on the

Etiology, Pathology and Nature

of

Tetanus

A Thesis for the degree of M.D. (Edin.

by

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Accurate descriptions of certain cases of lockjaw have been handed down to us from antiquity. Hittorff, Arbaco, Galen, and others, have described the disease and discussed its causes. It has been the subject of endless study and speculation in the ages succeeding, during which our knowledge of the circumstances under which it occurs has been much advanced. With the last thirty or forty years especially our knowledge of the disease has been considerably added to, and the groundwork of practical pathology is now being laid down.

I do not propose to discuss here all the problems which arise in connection with the etiology, pathology, and nature of a disease which has so often formed the subject of so many elaborate and original monographs; but principally to record some facts occurring under my own observation, and some speculations proceeding therefrom which happen almost to coincide with the view which has been comparatively recently put forth to explain the nature of this terrible disorder. I shall now proceed to detail some points in connection with the etiology.
Etiology

In the town of Cardiff and district as well as in South Wales generally tetanus has been looked upon as an exceedingly rare disease an isolated case occurring at intervals of some years being as many as one could be able to discover. Such being the case the series of cases which have taken place lately in connection with the Cardiff Infirmary are all the more remarkable. In the summer of 1883 an acute case was admitted into this Hospital - three cases followed within the next fortnight and by the end of September eight cases in all had appeared. In the middle of summer 1883 another series occurred which numbered seven by the end of July. In order to point out more fully the circumstances under which these cases took place I propose to call the former group the 1883 series and the latter the 1884 series.

History of 1883 Series

On May 21st 1883 a labourer aged 25 was admitted with severe symptoms of tetanus. On the 16th of the same month he had sustained a lacerated wound of the fingers and thumb. He was dressed as an out patient until the day of his admission. He died on the...
23rd - 2 days after admission. The outbreak accordingly originated outside the institution. To a certain extent, however, he was exposed to the same influences as the inpatients as he daily made a visit to the hospital remaining about half an hour or more each time. On the 23rd May - two days after the first admission - four major operations were performed by Dr. Shinn, the senior surgeon in the operating room of the institution - amputations in both legs below the knee in the same patient for a train car accident; a Syme's amputation for epithelions of foot; and one arm just below the shoulder joint for a compound comminuted fracture from railway injury - On the 24th the same surgeon performed variectomy. These four operations were in four patients - On the 29th - seven days after the accident - the amputation below the shoulder (Case II) developed signs of tetanus which soon a fatal course in less than three days. The double amputation (Case III) was paralysed with spasms of the stumps on 3rd June - 11 days after the accident - tetanus set in on the 5th and he died on the 13th day of the disease from exhaustion, the tetanic condition being considerably abated - On the 6th June - 13 days after the operation - the case of variectomy (Case IV) took a step of its own - the other symptoms showed themselves and after three weeks ended in recovery.

On the 27th June, then was admitted from
the out-patient room a farm labourer aged 30 (Case V) who had sustained a fall 27 days previously, a superficial wound of the arm — on the twentieth day after the accident, stiffness of the joints set in, but it was not until the 24th day that distinct spasms made their appearance. She was treated as an outpatient and the wound had been healed for some days. It proved to be a subsequent case and she was discharged well on 20th July.

A month later a severe tetanic symptoms appeared in the case of a boy (Case VI) who had been admitted 9 days previously with compound comminuted fracture of the leg for which a primary amputation was performed — the disease ran a rapid course and was fatal in thirty hours.

No further development pleased itself until September 26 of the same year when two cases lying in the same ward and in contiguous beds became affected — one was a man (Case VII) who five weeks had been admitted with severe fracture of the leg — suppuration at seat of fracture and spreading gangrene set in, necessitating amputation on the 13th Sep. The other (Case VIII) was a compound comminuted fracture of the leg amputated primarily. Both recoverd satisfactorily until Sept 26 when they were attacked at the same time with tetanic symptoms — in Case VII 12 days after, a secondary amputation, and in Case VIII 9 days after. Both cases ran an acute course — the spasms were very severe affecting to a great extent the muscles of the
stumps causing in both cases extreme fudmuring of the limbs and they died on the 28th within two hours of each other.

Thus, within six months eight cases of traumatic amputations with six deaths occurred in connection with a single institution—the first three cases appearing within a fortnight of each other; and of the remaining three, two took place within three weeks of each other, the last two on the same day.

The following are the cases in the order in which they occurred. They were admitted under the care of Dr. Shee and Vachell, the surgeons of the Infirmary, to whom I am much indebted for permission to make use of them. The notes are a pretty full abstract of those taken at the time.
Name: Wm. Cutland

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Pulse 114

Resp.

Urine O.

Sp. Gr.

Day of Dis. 6

1

2
Case I.

Summary: - Lacerated Wound of Finger & Thumb - Severe tetanic symptoms - Death.

William Cuthbert, aged 29, a labourer, was admitted into the Cardiff Infirmary on the 21st day of May 1873, complaining of inability to open his mouth and general spasm. On the 16th, he sustained a lacerated wound of the thumb and two fingers. He was dressed as an outpatient with carbolic oiled lint dressing until the day of his admission when general spasm came on. He had only noticed some stiffness in his neck from the previous evening. On admission, general spasms with spastic movements were frequent. He was treated with chloral hydrate and potassium bromide was administered. He was given difficulty in swallowing and spasm of the throat muscles. On the morning of the 22nd, his general condition was not improved, two of the fingers, whose wounds looked unhealthy and strongly were amputated under ether anaesthesia. Pulse was 104, pulseless. In the evening of the 22nd, there was improvement, general spasm continuing as frequently as before amputation. Patient was much emaciated and died at 8 a.m. on the 23rd.
Case II

Summary: Compound comminuted fracture of arm, primary amputation below shoulder. Tetanus - Death.


History: Patient was admitted with compound comminuted fracture of the right forearm and arm with severe crushing of the soft parts - slight collapse - patient rather noisy. T 98.4 - Amputation was performed just below the insertion of the pectoralis major and other with all antiseptic precautions.

23rd (May). Stump dressed - considerable oozing - T 100
24. Dressed morning & evening with eucalyptus gauge - wound looks well - free drainage, patient quite comfortable
26. Dressed. 27. Wound satisfactory - discharge free patients general condition good - appetite excellent - up in the garden at his own request. 29. Condition of stump good drainage tube present - complains of some difficulty in opening mouth & swallowing - went out into garden yesterday but was up. Patient much alarmed because (he says) he thinks he has 'lock jaw'. S 10th. Reim 31. Stump dressed
30. Patient has been very restless since yesterday morning, did not sleep at all last night because his right arm "jumped" and he had pain in the back of the neck. This morning the skin is freely caused into perspiration - his mouth can be opened only a quarter of an inch, but he swallows with little or much difficulty - holds his head in a constrained position, like toothache - he cannot flex his head on his chest - but can perform the opposite
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Day 9: Tr. 12:30 a.m.
movement - occasional involuntary movement of the
motions observed - Bounce very opened after Caster et al.
9.12 T. 484. Patient then inCamb. 2nd 31 three
times daily

6.30 pm - Patient batted in perspiration very restless
complaints of pain in the back of his head the 
'feeling of twitching constanc twitching of the thumb muscles - abdomen very
hand and head-like

10. pm - heat and general dignity could lift him up the muscle
conveys very possibly, the back muscles acting with the
mandible forced head through violently backwards - the
'twitching of the facial muscles has been but very occasional
T. 103. 9.18 very compressible

11.15 pm - In administering medicine he had a violent general
spasm which threw him half over bed - pulse and respirations
stopped for he came to again

31st (5th of tetrany) 7.15 am swallowed with difficulty at 3.30-
at 6.30 while being raised up in bed a violent spasm came on
his face became discolored - the remained as stiff as a board.
and then he was remained in a semi-comatose state

grunting - very slight twitching since 6.30am -ureau that is
great relaxation of all parts - pupils dilated marked
diminution in perspiration - conjunctival reflex not abolish
ished - has passed urine freely - took a large amount of
milk - is very thirsty - P. 152. very pale - T 101.6

4.45 - another general convulsion preceded by violent
'twitching of the muscles of trunk and extremities - respirations
stopped for a few seconds and pulse became very slow
immediately after attack spams came on again for
moments or two affecting the body generally - groggy


8 a.m. Patient making a great noise - occasional twitching. Pulse 152. T. 101.4. Dead.

Temperature (10 minutes after death) 104.8°F.

At Autopsy (12 hours after death) - Brain: no undue vascularity of membranes. Immediate points more marked than usual - general congestion. Card. general congestion especially marked in the lower dorsal region.
Name: C. Adams
Disease: Typhus, Meningitis, Tetricus

Date
May 22 24 25 26 27 28 29 30 31 June 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Pulse
92 112 104 102 110 108 106 105 105 90 100

Respiration
12 14 15 16 17 18 19 20 21 22 23 24

Day of Discharge
1 2 3 4 5 6 7 8 9 10 11
Case III.

