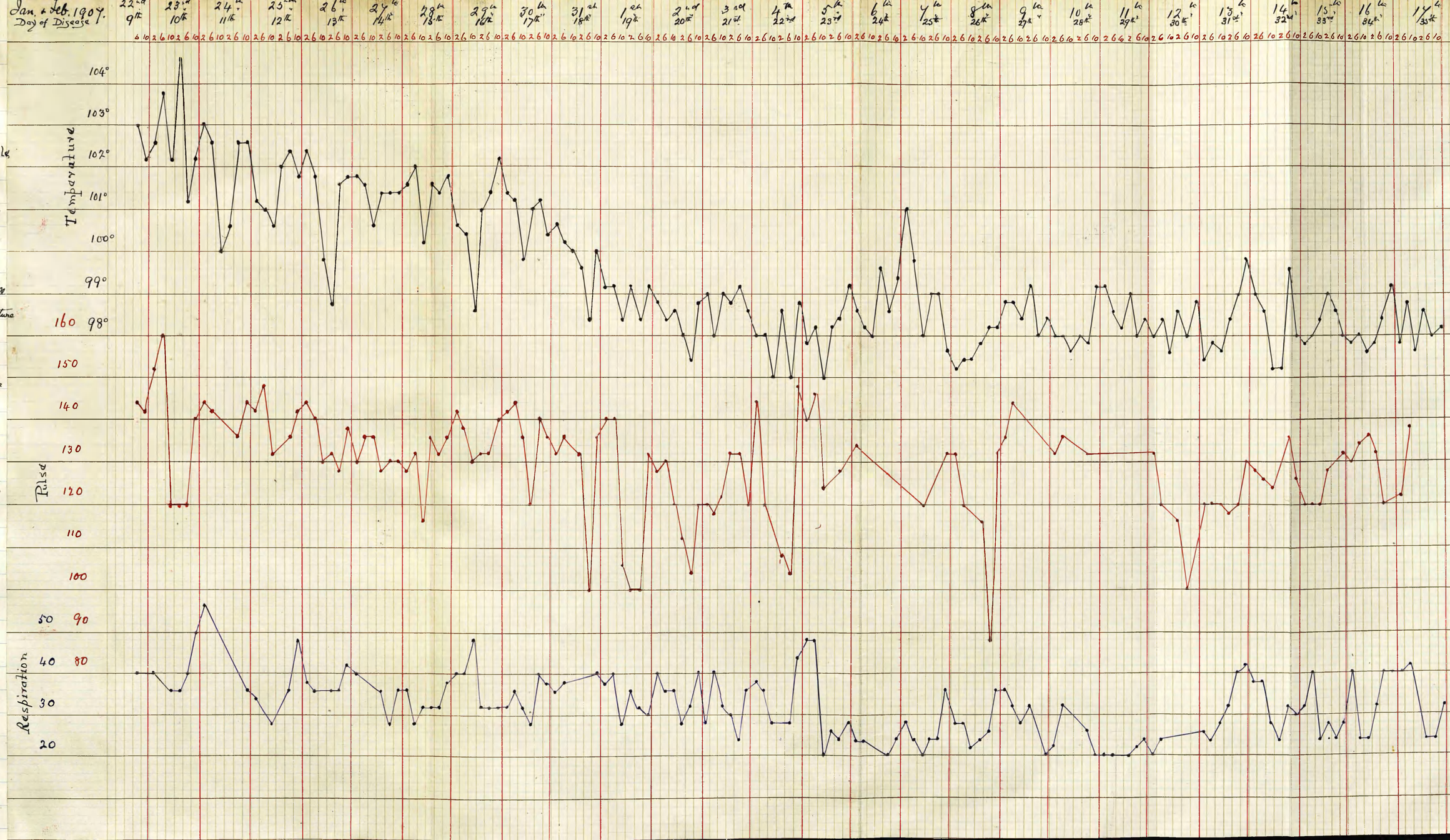
Patient was a healthy well-nourished child till October 20th 1906 when his head became retracted, and he began to lie with his eyes wide open and staring. About 1 week later the parents noticed that the child's head was swelling, and was becoming longer in shape. When admitted to Hospital on the 30th the child's head was swollen, ~~and~~ the anterior fontanelle was large and bulging, ~~and~~ the bones were widely separated. The temperature was 100° F, and the pulse on the first day of residence was noted as ranging between 116 and 160 beats per minute. Kernig's sign was present, but was not very marked. The child apparently did not see, as he took no notice either of a bright light, or of the fingers when they were waved in front of his eyes. His pupils were equal and moderately contracted. No herpes or rash was present at any time during the illness. There was no retraction of the abdomen though the child was obstinately constipated. A Lumbar puncture showed a few typical diplococci. As time went on the child's back became greatly arched, his head often nearly touching the middle of his spinal column. The arms and legs too showed a varying amount of rigidity. The legs were usually strongly flexed at the hip and knee; the arms were stiff and semi-flexed; the fingers were slightly flexed with the thumbs turned in to the palms. The spinal canal and, later, the ventricles were frequently tapped, Quantities of fluid up to 1 ounce being regularly drawn off, but still there was no appreciable alteration in the condition. The fluid from the ventricles showed the typical growth of the intracellular organism, small round transparent beads, like drops of moisture. The temperature which had ranged between 103° and 97° F gradually settled

Temperature Chart III

Chronic Case

Case 4, female, age 6 mths

Showing (a) gradual fall of the temperature and (b) marked variations in the pulse rate.



down, and for the last few weeks it never rose above 101°F. The child gradually wasted away requiring nasal feeding for the last week. The whole illness lasted 38 days. At the post-mortem examination the dura mater was found tense, and the cerebral convolutions were flattened. There was a large collection of pus in the basal cistern, and there was a layer of purulent exudation along the whole posterior surface of the cord. The ventricles were not opened as the specimen was preserved for museum purposes, but a large quantity of turbid fluid ran out of the 3rd ventricle when the infundibulum of the pituitary body was cut across.

The pneumococcal cases in no way differed clinically from the acute meningococcal cases except in as much as all were probably secondary to other mischief.