Summary: Camph. comminuted fracture of both legs — Double primary amputation — Tetanus — Death.

P. George Adams, age 40, Labourer.

History: Was admitted on May 23rd, 1883. The wheel of a tramcar passed over both legs below the knee. There was a complete amput. Primary amputation of both below the knee followed. Skin flaps on one was obliged with开源 dressing and the other with varnish and rind. May 21st: Right leg has been dressed nearly every day; the left once; has had a good deal of pain. Been very restless. Morphine injections several times. Both stumps dressed today. Edges of the right's little red and brownish. Free which about. Palmar perspiration. Left stump discharging freely.

June 5th: Right leg dressed. Edges of flap slightly separated.

6th: Patient has been very uneasy for last two days complaining of jumping in the legs especially at night. Both stumps dressed this morning. Edges of flap found drawn apart by muscular contractions. Restored by strapping. Explains to-day of stiffness about the angle of jaw and neck. Cannot open his mouth fully.

6th: Patient sleeps soundly after sleeping straight — no jumping of legs. Says he has no difficulty in opening his mouth this morning. T. 99.4. P. 70.4.

7th: Marked tetanic spasm developed in jaw. Notice well marked jaws closed today. To have Pot. bromide gr. 1/4. Chloral gr. 1/4 every four hours.
8th. T-99. Sleeping face quite calm - on awaking pianino manner. can open his mouth only one inch - no difficulty in swallowing.

9th. T-98.4. no change.

10th. T-99.796. Same pensive expression - can mouth only so far enough to admit little finger. Since 7th has not been able to eat solid food - swallows fluids well. Pulse weak.

11th. T-99. Pulse 100. Conditions much the same. slight more depression. Dry, brown tongue and foul breath.

12th. T-99. Pulse 100. no change. Patient much depressed. Mouth opens about an inch. Sleeps during greater part of day. Very drowsy. Passed urine 3 times in bed during last two days.


15th. T-101. Pulse 144. Patient dying. 13th day of illness - no marked quiet slumber; but whenever he coughed or wheeze - he drank anything he pulled himself up in general sleep.
Case IV.

Summary: Ovarian cystoma - Ovariectomy - Subcutaneous tetanus - Recovery.

Hannah Hopper, aged 40 - Housewife.

History: She was admitted on May 8th, 1883 suffering from ovarian tumour of about 3 years duration.

On the 24th May, she underwent ovariectomy under chloroform anaesthesia. There were no long membra adhesions. Pedicle was ligatured & clipped into abdomen. Wound packed with carbonised silk.

25th: Patient well - kept on cord milk.

26th: Patient turned in bed side along well. Temperature practically normal since operation except on evening of the 5th which rose to 100.1.

29th: Severe pains in left side - braces opened.

30th: Patient again severe - dressing removed - union of the whole wound except small parting about the middle - dressed with linen and wound & strapped.

One of my patients much better after surgery.

4th: All except a little pain referred to umbilicus. Patient has done well - braces opened daily - moved into general ward. Has complained slight of pain in swallowing and in joints of the jaw.

9th: Pain in jaw articulation and in swallowing yesterday also this morning - who going off to play, gets occasional jerks (referred to abdomen) - symptomless - firmness around the abdominal wound - parotitis to throat.

10th: Better today - jaw not so stiff - difficulty in swallowing less
11. Having looked & special ward - no improvement.

12. Not so well - pain essentially as far as the able to protrude tongue & pain in the front edges of neck - tightness of chest - seems most rigid - slept poorly but had shooting pains in abdomen - says she has had a cough for the last few days - cannot swallow so quickly - speech thick enough to inability to open the jaw - when talking, muscles of jaw contract and show pains - occasional phlegm - thoracitic jake which she refers to pain in the abdomen.

Unable to swallow several shots of fluid - bronchitis - some difficulty in breathing. Perspiring freely.

13. Patient brighter - dyspnea more marked - loud common phonchile at both bases & in front coryl troublesome condition.

14. Cough still troublesome - jaw the same. Can protrude tongue further occasionally - sees a back or sinus as before. To have 6 g wine every 24 hrs.

15. Cough eased - phlegm not well - jake, especially when dropping off to sleep. - poor expectoration of aerated sputum.


Pulse rapid - 132 - Tendency to increased distress. She may - partially under chloroform today which afforded slight relief to swallowing but - distressed breathing. Spasms have been worse to-day than at any time. Perspiring freely.
17. Looks much improved—yesterday—i.e. better today.—Pulse
and respiration got so fast so thin stronger—can open mouth wide.

18. After 11 am yesterday, several severe spasms—cough and
sweats—several times jekos during the day—inhale chloroform and
and tobacco which relieved. Last night (9 pm) distemper worse—Pulse 150—Poor stimulation renewed to sleep
5 or 6 hours so was better—perspiring freely today. Intestinal
stool as so good reason ordered a stimulant—expectorant
and 6 gr. morphine hypodermically from time to time also
chloroform inhalations.

19. Wont the same—face waxed considerably—very thin.

20. The same—face waxed considerably—very thin.

21. Said a comfortable night—plenty nourishment—taken
Pulse 150 regular—2 pint milk—1 pint pap.
tomatoed gruel—2 pints Beef Tea—2 eggs—tea with cham-
paigne in 24 hours. Pulse moderately contracted skin
perspiring—3 injections of morphia since yesterday morning
still. During day symptoms much less urgent—dizziness only
apparent on changing—complained once of pain in the throat with a choking sensation.

22. Slept well—had his tongue turned in the night—this mouth
being well open during sleep—had several jekos across the
stomach—sterno—manubreal stuffer today that yesterday then
a few days ago.
21st (Feb). Pretty comfortable all day - no cough - occasional

22. slept well with no cramps or pain in the abdomen - it came on as she was dropping off to sleep and produced

23. comfortable day yesterday and all night - morphia twice - one severe jolt on taking medicine - during the night occasional jolts - jaw the same - no rales in chest - expectoration less.

24. much the same - wrinkles on forehead not so pronounced - ordered klein's mist. with belladonna.

25. sick after medicine - jolts came on again - morphia injected three times - relieved them - phlegm - mastitist less hard.

26. cough more troublesome yesterday - expectoration increased but no jolts - slept well after morphia - during sleep twitching of muscles in left half of face and jaw - mouth can be opened more.

27. great troublesome yesterday - medicine again produced jolting - no jolts yesterday.

28. improving - no jolts

29. no jolt amid 28's - occasional cough - up yesterday.

30. still some stiffness in jaw - wrinkles on forehead.

6. some stiffness in jaw - wrinkles on forehead still -
Case V

Summary: Wound of arm - Subcutaneo Tetanus - Recovery

Mary Collins - aged 30 - married - laborer's wife
Admitted June 27 - 1883 - Discharged July 20 - 1883.

Note: On May 31st, patient having very drunk, fell against a piece of sanitation wire received a contused wound 1 inch long over the situation of the ulna nerve of the left arm. Nerve not exposed - pitted pustules and dressed with carbolic oiled lint. Was treated as out patient until June 9th, every thing going as well - on the 12th June (12 days after injury) noticed slight stiffness about the joints of 2 joints at the 24th June

Statement admission: Patient lying in bed with her head on a firm back - mouth closed, can be opened. Good sight only a cedar pencil - Ansious expression. Back arched - abdominal muscles tense like a board. Lower extremeties fully extended. Normal movements in them. Can be excited - perspiration profuse and general

Note: Situation of ulna nerve on left side between olecranon & internal condyle of humerus. There is the severe scarring of old wound. Pressure on it gives considerable pain - condition of arm much the same as if neuralgic old hemiplegia - the thumb is drawn into palm, the ring & middle fingers are flexed...
Considerable amount of rigidity & passive movements: Patient complains of pain in the back, present & continued jerking: also noticed that the jerks though not very severe are of frequent occurrence.

T 94° - Pulse 88.

June 28. Patient slept well for short time during the night after straight (Pot. Ipecac 60 Chlorm. 60 X)

Applique: jerks several times during the night - later, non-sharp well - condition better today. Pulse quiet; T 100°0. (last night 101°) Jerks still frequent origin considered spinal pain.

July 1. Yesterday jerks were frequent in the morning; less in number in afternoon - had a hypodermic of morphia yesterday - Patient feebly passed - general condition otherwise much the same - swam back etc.

June 29. Numerous jerks yesterday - slept a little during afternoon.

3. Hypodermic of morphia - during night slept about 1/2 hour at intervals - had several jerks, more again in frequent succession - perspired very freely. Though the rigid it has been very marked this morning, at 10.30 am there is slight relaxation of spine, face peaceful - skin moist.

July 1. Condition yesterday much the same as before. Has passed better night - periodic relaxation longer - morphia.

2nd. Yesterday as a whole was passed comfortably - had several jerks during the day - During night, patient was very restless, shouting, swearing - slept very little - this morning is no worse - he slept some 6 to 7 days - taken normal meal freely.

3rd. Condition much better - yesterday had numerous jerks.
Remained to darkened ward - Restless night.

4. Pelvic spasms decreasing in number - today night
   severe some area - to day hardly any spasm except
   jaw which has not varied

7. Condition improving - several jabs today - today pain
   condition is much the same - abdomen is lax & back is
   slightly arched - movements of lower limbs quite free - stiffness
   in left arm going away - anxiety expression less. Temperature
   fell tomorrow on the 4th has continued as since. Pulse 92.

9. Condition much the same - pain in back continues her
   most

11. Condition greatly improved - mouth can be opened to
    admit ordinary sized cedar pencil - occasionally, nurse
    states, to pull restraint. Movements of left arm still
    pass in back. Indolence in pressure over acetabum not
    very little - occasional jab - sleep poorly well

13. Steady improvement - still complains of great pain in back

15. Rapidly improving - mouth can now admit fingers -
    pain in back better - up about yesterday.

20. Patient left hospital today - movement of left arm
    still a little stiff - jaw condition much the same - pain in
    back still in dorsal region - she says she was 'upself
    straight before her present illness.'
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Case VI

Summary: Compound Comminuted Fracture of
Primary Amputation - Tetanus - Death

George Watts, age 14, Labourer's boy. 
Admitted July 23rd, 1883 - Died July 29th, 1883.

History: Foot caught in some machinery resulting in a
compound comminuted fracture of the foot. 
Lyons amputated. Operation was performed immediately
beneath the periosteum for drainage - Chloroform Ether.

24th: Slight state of distress - Patient might complain
jumps about foot - Drains open - P. 104 - T. 100.4

25th: Reverted - some retention of discharge. 
T. last night 102

6th: Pulse 84 - T. 100.

27th: Fresh drainage from joint.

28th: Meat offensive odour washed with carbolic lathe -
complains of little pain about the lower jaw - P. 112.

29th: Typical tetanic condition - anxious expression of face 

difficulty with speech began this morning at 1 a.m. 


Spasm very robust, frequent occurrence during day - unable to swallow - granules of beef tea, eggs
milk every three hours - No food. Except 3 cup 4 leaves.
Feces were passed during spasms during late part of afternoon.

Died at 10:30 p.m.
Case VII.

Summary: — Compound fracture of Leg — Secondary amputation — Letances & Death

Mark Haney, age 63, Labrador, admitted August 23rd 1883 — Died Sept 28th 1883.

History. Knocked down by trap which passed over his leg.

Compound fracture of left leg — Both bones in lower third — Wound in front. Dressed antiseptically.

Aug 25. Large number of blebs — Oozing of foot looking black.


To condition much the same. P. 98. T. 100.

Sept 2. Incision into abscess along ant. & post. striae. Bones comminuted, joint involved — no tendons, no black colouration, Drains.

3. Diarrhoea almost stopped — Leg looking better.

15. Amputation through middle of leg — Antiseptics.


27. Yesterday patient complained of pain & stiffness in his neck — a little difficulty in swallowing and opening his mouth — this morning there is no increase — occasional of pressure. Stump healed by 12th intention. P. 92. T. 98. 6 morning. Aug. 10.
Since yesterday patient has been gradually getting weaker & worse. He cannot open his jaw as well - has had several general spasm attacks several times - swallowing with considerable difficulty. Battled in perspiration all day yesterday - slept a little yesterday afternoon - very little last night. Tongue turned with thick muc. Bandage passed two days ago. - T. 99. Pulse 128.

Died suddenly at 6:45 p.m. During afternoon patient was very much worse - complete change in facial expression.
Case VIII

Summary: Compound comminuted fracture of leg; simple fracture of thigh; amputation. 

Leg amputated—Death.

Jervis W. Drake—Age 43—Laborer. 
Admitted Sept. 19, 1883—Died Sept. 28, 1883.

History: A portion of a wall fell upon patient while engaged in clearing brush away.

Examination: Compound fracture of the left leg in the upper third with extensive skin wounds and a simple fracture of the thigh above the knee. 

Amputation was at once performed through the upper fracture—lower and upper fragment being amputated—Antiseptic.

Sept. 20. Patient sick and after the operation complained of great pain in stump—except for hypochromia.

21st. Dressed—Looking well—And death at 7 p.m.

22nd. Dressed—Doing well—Complaining of pain in leg.

23rd. Temperature 102.

27th. On the 28th patient complained of pain in the neck and soreness in the throat—yesterday morning this pain had increased in the neck. He complained that he was not able to open his jaws. To-day the sues paresthesia has become well marked—muscles twitching have come on—patient covered with cold clammy perspiration—has had hypochromic mania—Pulse 96. T (exp) 102°.

28th. Patient much weaker and declining this
morning - had several jerks this morning during afternoon yesterday and all night - Bathed & inspissation - Pulsatile carotidic & brachial - Bowel movements have not been passed for some days - Great difficulty in swallowing - Hypodermic morphine four times yesterday. - Pulse 108.

Ref.: Several jerks of a mild character during the day.

Patient unable to swallow anything except a few drops of brandy and water.

Died of chloroform at 9 p.m.
All these cases were the exception. Two (I, IV) originated inside the house. They were placed either in the accident ward (male) situated on the ground floor or in the male surgical in the first floor. Case IV had a special ward because it was located to the “women ward.” All took place in the old Infirmary building which formed the Cardiff Infirmary and which were abandoned in our entrance into the new at the end of September 1883. The two wards in which 6 of the cases occurred were respectively 6-bedded and 9-bedded. The accident ward with 6 beds had three windows and gave to each patient 950 cubic feet of air. The male surgical had ten narrow windows, was partially divided across by a partition and gave nearly 1,000 cubic feet to each man. In both these a large proportion of the cases which constantly occupied it was composed of open suppurating wounds. The and thorough ventilation was difficult owing to difficulty in regulating draughts from the construction of the windows.

There was always a very great demand for beds—the number of beds being limited and altogether out of proportion to the district which the Infirmary supplied; an applicant was always ready to take possession as soon as one became vacant. And when had pressed, temporary beds had to be erected. Diseases resulting from this overcrowding and insufficient
mental strain was frequently present. Leggations and rhythmuses inflammations were frequently appearing among the cases, necessitating the removal of the patient from isolation ward to another part of the grounds. Septic sores appeared among patients and nurses, while the nursing staff of resident medical officers suffered frequently from malaise, loss of strength, etc. The content of the drains was rich in dirt, the traps were faulty and the supply of water uncertain. In the early part of July 1883, the medical staff sent in a report to the general committee of management calling attention to certain in the sanitary arrangements and suggesting alterations. These were carried out sometime later with the result of improving considerably the general health of the place.

The operation room which was used on May 23rd was on the ground floor, was small, ill-lit, and placed opposite side of the passage to the accident ward. It had been used on the 22nd the day previous for Case I who had his fingers amputated there.

The first four cases occurred in May 21st, May 24th, June 3rd, June 6th, respectively. From the 22nd May to June 6th there were admitted into hospital the following cases amongst others: - 3 cases of lacerated wound - 19 fractures, one compound, 29 contusions and 39 dislocated bone with open wounds. Operations were performed also on talipes, cataract, ununited fracture of leg and necrosis. All these cases
ultimately did well, remaining free from tetanic symptoms.

The meteorological conditions under which most of the cases occurred may be gathered from the table which I annex. In the months of May, June & July 1893.

### Readings of the Barometer: MAY - 1893

| DATE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
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### Wind & Weather

| DATE | MON | TUES | WED | THU | FRI | SAT | SUN | MON | TUES | WED | THU | FRI | SAT | SUN | MON | TUES | WED | THU | FRI | SAT | SUN | MON | TUES | WED | THU | FRI | SAT | SUN |
|------|-----|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
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### Readings of the Maximum & Minimum Thermometers

| DATE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
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**Mean Monthly**: 50.0 degrees Fahrenheit

**Mean Annual**: 53.0 degrees Fahrenheit

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**Mean Monthly**: 19.0 inches

**Mean Annual**: 29.0 inches
Cases in May. One occurred on 21st and another on 29th.

**Readings of the Barometer. JUNE - 1883**

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**Wind & Weather.**

**Readings of the Maximum & Minimum Thermometers.**

**Cases in June: one on 3rd, 6th, 27th.**
One case occurred on 28th July.

In studying the above tables, we find the barometer was fairly steady, ranging, on an average, from 29.5 to 30. Its highest point was 30.83 on the 1st of May, a figure which it also attained on the 2nd.
13th to 14th June, — On the whole the humidity was about 50. Ten days before the 26th May, the wind was westly and the humidity rose to 80 on several days. With regard to the temperature, the first half of May was cold, the maximum temperature being between 50° and 60°, and the minimum below 40°. On the 23rd temperature rose to 72° from 60°5° on the previous day, a rise of 11½ degrees. In the following week, it averaged 66° on the 24th it was 60-8° — on the 1st June 74° was attained — the average for the first half of June being 69°. In July, with the exception of 3rd (78°) and the 29th (73°), it did not rise above 70°, the average being about 65°.