The following is an example of the Tubercular cases:-

Case G Age 3 years, female. Temperature Chart IV

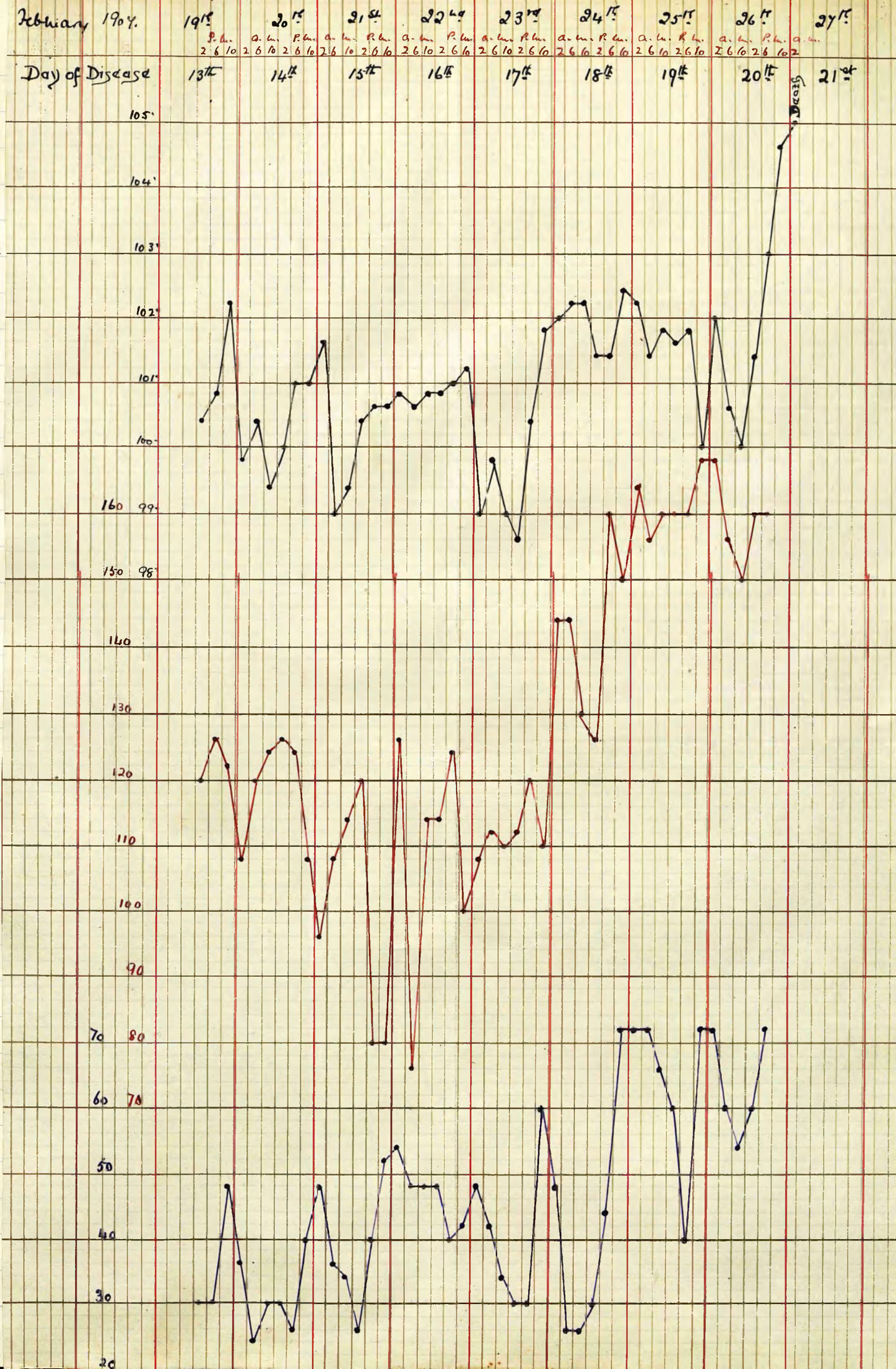
This patient was admitted to Hospital on February 19th '07 with a history of 12 days illness. The history was as follows:- From about the first week in February the child began to go off her food, and was fevered at nights. She became very costive, and her bowels would not move without medicine. She lost flesh steadily, and from time to time complained of abdominal pain. No history of tuberculosis in the relatives could be obtained. On admission the child was fevered, her cheeks were flushed, and there was a white fur on her tongue. A slight tache cerebral was present. No knee jerks could be elicited, and the plantar reflex was of the Babinski nature. There was no retraction of the

Temperature Chart IV

Tubercular case

Case G female age 3 yrs

Showing hectic temperature and ante-mortem rise of temperature



abdomen. The pupils were Equal, and responded well to light. 2 days later the pulse became very irregular, and the child was somewhat drowsy. The temperature had been hectic since admission. Lumbar puncture was done at this stage, but no fluid was obtained. On the 23rd a marked left internal squint developed. Lumbar puncture was done again, and this time 8 drachms of clear fluid were drawn off. The pressure was slightly above normal. The centrefugalised deposit was markedly mononuclear, though there were a considerable proportion of polymorphs. No pyogenic organisms were found, but Tubercle bacilli were present in considerable numbers. (see Specimen G)
The child became unconscious on the 24th. There was no alteration in her condition till the 26th when the right side of her face began to twitch. This was repeated several times before her death on the 27th.
The twitchings lasted 2 or 3 minutes on each occasion.
On the second last day of illness Kernig's sign was present. At the post mortem Examination an acute miliary condition of the lungs, kidneys, spleen, liver, peritoneum and meninges was found. Tubercles were present on the vessels of the median aspect of the Cerebrum, at the base of the brain, in the Sylvian fissure, and in the choroid plexus. There was some matting in the Sylvian fissure, and at the base. The ventricles were moderately dilated.

On Examining the "Clinical features and Post-Mortem findings" of the Non-tubercular cases we note :—

I Previous Health.

In all the meningococcal cases the previous health was good. In one there was a history of a wetting, and another had otorrhoea. One of the pneumococcal cases

was a weakly child, and had been in bad health for some time, and another was probably suffering from broncho-pneumonia when attacked, but prior to that had been quite healthy. Dr J. Lewis Smith says that since the Epidemic in New York in 1872 he has made careful inquiry into the previous health, and with only 2 or 3 exceptions he found the previous health good, or, if symptoms of ill health antedated the Cerebro-spinal fever, they were due to some ailment entirely distinct from the disease. (5)

II History of Onset.

With one exception the onset was sudden in every case, and often the exact hour of invasion was known. As an example we may take the following case — a boy, aged 6 years, was out playing one afternoon. He suddenly sat down and began to shiver violently. He was taken home and then he began to vomit and complain of violent headache. He was dead within 3 days. — This sudden onset is an almost invariable feature of the disease. In the New York Epidemic in 1904 out of 100 cases only 3 showed prodromal symptoms (6) Of the early symptoms vomiting was almost invariably present, and pain in the head was usually complained of. With one exception every patient over two years complained of it, and several of those under two indicated the same by crying and putting their hands to their head. In addition one or more of the following symptoms were present at the onset — convulsions, rigors, pain in the legs or epigastrium, a dazed staring look or retraction of the head.