August and September presented no striking meteorological changes.

In the town of Cardiff there are two other institutions which admits surgical cases for treatment — the Union Hospital with 200 general beds and the Seamen's Hospital with 60, chiefly surgical. In neither of them did any cases of tetanus occur during 1883 and it's presence is excusing care. In connexion with this, I have searched the records tabulated records of the cases admitted into the Cardiff Infirmary for the last 20 years and am able to find but one, which occurred in 1880. It was that of a boy who sustained a crush of the bicipital phalanx of the thumb 10 days before admission, being dressed in the meantime as an out patient — during that interval his admission, he was seized with abdominal pain and pain in the back and had a constipation in the evening — it proved but a very acute case,
the patient dying from exhaustion in their two days. In 1883 out of 4,605 admissions, there were 35 deaths from all causes. Tungus was responsible for six of these or 17.1% of the total deaths. In 1887 there were 5,588 admissions with 38 deaths. In 1881, 4,995 admissions with 36 deaths and 22 admitted, but no cases of Tungus occurred. In 1883, the proportion of Tungus to all other cases was 1 case in 45.6. In King Hospital in 32 years, 72 cases occurred amongst 113,020 patients, or 1 in 1,570 a statement which represents fairly the frequency of this disorder in the hospital.

In the autumn of 1883, the old Infirmary building was abandoned—the Institution being transferred to the present new building which was then in process of completion.

The year 1884 passed without a single case of Tungus making its appearance.

**History of 1885 Series**

On the 1st of June, a man (Case I) was admitted into hospital suffering from gunshot wound of foot—tungus set in on the 9th day and the Tungus symptoms ran a fatal course in 36 hours. During the last week in June and the first fortnight in July from other cases occurred in the surgical wards. Case II was admitted June 19th, had primary amputation of leg—both Tungus on the 9th day with a fatal issue—on June 30th, a child (Case III) was admitted from the out-patient rooms suffering from Tungus & epanas—the result of a wound sustained 10 days previously—on the 5th of July a child (Case IV) who was admitted on the 27th of June for 3 days previously—with a smash of the leg, became Tungus and died on the 8th. Case V came into hospital in July 13th with a compound comminuted fracture of the
leg for which amputation was performed. Lockjaw set in in the evening of 21st (the 9th day) and was fatal on
the 5th day of the disease from rhematism. On the 19th July a
case of apparently idiopathic tetanus (Case VI) was admitted
it ran a very severe course for six weeks, ending
ultimately in recovery. At the end of September a
better leg (Case VII), while being treated as an out-patient
for a wound near the knee joint, developed tetanic symp-
toms on the 9th day and died within three days.

Thus during 1885, seven cases—6 traumatic/idi-
opathic—occurred. 6 took place in June—July and the
9th late in September. In all the cases, the symptoms
set in on the ninth day after the receipt of this injury
and all were fatal except one. All the cases originated
in the house except two who were at the time being treated
daily as out-patients—one of these living in the street
adjacent to the Infirmary.

One case occurred in 1886. It was that of a
man admitted on July 20th with two huge scalp wounds
over the ankle. Tetanus set in on August 2nd (13th day) — recovery took place.

The following are the notes of the
1885 series as well as of the 1886 case.

I append also notes of a case which took place this
year in the Union Hospital under the care of D. B.
There to whose kindness I am indebted for having
seen the case and being allowed to use it.
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Day of Death: 1
Day of Tetanus: 1
Cases occurring in 1885

Case I

Summary: Gunshot wound of foot - Let amputation on 9th day - Death.

George Warm - aged 56 - Bell-poster - married. - Adsum. 16th.

History: Accidentally shot himself in the left foot - the charge entered the outer edge of foot close to base of 3rd metatarsal bone & came out on the dorsum near the proximal part of the 4th metatarsal bone. Besides the ragged wounds there was a fracture of the 4th metatarsal bone - small shot & wounds were found in the wound. It was dressed with carbolic acid & 4th. somewhat swollen & a bluish on the dorsum. Pressure applied.

5. Redness & burning feeling have disappeared.

8. Several small sloughs removed.

9. Had chills & fever last night.

10. Is unable to open his jaw - complains of stiffness in the neck - cannot protrude his tongue which is swollen and enlarged - complains of throat being very sore and a tight feeling around it - there is no fever past seven. Pulse 110. T. 101.8.

10. Jaw entirely closed - is unable to open mouth - great stiffness of neck - some slight cough this morning - throat very painful - great pain complained of in epigastrium - complains of being very weak & is deathly ill. Perspiration - is unable to swallow but little hay to choke - feeling in the throat which seems as if it were grasped tightly if deglutition attempted -
Pulse 120 - weak & uncompressible - T - 101° - No general spasms observed - complaining of occasional "grappling of the throat" ordered medicines of beef tea, milk & eggs with large doses of chloral & bromide

No spasms, suddenly language referred to throat, began at 7 p.m. - in 10′ the patient becomes cyanotic, pulse becomes very quick & the breathing stops - after a few seconds, the patient "comes to" - patient lie propped up in bed as it eases his breathing - pain in the epigastrium is greatly increased - had had morphine & hypodermic every hours for pain - unable to retain anima - chloroform inhalations tried go to relieve breathing but during administration several severe spasms rendered it unsafe to proceed with it. - at 8 p.m. had first general spasm affecting trunk & both limbs - 11 p.m. General spasms very frequent - as many as 36 in 24 hours - heart movement & voice brings them on. Pulse 180 - very feeble - is unable to swallow - loses all attempt bringing on severe spasms - teeth firmly clenched - complaining of great & thirst.

11 - 3′30″ a.m. Died - had a great number of general spasms a severe general spasm affecting however the longest specially terminated life. -
Case II

Summary: - Comp. comminuted fracture of leg.


History: was admitted on the 17th June 1885, with his right leg smashed caused by the passage of
over it of several railway trucks - amputation below the knee was performed a few hours after the
occurrence - skin flap - dressed under spray.

27. Last flap oiled up - wound over - spray discontinued and wound dressed with Boracic ointment.

28. Complains of stiffness and inability to jaw jaw,

properly - also of his throat being very pain, - there

is a feeling of tightness is the throat and pain at

the back of the neck, - swallows slowly and with diffic-

ulty - wound looks generally healthy - to have type

ext. Physostigmine hypodermically every 6 hours

now. Swallowing slightly better.

29. Definition more difficult - although able to get

down a fair quantity slowly. Neck very painful - is

unable to move it and his back bent back.

To able to move his facial muscles freely - can laugh

and seems in good spirits - Pulse 80 - perspired freely

30. Now quite closed - good deal of pain at back of neck

is still able to swallow, slowly. Rises paroxysms

very slightly marked - had fits. Ext. Physostigmine hypodermically

yesterday, may 6 hours - no improvement in condition.

Pulse 80.
July 1st. Dies with utmost drawn back, bent in the
fellow is quite unable to open his jaw - and swallowing
much worse. Epigastic pain more frequent - pain in
neck very great. Shocking feelings in throat came - is in-
creased by swallowing anything - was able to take
2 pints milk yesterday. Increased Thymus to gr ½
Pulse 100. 94.

July 2nd. Pain in epigastrium & neck so great that 
he had to be obliged to 

have morphine injections - facial muscles stiffened

and pains were marked - no general spasms. Pulse 100.

2. Spasms of trunk began this morning - marked about
the arms but very spasms - and legs to dome very
rigid - spasms more marked in trunk than anywhere
throat much worse. At times pulse as if something
were strangling him. Swallowing almost abolished.

Pulse about 3½ at a time with difficultly in not without
setting up of spasms - Pulse 108 very weak & impossible-

Skin most spasmic - mouth has no healing action.

To have morphine gr ¼ substaneously every 8 hours.

3. Spasms of whole trunk every 10 or 15 minutes at
least worse will them - seems fresher complaints greatly

pain in comfort in his throat - jaws clenched

tightly - facial appearance well marked - Pulse faible

and rapid - Morphed gr ½.

4. Died in a spasm - he became much weaker - pulse
almost failed - Echocardi. At time when he had an adequate

spasm, became agnostic & died - Spasms his frequent during
last 2 hours.
Case III

Summary: Injury to fingers - tetanus - death

Little Collins, aged 2 years, living at 55 Castle Road, was admitted June 30, 1885.

History: On the 21st June, while playing (pale, middle finger) of the left hand, was caught in a chaff-cutting machine & crushed. The middle finger was slightly lacerated, the other merely contused. She was dressed daily as an in-patient, with carbolic acid lint dressing until early that day: this morning early, the mother says the child became stiff, and its face clench.

On admission the child had a spasm - the trunk arms legs became rigid: the lips tightly closed, and the face puckered. There was some difficulty of breathing: after the spasm passed away, the jaws remained closed and stiff - the "grimace" well marked - the eyeballs remained drawn up. There was some difficulty in swallowing. The cries on being disturbed. Pulse ranges from 120 to 130. Became gayer yesterday - passed urine freely - hinged the fingers are healing. The hand is slightly deformed. There is a peculiar furceil occasionally like that from the discharges in other tetanus cases: parts are evidently painful - ordered 3 grs. chloral 3 grs. bromide.

July 1st: 3 spasms similar to that of yesterday.

Four spasms observed to day - one very severe: about 11 a.m. child as rigid as an iron bar - there was difficulty of breathing - the pulse became
very rapid and then stopped - there was extreme cyanosis, the breathing ceased and the child was apparently dead - after a few seconds, the normal functions were resumed - child asked for milk this afternoon and swallowed some very slowly. There is little improvement. Had kymocril 60 to substantively help a feeder of milk during the night - no spasms observed - had a very severe one this morning (10:30) - arms and legs are extended and very rigid - legs abducted - toes pointed - with some difficulty - legs are powerfully flexed - the muscles are from hard - gave 1/2 gr. morphia.

very - morphia gr. 1/2 at 4 p.m. - severe opesis at 4:30 - morphia still in state of tonic contraction - can lift the child in masses - the legs being very rigidly extended - morphia gr. 1/2

6/1000 power observed during the night - two this morning - morphia gr. 1/2 at 11 a.m.

8 spasms during day - 9 appeared character had not very severe - morphia at 8 2/12.

Good deal of severe twitching all night - 9 severe spasms. T. - 105.2. Child in a somewhat comatose state - perspiring freely - jaw fell except in opesis when it becomes somewhat symmetrical - hands twitching - limbs - limbs rigid - legs extended - jupito abducted - equal - is still able to swallow but with some difficulty - breathing very rapid - pulse rapid & weak during opesis. In-maker in pregnancy and other spasms - morphia gr. 1/2 at 10:30. Great exhaustion - child died in a opesis at 12 noon.
Case XV

Summary: Compound Communion Fracture Right Leg - Primary Amputation - Tétanos Death

Mollie Collins, aged 4, was admitted June 27th 1883.

History: Child was run over by a train car, the wheel of which passed over her leg. There was a severe compound Communion fracture of right leg while the soft parts were torn nearly half way up the thigh. Amputation was performed below the middle of the thigh. Skin flap re-attachment attempted.

Restless, might have suffered considerably from shock. Had about 31 of fever, badly able to take nourishment well.

July 4th: Dressed - large part of the under-play, stark and shaggy looking - propose discharge - dressed with Jodoform and bacic ointment - parts strapped.

Aug. 4th: Dressed daily - propose discharge - large plug removed leaving base of bone exposed - later amputation well.

Aug. 31st: Day noticed some difficulty in swallowing, did it slowly and evidently with difficulty. Patient moved into a special ward - mouth can be opened fairly well.

Pneumococci begin to appear - an attempt to drink there is evident, as the throat muscles and a good deal of the fluid is regurgitated. Occasionally there is general shiver - pulse increased in frequency and then stops to start again when the shiver is over. The mouth cannot be opened at its fullest extent. Child has been very restless during the
night and several general jerks - look about
1/2 pint of milk

8:30 p.m. Several spasms during the day - slept 1/2 hour
affected limbs and trunk - Rious more marked
later 1 pint of milk without much difficulty.
T 101.2 - child much depressed - pulse very feeble

1. Several spasms during the night - normal breathing
   decided still present - has had for several days the
   peculiar ones small observed in other cases - most
   occasionally as special organisms beyond swarming
   bacteria - Rious more marked - few closed more
   has had medicine (chloroform 1/2 in 10) regularly but it
   seems to have no control over spasms - Bedwell
   well opened today - Pulse 148 - very feeble.

2. Patient very depressed & weak - pulse very feeble
   Branchial rales over chest - has had constantly re-
   curring general spasms today and is unable to
   swallow -

Died at 2 a.m. on the 8th June 1898.
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Name: George Clarke

Day of Tetanus: 1 2 3 4 5
Case V

Summary: Compound comminuted fracture of leg, primary amputation, tetanus, death

George Clarke - age 46 - Labourer

Admitted July 13th 1885 - Died July 26th 1885

History: Run over by railway truck, inflicting compound fracture of right leg - amputation through the middle of leg - antiseptics (Rustemans)

13th: Debrum through the right

16th: Wound was protected by pack, sloughing, spray dressing discontinued.

20th: Discharge from stump, less healing process very slow - separation of part from discharge complaints today of stiffness in neck and angle of jaw

23rd: Patient is able to swallow - jaw more closed today - muscle space slightly affected

25th: Little change - is still able to take nourishment

26th: Execution more marked - risus developed - complains of much pain at angle of jaw and stiffness of neck - there is considerable difficulty in swallowing - hypotonic spasms observed as yet

29th: First general spasm affecting trunk and neck - unable to swallow - his eyes - usual position with his head buried in the pillow - had inanimate but refused them. Pulse 104, weak, compressible - patent perspiring
had pain throughout the night. In some of them and the legs & arms appear to be affected. complaints of much abdominal pain. Pulse 110.

Spasms increase frequency considerably. Patient much exhausted.

11 p.m. died from shock. During the day there were several general spasms - unable to take but very little nourishment by the mouth.
Case VI.

Summary: - Paralytic Tetanus - Recovery.

Christopher Alfred Brown - act: 11 - Schenley.
Admitted July 19th 1878 - Discharged Sept 21st.

History: In the afternoon of the 17th patient noticed his jaw and the back of the neck becoming stiff - his jaw became drawn up and he could not open his mouth next day - difficulty to swallowing appeared. Today he complained of pain over the stomach and general spasms commenced. He was therefore removed here this evening. There is no history of any previous injury.

On admission. Brown said: extremely well marked - the jaws is drawn, his eyes deeply marked - nostrils widely dilated - head is drawn back - brain in the pillow - this is unable to open his jaw - swallows slowly and with difficult general spasms often coming on during the act. The general spasms are very frequent, involving all the limbs and trunk - induced by the least noise or the appearance of a bright light - body arches in spasm - voice. Severe pain is referred to epigastrium - rigidity of the lower limbs, well marked although in general spasms, arms are affected as well. Pulse 120 - a pain strength - patient is very irritable - wants to be kept alone - dreads anyone approaching the bed side. The pulse is much increased in general spasms becoming quite uncountable. Respirations almost stops, but there is no hard colour of face - nostril - page of pulse. 17 101.

All other systems normal.
He was given 6 gr. Morphia subcutaneously. With a very
little of Chloral gr. 1/2. Bromide gr. 2 3 4.

20th. Spasms very frequent all night - slept a good deal however
spasms often came on during sleep; patient would cry out but not
awake. Slightness thirsty but quite well. In all to go down
milk and buy tea - T 98. Pulse 116. Patient put into a
darkened room and all noises shut out.

W££T 103.7.

21st. Spasms about every 1 1/2 hour all day yesterday. The least
noise by bedside would induce one - very in character. The pulse
would rise much in frequency and subside to normal rate
about 10.5 when spasms passed away - slept sound and yesterday
very drowsy today - Risus is less marked and the face
is not so shown - takes a fair amount of nourishment.

T 102.7

W££T 102.6.

22. Passed a fair night - numerous spasms yesterday
had one very severe one in which pulse a respiration ceased
for a few seconds - Pulse 140 much weaker - T 100.

23. Passed a more restless day yesterday - spasms more frequent
and more pehrenchy excited - still affect the whole body.
Inflexibility of arms legs and abdomen very marked. T 104.9. 108.
Chloral & Bromide increased to 7 and 15 gr. respectively.

24. Passed a fair night yesterday - 3 pm - Steps well after
increased dose of morphia - perspired freely

24th. Patient very drowsy today difficult to awaken him.
He had a number of slight spasms yesterday. Some between 2 AM
and 6 AM today. Is very drowsy. This morning difficult to
awaken him - Spasm however easily excited

25. Passed a good day yesterday - had a good day.
Slept much and had few spasms — did not sleep well through the night — had a great number of severe spasms — severity much relieved by pressure on the epigastrium. In the last few days has voided nine or ten times during spasms — stool has been no motion for several days — gum of Ricin. 3/ — takes nourishment well although poorly — passes very much.

26. Passed a fair day yesterday — and had few spasms — slept all night and was free from spasms — Bowels moved pleasantly today.