III Nervous Symptoms

(1) Pain Of the 10 children over 2 years of age, as already noted all except one complained of pain in the head. In addition 2 complained of pain in the neck, 2 of pain in the epigastrium, 2 of pain in the legs, 1 of pain in the back, 1 of pain in the chest, and 1 of pain in the throat and ears. Many were too young to indicate much in the

way of pain.

(2) State of mind — The most common condition was one of apathy. The patients were very often quite conscious though at times the apathy bordered very nearly on unconsciousness. As a rule however it was only towards the end that the patients became quite unconscious. This retention of consciousness was remarked on by Faure Villars as early as 1839. "The delirium and coma", he says, "yielded momentarily when the attention of the patient was fixed by a loud word. The replies were brief but lucid, and this preservation of the intelligence is not one of the least remarkable phenomena of the disease."(7) Delirium was not a common feature. 5 in all were delirious at some period of their illness. In 4 it was nocturnal. One was continuously delirious.

(3) Hyperaesthesia — Almost without exception the patients were extremely irritable if touched; indeed this hyperaesthesia was one of the most marked features of the disease being absent only in one or two cases that were early comatose.

(4) Contractions of Muscles — Under this heading the most noteworthy symptoms are head retraction, and orthotonos, or even opisthotonos. Less common features are extreme flexion of the thighs and legs, and clenching of the hands. Head-retraction was present in 18 out of the 22 cases, but in all, with the exception of 1 pneumococcal case, the muscles of the neck were stiff, and the head could not be flexed on the chest. In 7 cases the retraction was very well marked, in the other 11 it varied from a moderate amount of retraction to such a mild degree as was barely noticeable. It was much more marked in chronic cases than in acute. (see all the figures except Fig 4.) Opisthotonos was present in 5 cases and was well marked. (see Figs 1, 2, 3.) In 7 others there was orthotonos. Both the head retraction

Fig I Case 4

Shows marked Retraction and Opistotonos

Fig II Case 4

Same case in natural position

Fig III Case 18

Shows marked retraction and opisthotonos

Fig IV Case 12

Shows strong flexion of legs and thighs without retraction of head

Fig V Case 11

Same as Fig IV with retraction of head

Fig VI Natural Position Case 11

showing head retraction better

Fig VII Case 14

Showing Head retraction with complete absence of flexion of legs and thighs.

Fig VIII Case 9

Showing Head Retraction with some retraction of the abdomen.

and the opisthotonos varied from time to time, but became more pronounced the longer the illness lasted. The movements of the neck in an antero-posterior plane were ~~only~~ quite free in only one case, a pneumococcal case. Head retraction is so marked a feature of this disease that in Germany it has given a designation to the disease itself (Nackenstarre). Various explanations have been brought forward to account for it. Burdon Sanderson has attempted to show that it is a direct consequence of the pain so often complained of, but Edward W. Collins refutes this by instancing a case where, though no pain was complained of, there was great retraction of the head.(8) Several of our cases with very marked retraction lay quite quietly in bed apparently suffering no pain at all.
Flexion of the legs at the knee and hip was present in fully $\frac{1}{3}$ of the cases. In some it was very marked, (see Figs 4+5), in others less so. (see Fig 1.) In others the legs were extended either rigidly or lying quite flaccid. (see Fig 7). Rigidity of the arms was less marked. In about $\frac{1}{2}$ of the cases there was some stiffness of the arms with clenching of the hands. In 1 the arms were strongly pronated throughout the whole course of the illness

(5) Convulsions, twitchings, or varying rigidity.

General convulsions occurred at the onset of the illness in 3 cases. In 4 the illness was a series of convulsions from beginning to end. 2 of these latter were pneumococcal cases. In another case a terminal convulsion occurred. In 5 cases twitchings or irregular jerkings were noticed in the hands or feet. 1 case had a continuous tremor of the jaw, and in 3 there were twitchings of the mouth or side of the face. In about $\frac{1}{4}$ of the cases there was a certain amount of varying rigidity of the arms and legs, or of the whole body.

(6) Paralysis This was an uncommon symptom. Netter says that in certain epidemics paralysis seems to be entirely absent(9). In 2 cases there was slight facial paralysis. A paralytic squint however was present in nearly $\frac{1}{3}$ of the cases. In

1 or 2 it was double. It was usually fleeting, but occasionally became continuous. Neller noted this symptom in only 2 of his cases, but states that J. Lewis Smith found it quite regularly.(10)

(7) Reflexes. Of 15 cases, in which these were noted, the knee jerks were increased in 6, 2 of these being pneumococcal cases. Both jerks were absent in 4 cases, and the right was absent in 2 others. Omerod states that in 23 cases examined by Strumpell in Leipzig in 1879 the knee-jerks were absent in 5 cases. Sometimes the jerks were lively, sometimes much increased.(11) The Plantar reflex was extensor in 6 cases, flexor in 8 and in 1 it was absent. Ankle clonus was only noticed twice, once slightly, once very markedly. The latter was a pneumococcal case.

Kernig's sign was absent in 7 cases, two of these being pneumococcal. It was present in 14 cases; in 4 of these it was very marked, in 10 it was slight. In a few cases it was only present from time to time, and in 3 it was present on one side only; in 1 of these, however, it was present on both sides at a later stage of the disease. This sign, one of the most marked of the disease was pointed out by Kernig in 1884. He notes that by putting the patient into the sitting posture (or flexing his thighs as he lies) a certain spasm is induced in the flexors of the knee, so that this joint cannot be completely straightened out.(12) Dr Osler considers this sign of the greatest possible importance, and speaking in 1901 remarks that he found it present in all the cases of meningitis in which it was looked for, and in no case in which meningitis was absent.(13) On the other hand Koplik states that he attaches no value to the sign in young children, on account of the age and spasticity, inferring therefore that it may be present without any inflammation of the meninges.(14) With regard to the

cause of the sign various theories have been put forward. Dr Cecil Wall of London states that the stretching of the sciatic nerve involved in bringing out the sign causes traction on the spinal meninges, and that consequently the hamstrings contract to prevent this.(15) The presence of this sign on only one side in 3 of the present cases is rather against this view, as traction on the meninges would be caused on both sides.