27. Bowels moved to night — passed two pound worms.

28. Had night spasms very frequent — severely than being very severe.

29. Spasms during last two days very frequent but much less severe.

30. Passed another pound worm. Johane castor oil and 3/3 of Santonii.

31. Liver spasms yesterday but much better since occurring every 1/2 hour or so — face is less drawn — swallow is now perfectly good — nostrils still dilated — good deal of evacuation.

August 2nd. Restless night — one or two severe spasms — sleeps a good deal.

4. Spasms extremely slight and very few — bowels well amused after castor oil + santonii but no worms passed.

5. Can spit fairly and swallow well — severe spasms — medicine stopped for present as patient sleeps a great deal.

6. Restless night — did not sleep much — no increase in number of spasms. Medicine occasionally required.
1. Very restless night - rigidity of legs less but that of arms still continues - great emaciation - pulse 67 - feeble and compressible

2. Not so restless only one spasm during the night - rigidity of legs - abdominal muscles still - reflexes increased especially the plantar and patellar - ankle clonus to slight extent - brings on spasm - takes a quantity of milk and fruit wine - pulse 70 irregular

3. Spasms less frequent since yesterday and not so severe - rigidity wanes - more in the legs than arms - more in the morning - can open his mouth - gutter and protrude his tongue slightly - considerable pallor - nostrils not so widely dilated and face not so drawn - rigidity of muscles marked - greater this morning

4. Fairly good night but pulse weaker this morning - height decreased - bowels well opened

5. Although spasms fewer and less severe, he seems more prostrated - pulse feeble and more irregular - stimulant - the pulse has been prolonged spasm more severe than any for the last three days - Pulse was 80 - very feeble

6. Quiet night but patient weaker - rigidity less than yesterday - pulse feeble and still irregular 74 -

7. Pulse 60 irregular - no severe spasm all day - rigidity only of very slight to right

8. Slightly delirious through the night - less spams - rigidity increased - Pulse 88 intermittent and irregular - cannot

9. Use mouth as well today and swallowing evidently somewhat difficult - hemorrhage increased

10. Pulse 50 irregular and feeble
13. Better night - no spasm - still a little delirious - resp not so well - Pulse 120. T 103.2 - spasm returning and rigidity greater - Morphine given - Improvement after -

14. Quiet night - appearance much improved - rigidity less - resp. Good day - Brunch served readily - Pulse 140 with a slight spasm; 80 when quiet - no delirious day

15. Rigidity less - keep hand on legs - reflexes increased

17. Improving - my few slight spasms

21. Much better - rigidity less but still considerable - can keep legs more - abdominal muscle may rigid - ankle clonus only slightly present - disappearing rapidly

22. Doing well - pulse very poor - 20 stronger one or two slight spasms during the day

Sept. 15. Warm bath daily - shampoo to reduce rigidity

22. Patient out of bed - walks in spastic manner with his legs spread out - many stiffy - back to pressure foot along floor - increase of reflexes still - still considerably reduced but improving rapidly

19. Doing well - rigidity slowly disappearing - looks pale

21. Discharged

After progress: Ankle clonus remained to my delight of that for 4 weeks after discharge - Risus was apparent for a few weeks - stiffness and rigidity remained for some months - the increased patellar reflexes remained for about 6 months - 12 months after reflexes were only slightly marked.
Case VII.

Summary: - Wound on knee joint - Tetanus - Death.


History: 10 days ago he sustained a contused wound over the knee joint - he was treated as an outpatient and dressed with ordinary dressing, 2 days ago he became febrile, languid and refused food - yesterday he became worse on swallowing with difficulty and the jaw was not strong to be clamped. This morning the palsy sandenvoorg developed itself. To-night he had the first spasm (general) which took place when drinking.

State on admission: - Pains slightly marked - lies on his right side with his drawn back - can open his jaws but slightly, protrudes his tongue very slightly to small extent - swallows with difficulty - rigidity of muscles of the back of the neck - no apperance of trunk muscles - pulse rapid - weak & compressible 120.

Oct 5th: One spasm affecting leg & trunk occurred during the night when drinking - great pain in epigastrium during spasm - head drawn back - jaw more closed - pulse 120 - weaker - halts in perpiration, swallows milk very slowly - wound dressed with bacine ointment - looks pretty well.

Oct 6th: Had two spasms during the day - had two hydrodynamic injections of 2 1/2 gm raphine - great chromatia - pulse 130. Pasts
October 6th. 8 spasms during the night - first on small  
owing - but latterly they have come or without it - may  
seen obstructed - child becomes almost asphyxia  
ated - respiration stops - pulse becomes exceedingly  
rapid - Pulse 188 was very weak - scarcely perceptible  
T 104.1 very little nourishment taken as it produces  
spasms - to have ammonia q Day tea & brandy.  
11 a.m. child collapsed - great exhaustion had one or  
very severe spasms this morning - bathed in cold seawa  
reject ammonia  
12:30. 2 or 3 severe spasms consecutively and child  
from exhaustion.
Case occurring in 1886.

Summary: - Scalp wounds and injury to ankle

Fred. Harris aged 21 Labarmer
admitted July 20 1886 Discharged Sept. 12 1886

History: - While driving wagon along the road, the horse bolted - threw him out - wheel passing over his head and left ankle

On admission: - Two large scalp wounds - between four and five inches long - behind each ear - parts covered with mud - difficult to thoroughly cleanse them. Wound on the inner side of left ankle near the tip of the malleolus probably into the joint - sutured with silk - leg dressed with antiseptic spray - dressing

21st: Teeth somewhat loose - legs eye gints closed

23rd: Right eyelid closed - prepare discharge

30th: Scalp wounds healing with little discharge - leg doing well

August 2nd (13th day) great stiffness and rigidity of the muscles of face and neck - unable to open mouth properly

9th: Inability to open jaws now much greater - yesterday there was some trismus - spasm of the jaw muscles bring his tongue - trismus marked

10th: Abdomen very rigid - some painful contractions of the diaphragm

12th: Back muscles affected - no difficulty in swallowing

13th: During last two days, he had had distinct spasms - being raised off the bed and the back being much arched - Scalp wounds which lately pleased
no sign of healing are looking more healthy. Spasm dressing taken off leg which was found healed - hacking with a cough - rhinorrhea & uterus - great rigidity of the neck and trunk - sternomastoid muscles standing out like cords and the cervical muscles being very hard - spine still - can just open his mouth - respiration entirely abdominal - is able to perserve fairly well.

20th (19th day) Had severe spasm to day and bit his tongue - chloroform applied but soon was going off.

He had a severe spasm in which the pulse stopped.

21st Much worse at night for the last four or five nights - tumbles and tosses about and is restless - good evening spasm during the night - blindly stipped.

Pulse 96. T normal - perspiring freely has lost flesh considerably.

22nd Much better - can open his mouth 1 inch - had one severe spasm during the night and bit his tongue.

Pulse 74. Much perspiration - much more so stiff abdominal muscles very rigid - reflexes increased.

Both patellar & plantar - often sets up spasm.

23rd Better - wounds healed - tendon reflexes still increased slight. - plantar reflexes strongly marked - great rigidity of flat, neck and abdominal muscles, legs now no marked.

24th - Rigidity less marked - has had warm baths day can open his mouth 2 1/2 inches - is up and about but walks very stiffly - patellar tendon reflex still much increased - no clonus.

Treatment on August 6th he had one dose of Chloral.}

XXX
Pot. Brandy 40 X (10th) Colombo 40, and at the
(13th) 40; (15th) Luminete used every alternate day; has
had morphine inj. 0.5 cubic daily - took 2 pints milk
1pt Bury tea and 2 eggs since the 7th, and 30c. of Brandy
since the 12th. Brandy was stopped on the 23rd as he
appeared better after that. On the 30th he had mixed
meat-diet.

Progress: He walked every stilly for several weeks
after during which he had a great amount of rigidity
in the hips' - abdominal muscles. His deep reflexes
were 4x appeared for at least two months. 6 months
after they were still brisk.
Summary: Burn on leg. Death.

Ira Ques, aged 31, labourer, was admitted into the Cardiff Union Hospital on 17th January 1867, died on 24th January.

History: He was brought to hospital by the police who found him in an outhouse in a very filthy state and smeared chiefly around the legs, suffering from spasms. Patient says that two weeks ago he burned his right leg on the outer side of the calf. He applied no dressing to the wound but walked about as usual until four days ago when stiffness of the jaw and neck began. Several spasms came on with pain in abdomen and back two days ago.

Examination: Small ulcer about the size of a shilling on the outer side of the right leg — evidently recent and inflamed from the chafing of the trousers. On the left leg in the lower third there is a small callous ulcer.

Ribs, spine, muscles well marked — angles of mouth much retracted — forehead wrinkled — is able to swallow fairly well — only slight difficulty which however does not seem to excite spasm — is able to open his mouth about 3/4 inch — great stiffness about the jaws and neck — abdominal noise in spasm — present perpiration necessitating
Frequent changing - Pulse weak and compressible. Temperature 101.8° - Patient in state of great exhaustion. Spasms very frequent. Least noise set them up.

Gave Morphine 6½ hypodermic at 4 p.m. & at 8 p.m. Spasms very frequent all night. Every few minutes able to swallow fairly well - complained greatly of abdominal pain. Perspiration still present.

Died of exhaustion at 10:30 a.m.
With regard to the other cases treated in the wards during the two months of the tetanic outbreak in 1885, during the first week of June and first two weeks of July, there were admitted into the house 25 cases of puerperal fever, 18 cases, 1 leg, 7 cases of wounds of scalp and leg: 12 cases of contusions — 3 skull fractures, 2 spinal fractures and a severe scalp. All these were in hospital more than a week.

Operations were performed during the same period for loose cartilage (2), varicose, pilonidal, epithelioma, thymus of scalp, general anemia, carcinoma of thigh, etc. None of these cases took tetanus, most of them did well with the exception that a number of them suffered from a form of sore throat — a circumstance which I shall allude to further on.

The meteorological conditions under which these cases occurred will be found in the appended chart for the three months June, July, and August.
Cases occurred on June 9th (9th) and 30th.
Readings of the Barometer, July 1885.

Wind & Weather.

Readings of the Maximum & Minimum Thermometers.

Data and charts showing measurements and observations over the course of July 1885.

Note: Cases occurred on July 5th, 17th, and 21st.
### Readings of the Barometer, August - 1895

#### Wind & Weather

| DATE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| DATE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| MAX.  | 80.1| 80.3| 80.4| 80.5| 80.6| 80.7| 80.8| 80.9| 81.0| 81.1| 81.2| 81.3| 81.4| 81.5| 81.6| 81.7| 81.8| 81.9| 82.0| 82.1| 82.2| 82.3| 82.4| 82.5| 82.6| 82.7| 82.8| 82.9| 83.0| 83.1|
| MIN.  | 79.7| 79.9| 80.0| 80.1| 80.2| 80.3| 80.4| 80.5| 80.6| 80.7| 80.8| 80.9| 81.0| 81.1| 81.2| 81.3| 81.4| 81.5| 81.6| 81.7| 81.8| 81.9| 82.0| 82.1| 82.2| 82.3| 82.4| 82.5| 82.6| 82.7|
| RAINFALL | 2.74 units |

#### Readings of the Maximum & Minimum Thermometers

| DATE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| MAX.  | 80.1| 80.3| 80.4| 80.5| 80.6| 80.7| 80.8| 80.9| 81.0| 81.1| 81.2| 81.3| 81.4| 81.5| 81.6| 81.7| 81.8| 81.9| 82.0| 82.1| 82.2| 82.3| 82.4| 82.5| 82.6| 82.7| 82.8| 82.9| 83.0| 83.1|
| MIN.  | 79.7| 79.9| 80.0| 80.1| 80.2| 80.3| 80.4| 80.5| 80.6| 80.7| 80.8| 80.9| 81.0| 81.1| 81.2| 81.3| 81.4| 81.5| 81.6| 81.7| 81.8| 81.9| 82.0| 82.1| 82.2| 82.3| 82.4| 82.5| 82.6| 82.7|

#### Diagram

- Barometer readings for August 1895
- Wind direction and state of weather recorded for each day
- Thermometer readings for August 1895
The following are chief points to be noted in the rain-point chart. In the Barmbek, a considerable depression took place on the 6th June to 29.03 while on the 20th of the same month it stood at 29.5'. The rain-point remained very steady during the three months. The temperature rose on June 5th to 76.5° from 65° on the 1st; two days later it fell to 64.5° corresponding with the barometric depression. On the 15th it gradually rose until it attained its highest point during the month—78.5°. The following day it fell to 66.5° (12° lower) and continued below 65° until the 28th when it began to rise, and reached 74.5° on the 30th. During the first three weeks of July, it was fairly steady, varying about 3 or 4 degrees; on the 6th and 11th it fell to 73.5° and on 17th 76.1°. As a rule it averaged 70°; on the 24th it began to rise steadily and reached its maximum—86.2° on the 27th. Three days after it had dropped to 71°. During August, the temperature fluctuated slightly and averaged 70°. Humidity: The atmosphere was fairly dry during the first half of June—from the 19th to the middle of the month it closely approached saturation, being about 95%, except two days when it fell to 90%. July and August averaged 90%. During the first 17 days in June, easterly wind prevailed.

The general surroundings under which this period occurred appeared somewhat closely to the state of matters which existed in 1883.
In the present building we have 110 beds—60 of these are devoted to male patients and are arranged in two plates—30 in each. Both the male and female blocks have got an eastern exposure. In the middle of May the committee were anxious to complete the painting and decoration of the building; one half of male beds was given up to the women and our male beds were reduced to 30—½ the number until the end of July.

Most of the cases treated during this time were severe surgical cases with large open wounds necessitating frequent dressing. The strain on the ward up to the end of July was very great—it was constantly full—in some instances as many as two or four extra beds being compelled to erect in the ward for accidents, while in the case of smaller lads, some of them slept two in a bed. During the 2½ months during which this overcrowding took place six cases out of the series in the series occurred. One [the] first indications of this state of matters phoned itself in the appearance of an encephalitis blennorrhagic over the whole circumference of the joint. Case I. This was seen on the 4th June and hardly had the remains of the redness disappeared when it again set in on the 9th. Cases I, II, IV occurred in the same ward (male surgical) close after each other. No III was admitted into the children's ward with locked jaws and lay in the cot to antiseptics to No. IV who was septic with it later on.

On June 29th a man Thomas M—— was
admitted with a severe crush of the foot forepart of the foot resulting in the loss of several toes. He occupied the bed next to No. II. - After a short time after admission he had an attack of sore throat - jejunal white patches appearing on the tongue accompanied by considerable fever. While the wound was granulating, he had very great tenderness in it and could scarcely allow it to be touched - in the course of the first week part of the skin had sloughed leaving bare some of the metatarsal bones. Streaks, some small vein filaments were seen in the bottom of the wound swollen and enlarged.

Another case, Thomas H. - who had a large granulating wound after amputation of the leg, suffered from sore throat - there was redness of tongue and slight rise of temperature but no patches were observable - he had slight stiffness at the angle of the jaw and was in a state of subject terror for several days from the year of the appearance of tetanus as he knew that case I had joined qatal. One or two cases of tetanus made their appearance among the probation omissions.

The patient's state as far as the drainage was concerned was imperfect condition: ventilation however was a matter of some difficulty as the room was having an eastern exposure, became very cold during the prevalence of that wind and it is a matter of considerable difficulty to have the windows kept open and efficient ventilation kept up. It is a very noticeable fact that in the man's block after the prevalence of cool wind for some days
aphthous throat to make their appearance. For 17 days in the first 2 weeks east wind prevailed with him. That time, cases of tetanus, erysipelas and sore throat appeared in one wards.

Here again as we find the tetanic outbreak strictly confined to this institution – no cases occurring in either of the other two hospitals.

In February 1886, there appeared for the first time in the new building an epidemic of an erysipelas native disease. The wards were very full at this time and had been so for some weeks. The first case to appear was in a large lacerated wound of the leg – an erysipelas at first attacking it on the 13th February. It was at once removed from the building and isolated – on the 22nd 3 cases which had been operated on a short time previously by amputated hernia, primary amputation of arm & necrosis of thigh were attacked and at once isolated – on March 16th a case of operation for gum valgum where the wounds had been healed for some days was attacked by an erysipelas bluish in the region of the sciatic – this case occurred in the floor above the mortuary accident ward. On March 25th 2 cases of bone disease in cart grain beds were attacked and on April 4th a primary amputation of the leg. All these cases were inoculated in dry figures – kept temperature (in one case 105°) the bluish spread rapidly – abscesses formed and there was great prostration.

During 1886, one case of tetanus was under observation – it came on on 13th day and terminated in recovery. Another case occurred toward the
end of June. He was treated here as an outpatient for a day or two for lacerated wound in the axilla. I was informed afterwards by his club-doctor who subsequently attended him that he developed tetanus about the 8th or 10th day and died in three days. I had no opportunity of seeing him.

In March 1887 another outbreak of phlegmonous erysipelas appeared. On the 7th it attacked a case of suppuration of wrist joint which had been in hospital six weeks—this other case in same ward followed during the same week—all were at once isolated. For two weeks preceding the occurrence of these cases, the weather was hotting cold, the wind being easterly. Small thundery showers, high temperature (104° or two) which caused of wound abscesses were present. During the same week in the ward above (medical ward) five cases of sore throat with grayish white patches occurred amongst the patients and two amongst the nurses. In all, there was rise of temperature, the female block had remained free during the year of these invasions.