IV Digestive The tongue was usually coated with a white fur. Vomiting, as already noted, occurred at the beginning of the illness except in a few cases. In the chronic cases it was usually marked also in the later stages, and interfered greatly with nutrition. Two thirds of the cases were markedly constipated, but retraction of the abdomen was only noticed in 2 or 3 and was very slight. (see Fig 8) 4 suffered from diarrhoea. Emaciation became very extreme in the chronic cases, the patients being little more than skin and bone. Most of them had to be fed nasally towards the end, and in a few, where vomiting was very persistent, rectal feeding was tried. A very profuse and continuous discharge of muco pus from the naso pharynx was present in 3 or 4 cases.

V Pulse As one would expect in a febrile condition the pulse was, as a rule, accelerated. This corresponds with the findings of Ed. Collins in his report on Cerebro-Spinal Meningitis.(16) On the other hand Netter states that for 3 or 4 days at the start the pulse is rather slow, and then is replaced by a notable acceleration.(17) In ¼ of the cases at some period of the illness the pulse was noted as slow. In ½ the cases some irregularity was noticed from time to time during the illness. This was either in rate, or volume, and occasionally it was in the form of intermittency. One of the most marked features however was the great and rapid variation in rate that often occurred, records such as the following being by no means uncommon:- 100, 90, 72, 132, 96, 76, 120 (see Chart II)

116, 88, 132, 136, 144, 132 (see Temp. Chart III), the pulse being taken at intervals of 4 hours. These variations were quite irrespective of the temperature curve. This has been noted in other Epidemics; for example:- J. Lewis Smith obtained the following figures — in an infant of 2 years 136, 152, 130, 132, 136, 140, 152, 140, 136, and in a child of 6 years 120, 120, 88, 86, 92, 124, 128, 120. (18)

VI Temperature. Elevation at the onset of the illness was the one constant feature of the series. This is apparently not always the case, as Neller remarks that Cerebro Spinal Meningitis may be apyretic at the outset, and may remain so indefinitely. (19) In the acute cases the temperature remained elevated throughout. (see Chart I) In the chronic cases the fever always exhausted itself sooner or later, in some falling to normal in a few weeks or less, (see Chart V) in others continuing for many weeks, but eventually approaching normal. A (See footnote) (see Chart III) One type of temperature that occurred in a number of the chronic cases calls for notice. This was of an intensely intermittent character, a fall or elevation of 8 degrees in 12 hours being by no means uncommon. (see Charts VI & VII) This character of the temperature is so well recognised that by many an "Intermittent" type of the disease is recognised, and Neller notes that sometimes quinine has been given with a lavish hand, under the impression that the case was one of true intermittent fever. (21)

VII Respirations:- Where there was no lung complication the respirations were usually only slightly elevated. Irregularity or any approach to Cheyne Stokes breathing was rather unusual

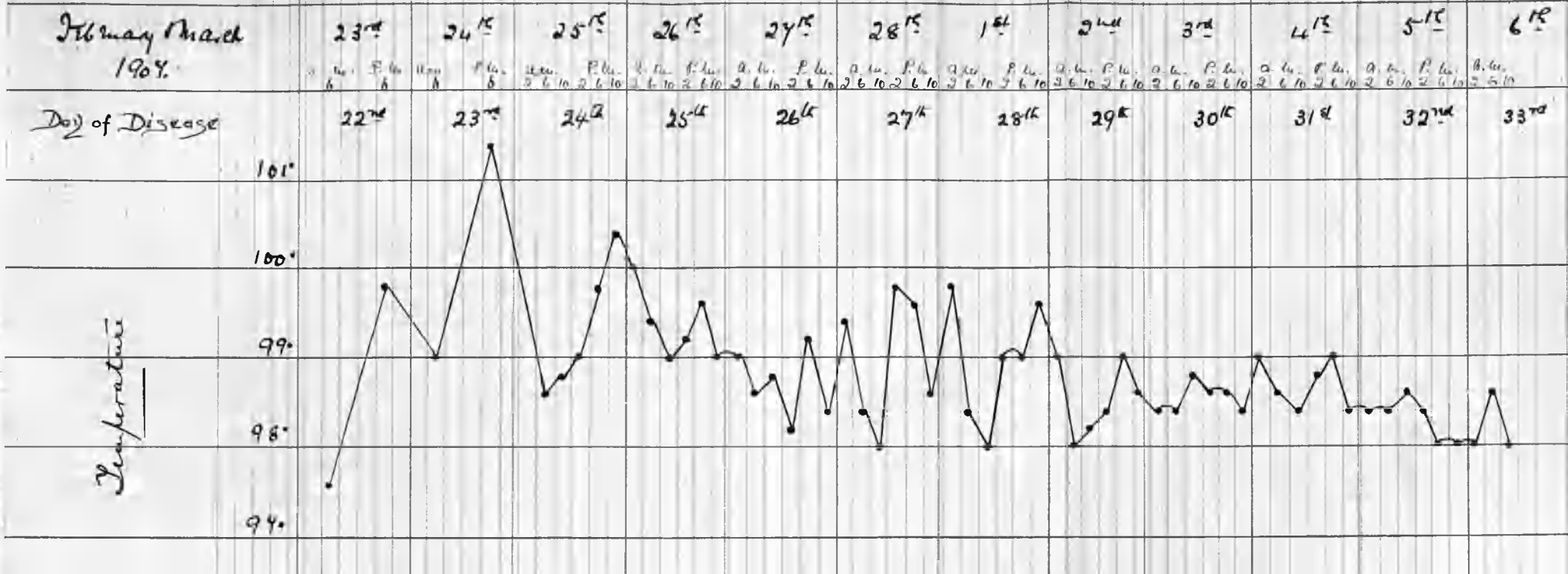
VIII Cutaneous Surface. The skin was usually flushed at the onset, and later assumed a very marked pallor. Rashes, which are often a striking feature of the disease, were rarely seen. A petechial rash was never seen. In the present epidemic in Scotland, as far

[A Dr Stanford records 3 fatal cases when the temperature remained normal for weeks without other signs of improvement (20)]

Temperature Chart V

Case 9 female age 1 1/12 yrs

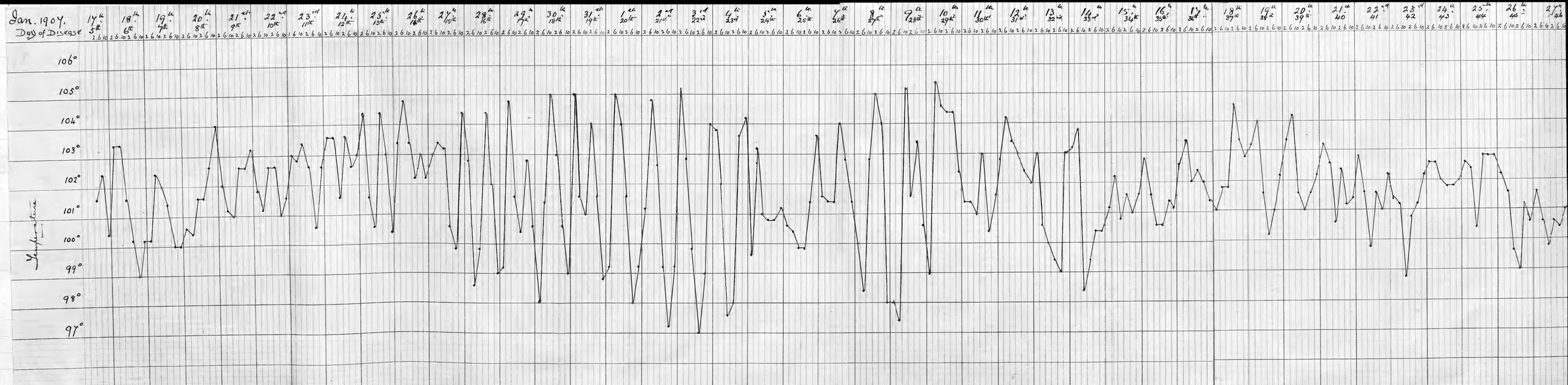
Fatal case in which temperature fell to and remained abnormal after being elevated for 4 weeks



Temperature Chart VI

Case 3 male age 3 yrs

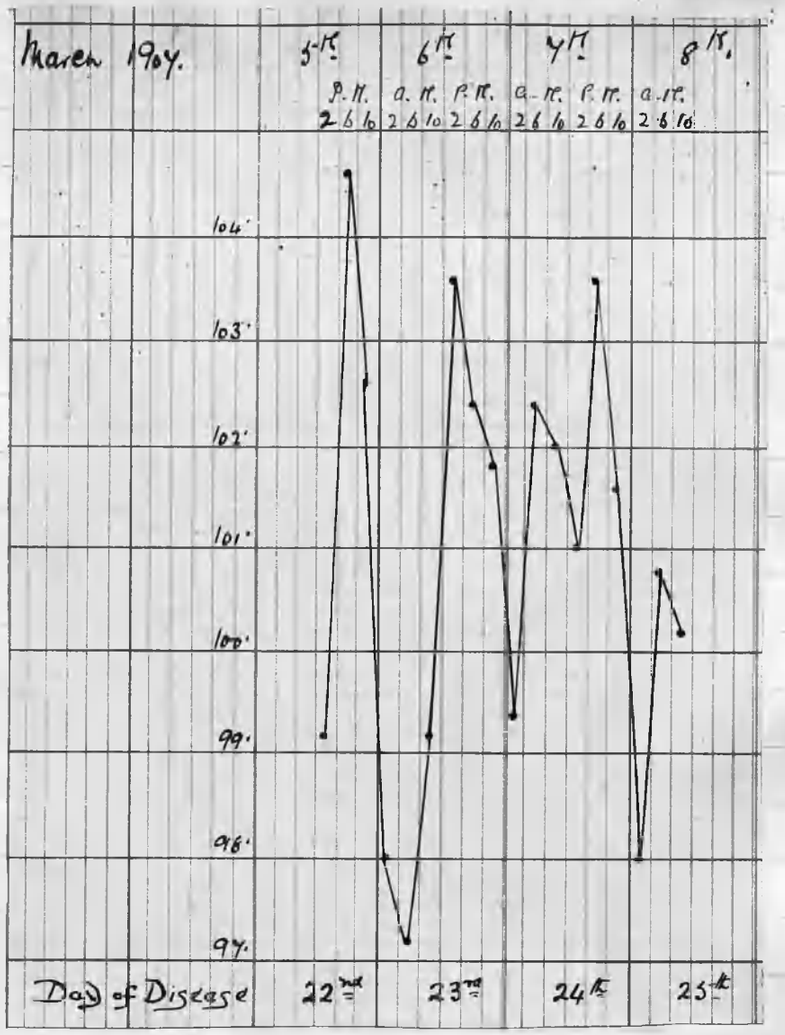
Showing great intermittency of the temperature



Temperature Chart VII

Case 12 female age 11 mths

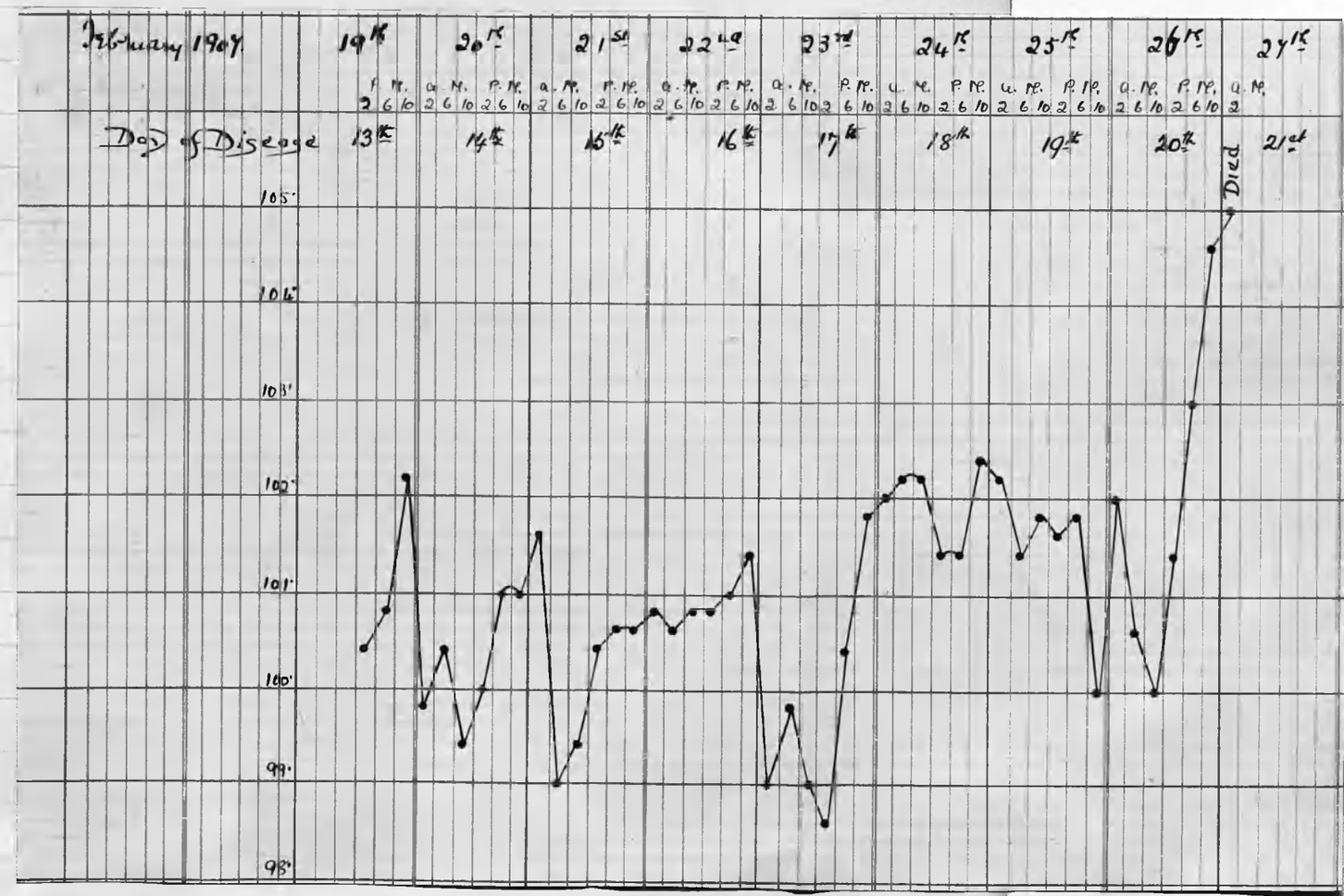
Showing intermittent character of the temperature



Temperature Chart VIII

Case G female 3 yrs

Showing ordinary character of the temperature in Tubercular Meningitis with an "Ante-mortem" rise.



as published cases go, there have not been many instances of true purpura. Among the cases reported by Dr Fowler from Edinburgh a true haemorrhagic rash was present in 3 cases. In one the whole body was covered with purpuric spots, varying in size from a pea to a threepenny piece, with a large extravasation over the knee joint. In a second case, on the morning of admission, (2nd day of illness) the rash consisted of reddish purple macules, sparsely scattered over the chest and arms; next morning most of the spots had faded, a few had become haemorrhagic, and persisted till death.(22) Dr Chalmers gives notes of 3 cases where a few spots, petecial in character, and irregularly distributed, were present.(23) Later Dr Wright notes 3 cases where a few purpuric spots were present(24) One case reported by Dr James Hamilton showed a diffuse purpuric eruption some spots being as large as threepenny pieces.(25) Profuse herpes was present twice on the lips, nose, and cheek. Statements with regard to this symptom are very conflicting. For instance Oberod says "Herpes of the lips and face is so frequent that it has been called characteristic of the disease."(26) Stillé notes of the Massachusetts epidemic that "herpes labialis was noticed in a few instances ——— it is certainly much less common as a symptom of epidemic meningitis than either roseolous or petechial spots."(26) A pustular rash was seen twice late in the disease, in one on the face head forehead and buttocks, in the other on the lower part of the back. Tache cerebrale was present in 12 cases and absent in 5.

IX Urinary Organs The urine in more than half of the cases contained a haze of albumin. Twice it was very much diminished, and twice it was in excessive Quantity (B) footnote.

X Special senses (a) Vision Squint has

B [In Keating's Diseases of Children it is noted that Mosler observed a boy aged 7 years who had an excessive secretion of urine which dated back to an attact of Cerebro-Spinal fever in his 3rd year, the polyuria probably being due to injury to the nervous system.(27)]

already been considered. The pupils were usually medium in size, equal, and reacted well to light. In 3 cases they were contracted, and in 2 they were dilated. In 5 cases they were unequal. In 2 they reacted only slightly and sluggishly to light, and in 1 they were fixed. In 2 the eyes were oscillating, and in 1 they were deviated to the right. 1/3 of the cases were apparently blind, and in 2 others the sight was defective. 4 had retraction of the upper eyelids, showing a rim of sclerotic above the cornea, and giving a peculiar staring look to the eye. One case presented a corneal ulcer with a severe conjunctivitis, while another showed a corneal ulcer with a hypopion

(b) Hearing Nearly 1/3 of the cases were unable to hear.

XI Complications Very few were seen. One case had a complicating Pneumonia. Another had a synovitis of the right elbow. This latter is interesting as it has at times been of so frequent occurrence as to give rise to the term "Joint Fever" as one of the many synonyms of the disease. Two cases presented the eye complications already noted.

XII Lumbar Puncture Occasionally a mechanical difficulty presented itself, and for some reason the fluid would not run. In all cases however this was eventually overcome. The pressure was almost always increased, the fluid usually running from the needle, sometimes spurting violently out. Sometimes the fluid was merely hazy, but usually it was quite turbid, and occasionally it was pure pus. The deposit was always markedly polymorphonuclear. Dr. F. Peyton Rous, in a record of Cases in the American Journal of Medical Sciences, states that in acute cases the pressure is always high, and the same

remark applies to the cell content.[28] Diplococci were usually abundant in the acute cases, and more scanty in the chronic especially if examined late in the disease. Dr Osler states that the later the disease the less likelyhood is there of finding the organism. If moderately early it is usually found.[29] In the present cases it has been found as late as the 45th day (Case 3) J. Huber states that he has found it as late as the 104th day[30]. A large number of the organisms were extracellular, but a considerable proportion were intracellular, the polymorphs sometimes being literally bursting on account of the number of organism they contained. In one of the pneumococcal cases only one or two organisms were seen. In the others the organisms were numerous, all extracellular and definitely encapsuled (see Specimens)

XIII Post Mortem appearances. Among the acute cases those dying earliest presented oedema of the whole surface of the cortex with pus distinct only in a few of the sulci, and presented also congestion of the cerebral cortex. Dr Osler remarks that in malignant cases there may be no characteristic changes, the brain and spinal cord showing only extreme congestion[31]. This was the case in one of our pneumococcal cases. In those dying a little later there was distinct pus along most of the sulci of the cerebrum, as well as in the basal cistern, and on the cerebellum, medulla and upper part of the cord. There was usually no excess of fluid in the ventricles. In the Subacute cases there was a moderate amount of turbid or frankly purulent fluid in the ventricles, and pus had extended further down the cord. In the Chronic cases the ventricles were greatly distended with turbid or purulent fluid, the convolutions were

flattened and no pus was present in the sulci, but there was a large collection of pus in the basal cistern, and the pus also extended out along the Sylvian fissure, and between the cerebellum and cerebrum. There was also a thick layer of pus along the posterior surface of the cord.

Comparing the symptoms &c, found in the 10 Tubercular cases we note.

I Previous Health The previous health was very often bad, and the children were usually badly nourished and delicate.

II Onset. The onset was almost always gradual, and was preceded by a period of failing health. For Example :-

Case C age 7 years female. Admitted Nov. 14. 06

3 weeks prior to admission patient began to go off her food. She lost flesh, was fevered in the evenings, and broke out into profuse perspirations. She became very costive-her bowels rarely moving without medicine. One week prior to admission she began to complain of pain in her temples, took to bed, and objected very much to being disturbed. Her temperature remained heetic, she became very dazed, and heavy looking, and gradually by about the 3rd week in November began to show definite signs of Meningitis. This however is not the invariable mode of onset, as will be seen from the following case

Case J age 2 10/12 years, female.

This child suddenly turned pale on March 12th, began to retch and to complain of pain in her head and neck. On the morning of the 13th she was dull and heavy looking, and took no notice of anything. Twitchings of her left arm and leg were noticed. By the evening she was quite unconscious. In this case Lumbar puncture showed no pyogenic organisms. The

deposit was mononuclear and tubercle bacilli were present (see Specimen) Other similar cases have been reported for example Dr Raw relates the following case A child, aged 8 years, complained of severe pain in the head and vomited on February 10th On the 12th he became very drowsy. When admitted to Hospital on the 13th he was quite comatose. (32)

III Nervous Symptoms Head retraction was present in very few of the Tubercular cases and only in 1 case was it at all marked. There was never any opisthotonos. Usually however there was a contracture of some kind. One or both hands might be clenched; one or both legs might be drawn up and stiff; the head might be deviated to the right or left, or one or both arms might be flexed and stiff. Convulsions were not so often noticed and were never so marked as in some of the pyogenic cases. Isolated twitchings, however, as of the face, the side of the mouth or arm, or a tremor of the hands, were often present.

Paralysis Strabismus was present oftener than in the Meningococcal cases, but otherwise paralytic symptoms were almost entirely absent in these cases — one child, however, had a ptosis of the right eyelid.

Reflexes The knee jerks were almost always absent. The plantar reflex was as often of the Babinski nature (extensor) as it was flexor. Kernig's sign was only present in 3 cases.

IV Digestive Retraction of the abdomen was present in about ½ of the cases thus differing markedly from the Meningococcal cases.

V Pulse This was only accelerated in a small proportion of the cases. In 3 it was markedly slowed throughout almost the whole course of the illness. Almost without exception

irregularity was present at some period of the illness, and often this persisted for a considerable time. Variation in the pulse rate, though not as often present, was quite as marked, when present, as in the meningococcal cases. For instance the pulse taken four hourly was in Case H. 120, 104, 176, 148, 144, 140, 168 (see Chart IX), " Case D. 120, 80, 80, 126, 76, 114. (see Chart IV) " Case C 114, 76, 104, 105, 160, 156, 132 (see Chart X).

VI Temperature The temperature was always hectic throughout and often ran up at the end to 105°, 106°, and 107°. (see Charts VIII+X) It did not show the same tendency to exhaust itself, and never showed the striking intermissions that were seen in the meningococcal cases.

VII Respirations The respirations showed a greater tendency to irregularity, sometimes being of the Cheyne Stokes variety.

VIII Special Senses. The pupils were unequal in these cases more often than in the meningococcal. Otherwise they behaved in much the same manner

IX Lumbar Puncture The fluid was always clear, and the deposit mononuclear. The pressure was usually increased Bacilli were abundant in 4 cases, were present though often scanty in 4 or 5 others, and in 1 were not found.

X Post Mortem appearances. These were widely different from the meningococcal cases. There were tubercles along the vessels at the base of the brain, in the Sylvian fissures, on the cerebrum and cerebellum, and in the Choroid plexuses; there was matting at the base, along the Sylvian fissures, and between the cerebrum and cerebellum.

Shortly stated the differences noted were

I That whereas in the Epidemic form the onset is sudden, and the patients are usually in very good health when

struck down by the disease, in the tubercular cases the onset is gradual, and the disease is at least preceded by a period of failing health. This however was seen to be not an invariable rule.

II That whereas Head retraction and Kernig's sign are almost invariable accompaniments of the epidemic disease, in the tubercular form they are uncommon, and anything like Opisthotonos is rare.

III That, though individual paralyses are usually considered much more frequent in Tubercular Meningitis than in the Epidemic form, with the exception of Strabismus this was not noticed in these cases.

IV That while retraction of the abdomen was a marked feature of the Tubercular cases, it was quite uncommon in the epidemic.

V That slowing and irregularity of the pulse were more marked features of the tubercular disease than of the epidemic form

VI That while rapid variations in the pulse rate are very characteristic of the Epidemic disease they are often present in the tubercular form.

VII That great intermissions in the temperature which are often seen in the Meningococcal cases are not found in the tubercular.

VIII That irregularities of the respiration are more common in the tubercular disease

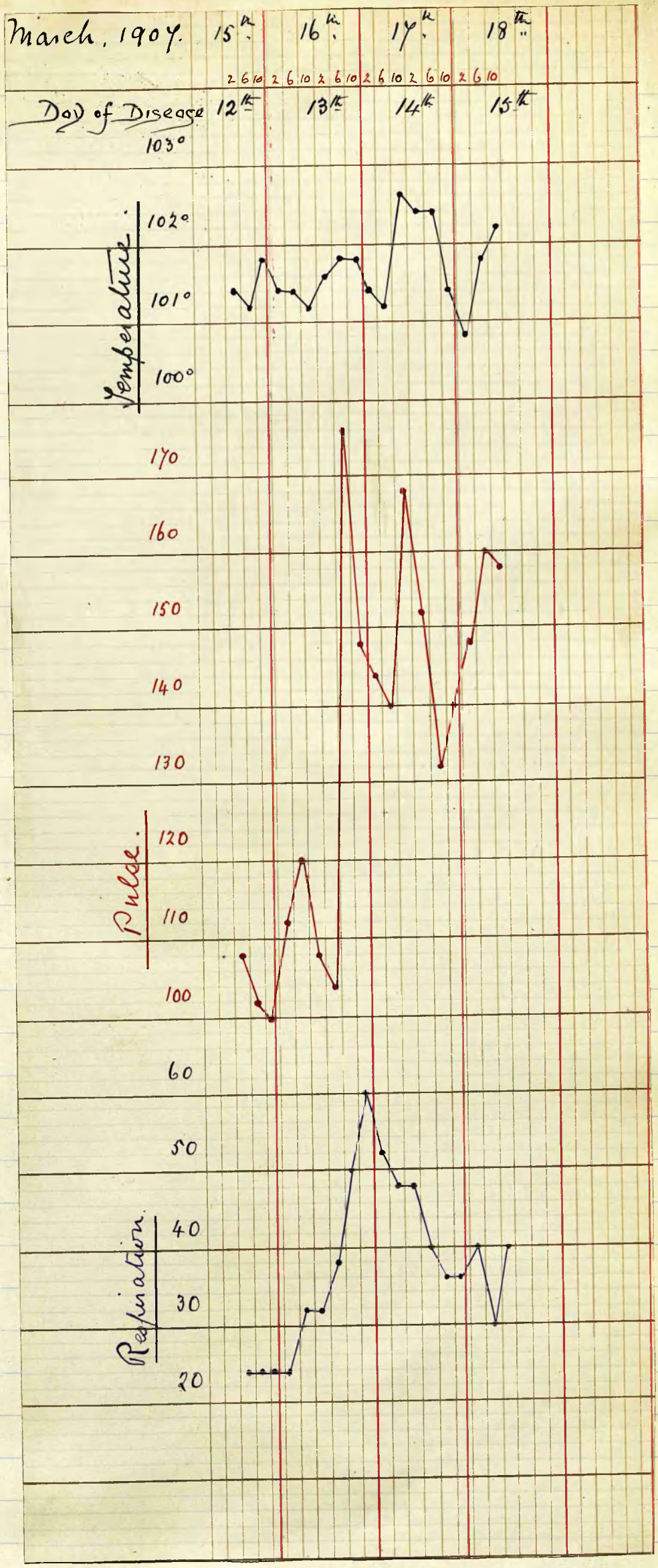
IX That, with regard to the Cerebrospinal fluid, this was always clear, gave a mononuclear deposit, and was sterile in the tubercular cases, whereas, in the Epidemic, it was turbid, gave a polymorpho nuclear deposit, and showed the diplococci Meningitidis. Dr Osler however notes that clear fluid may be obtained when epidemic meningitis exists, and that a clear fluid may be obtained from the 2nd lumbar interspace while lower down a turbid fluid may be withdrawn, inferring that there may be a

Temperature Chart IX

Case H female age 24/12 yrs.

Tubercular Case

Showing a very great variation of the pulse



Temperature Chart X

Case C, female age 4-7 yrs

Tubercular case

Showing (a) great variations in the pulse rate and (b) an ante-mortem rise of temperature

November 1906

	15th	16th	17th	18th	19th	20th	21st	22nd	23rd	24th	25th	26th	27th
A.m.	6	6	6	6	6	6	6	2 6 10	2 6 10	2 6 10	2 6 10	2 6 10	2 6 10
P.m.	6	6	6	6	6	6	10 2 6 10	2 6 10	2 6 10	2 6 10	2 6 10	2 6 10	2 6
Day of Disease	9th	10th	11th	12th	13th	14th	15th	16th	17th	18th	19th	20th	21st

Died

Temperature: 106 105 104 103 102 101 100 99 98

Pulse: 160 150 140 130 120 110 100 90 80 70 60

Respirations: 60 50 40 30 20 10

sedimentation of the fluid in the canal. (33)

Deagnosis :-

To make the diagnosis absolute lumbar puncture was always resorted to. With one exception organisms were found in every case. In all the non-tubercular cases, that were frankly primary, the diplococcus meningitidis was found. Of the 3 cases in which the pneumococcus was found, one had at least a coincident pneumonia and a definite pneumococcal middle ear disease. (The meningitis however was not a direct Extension from the middle ear, as the dura over the temporal bone was quite healthy). Another case was definitely secondary to pneumonia, and the third was at least coincident with a pneumonia, if not definitely secondary to it. In the meningococcal cases pneumonia was present in only one case, and this was definitely secondary, developing while the patient was under observation — after the onset of the meningitis. The bacteriology of Epidemic meningitis, though long in doubt, may be now considered as definitely settled. Dr. M. Gordon reporting this year to the Local Government Board says "Recent observations of the disease in New York and Germany have confirmed Weichselbaum's work of 1887, and at the present time it is generally admitted that the diplococcus is certainly the chief, and probably the sole cause of Cerebro-Spinal Meningitis. (34)

In the tubercular cases the organisms were isolated in 9. In the 10th the absence of pyogenic organisms, the mononuclear deposit, and the clear character of the fluid at an increased pressure, along with the history of gradual onset, was considered sufficient to establish the diagnosis. Two of the cases in which the bacilli were found subsequently recovered. One, after being free of symptoms for about a month, relapsed. The symptoms

recurred along with a pulmonary condition. At post-mortem pulmonary and meningeal tubercle were found. The other case is still alive and going about. Occasionally she suffers from headache and vomiting but, apart from this, has had no symptoms, and has been quite bright and intelligent for the last 3 months. These cases are interesting in view of the few cases of recovery recorded. In the American Journal of Medical Sciences in 1898 Drs Councilman, Mallory, and Wright remark "We believe that all infections of the meninges other than the diplococcus intracellularis are fatal, but this can only be determined by microscopic and bacteriological examination of the exudation obtained during life by spinal puncture. If tubercle bacilli are found with the evidence of meningitis in a case which recovers, it would settle the point; clinical evidence without lumbar puncture will not. (35)

Treatment:- The treatment of the foregoing cases was mainly symptomatic combined with nursing and feeding. In 1 of the meningococcal cases, and in 1 of the tubercular, repeated tapping was resorted to, in the meningococcal case at first from the spinal canal and later from the ventricles, in the tubercular from the spinal canal only, but in neither was there any lasting effect. 3 of the Meningococcal Cases were given Kollés anti-meningococcic serum, but no good effect was noted from this.

Specimens

The Meningococcus from the cerebro-spinal fluid is shown from Cases 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 stained with Methylene blue, dilute carbol fuschin, or Gram's stain, the organisms being Gram negative

The pneumococcus is shown from the cerebro-spinal fluid of 10a and 11a, also in pus from brain of 10a and from middle ear of 2a

Pus from an eye discharge in 19 is shown, showing some bacilli but no meningococci

Tubercle bacilli are shown from cases G, I, J, and Mononuclear deposits from cases H. G. I. J.

Specimens from the remaining cases are not shown as the fluids were sent out of hospital for examination.

Case 1. June '06 has been included to give a complete list of the epidemic cases this case was not examined. The rest were all seen + examined.

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