A very striking fact also observed in the foregoing account of the health history of this institution is the remarkable alternation of two diseases which hitherto generally been considered to be due to entirely different causes. Taking the case of the male surgical ward we find in 1885 severe cases of tetanus occurring with in a limited period of time while the patients in adjacent beds are attacked with sore throat—in 1886 a number are affected with phlegmonous erysipelas within a fortnight, while 8 cases
A. None I. page 90.
month later tetanus again occurs. In 1857 several cases of encephalitis again appear while a similar phase itself at the same time in a neighboring ward.

Having drawn attention to the different sets of breaks on aggregates of cases which have appeared at the Cardiff Inquiry, I shall endeavour to point out some further examples of occurrence in this frame. All the described cases are presented with two large groups of cases which I propose to examine in some detail. These are the not breaks of tetanus occurring among the wounded on the battle field; and trismus occurring among the uninfected frame of the disease.

About the beginning of this century, Laurey pronounced the idea that tetanus among the wounded on the battle field was due to a sudden change in temperature especially when it was accompanied with a moist cold. In his "Chirurgie" he says "le tetanos ne se declare ordinairement chez les blesses que dans la saison où la temperature passe brusquement de une extreme à l'autre — cela, accident sur centenaire, paraîtrait parment lorsque la temperature est a peu pres egale point en hiver point en ete " and he proceeds to point out how during the wars of Austria in 1809, the wounded exposed to the cold and damp at night and strong heat during the day were nearly all victims of tetanus. In Egypt he had 5 cases after the building of the Pyramids; 7 cases in Cairo and Suez at El Arish. On the other hand Hardy says that at the time when Laurey had a number of cases at Acheron, in 100 of the English wounded, no cases
A. "Military Surgery"

Bi. Bulletti del Senato Midi. 1829
C. Medici Chimici. Travo. 1815

D. Dublin Hospit. Reports. Vol III.
occurred. It was frequent that it was frequented after the capture of Jaffa and accidents it to be noted as the wounded remained on the field all night without shelter, or lying in open air. It was considerable. After the battle of Paris more than 1000 cases occurred. Happens in the cases that occurred after Lutzen and Sluing in those after Bautzen, considered that the same cause was at work. The latter points out how in the night after the battle (May 20th 1813) the wounded having been left in the clammy ground over night as many as 110 cases of tetanus appeared.

In the Peninsular War. Sir James MacGregor observed a great number of cases. From December 1811 to June 1814 12,068 wounded were 263 cases of tetanus. After Salamanca and during the siege of Burgos it appeared as well as at the siege of Rodrigo Thomas, however, was more prevalent after the battles of Vittoria and Ampeluma than it had been anywhere else in the Peninsular. Hospital gangrene was also much worse after these battles. The number of the wounded was very great and the hospitals were densely crowded with British, French, Portuguese, Spanishicks, wounded. Tetanus with elephantiasis, typhoid and cholera were very prevalent. O' Brien states that the disease attacked 1 in 200.
A. Zevanski's Cyclopedia. Vol. XIV

B. English troops before Sebastopol - Bryce.

Both Guthrie and Turner Lacey relate numerous instances also in this war. After the battle of Wabash Lacey observed a number of cases. In 1834 after the battle of狮子山 there were 277 wounded 12 died of tetanus.

In the Crimea, the English army remained comparatively free from the disease - 3 cases occurred during the first winter and 29 during the period 1855-56. But here we find that the wounded were largely decimated by other septic diseases, e.g. hospital gangrene, erysipelas and typhus. Medical officers, nurses, enchilas, chaplains, etc. as well as the wounded succumbed to general.

In the Austro-Italian war of 1849, Lachman had 86 cases and his colleague 75. Here again they considered that cold and damp had a profound influence. At Laim 8 cases of 15 occurred while at Vintian 27 cases; the heat during the day and the cold night winds from the Alps at night were thought to be the principal factor in causing it. The same cause was assigned when 13 cases occurred at Langenadlaa in the Austrian war of 1860.

In the civil war in America out of 2646712 cases of injuries, 5'05 (20%) were followed by tetanus - of these 4'51 are dead - a mortality of 89.37. It came on on an average between the 6th and 11th day - only in 6 and it came within 24 hours.

In the Franco-Prussian war of 1870 while Strasbourg during the month of September 11 cases occurred and daily. In the German army few cases occurred. Most of the military surgeons quoted above concluded that exposure to cold after during the
A. quoted by Curley in "Treatise of Intemperance"

B. Cooper's "Surgical Dictionary"
might after considerable of heat during the day, was certain a strong predisposing cause if not the main origin of the disease. Such a cause would help a large extent in operations in naval battles; but we do not find their records entirely destitute of such cases. Lindl states, that, about the middle of last century when physicians to the fleet, judge cases of amputation out of six men to have fallen from atium. Sir Gilbert Blane in his "Diseases incident to Seamen" records that after an engagement at the West Indies in 1782, 82810 wounded 20 both at arms—1 in 40.5. At the battle of Copenhagen a large proportion of the wounded took it on. The question points out how in certain ships the disease took up "jumps" although there was nothing observable in connection with the wound. François d' Arvène states that on board the frigate "Amazone" during the American war at Charleston, the greater part of the wounded were seized with atiums before the 14th day. He attributed it however to the painting and wet weather which had succeeded a longer period of dry. On board the "Dreadnought" hospital ship atiums has been observed to prevent at certain places of the weather and that it has attacked certain sides of the wound.

The disease is however now very much more rare after engagements than formerly, and the advances in the methods of wound treatment as well as the vast improvements in the sanitary arrangements for troops in the field, have contributed largely to this desirable result.
A. Transactions of Royal Irish Academy.
Trismus Monstrum, also called "ruey deep fits," usually comes on during the first two weeks after birth. Various causes have been assigned to it as in the actual form, but the most frequent and well established cause is apparently a vitiated state of the atmosphere, brought about in most cases by the filthy habits of the people and imperfect means of ventilation. It is by far the most common among the Negro races. Its endemic area is largely confined to the tropics. In the West Indies, it is to a very considerable extent affected. In Cuba, Jamaica, Martinique, Antigua, Barbados, Guiana, it is constantly present. Rush states that in the West Indies a tenth of all the children born die before they are twelve months old; at Boston, where well provided for, 15 per cent at 2 years. In Jamaica 25 per cent of the negro children die of it. This is common a large extent of the northern part of South America and the eastern United States. In Buenos Ayres, with a population of 200,000 in 1875, the deaths from trismus were 445, or in 1876, 433. In Charleston in 1876 4 per cent of the deaths are due to it. In the western part of Africa and the Cape of Good Hope it is also very prevalent. It is seen in Central, Southern Europe, and as far north as Iceland. Dr. Joseph Clarke gives an account of an extraordinary mortality that took place among the infants in the Dublin Lying Hospitals at one time, from 1767 to 1782, out of 17,650 infants born alive 2,416 died within the first fortnight, being nearly 6 per cent. 17 per cent - observing the real cause of this terrible mortality, he introduced many sanitary


reforms, such as improved ventilation and keeping the infants clean, with the result that between the years 1782 and 1790, out of 8033 infants born alive, 4114 died of this disease; the percentage falling from 17 to 5.06%.

In the byngo hospital in Stockholm in 1834, 242 deaths from tetanus neonatorum out of 506 children took place in the year. An outbreak occurred in large nursery hospitals in 1838-39 which there was reason to associate with an epidemic of pernicious fever prevalent at the time. I may here point out that in Dublin in the byngo hospital in 1787, a very serious epidemic of pernicious fever occurred, on account of, according to Clarke, the crowded state of the institution.

In the institution mentioned above in Stockholm, nine epidemics of pernicious fever took place in the years 1825, 1840 and 1868 under conditions similar to those in 1834 when tetanus prevailed: defective hygiene such as overcrowding.

In the island of St. Kilda, there is an enormous infant mortality from this disease. Dr. Morgan states that out of 60 deaths which occurred between 1830 and 1860, 39 were due to tetanus – or '8-day sickness'. It feared that 8 out of every 10 infants born on the island. Between 1856 and 1861 out of 17 deaths, there were 8 cases. He ascribed to a defective system of ventilation in the construction of the huts. Hall and observed that although the disease was very rare in the mainland and in Iceland it was very destructive in the island of the Hebrides with a population of 200. Schellingerhout states that 64% of 8000 infants died of it; in the
small island of Westminster off the southern coast of England while in China off the north coast. Two of these children born there as a rule died of tetanus. Great improvement followed in hygiene when Scheiner's use of hot air and a well ventilated house for lying-in where the women and children could be carefully tended, reduced the percentage from 62 to 12.

There is a difference of opinion as to whether the disease should be looked upon as a traumatic or idiopathic, in the former variety, attention has been paid to the state of the umbilical cord, both from pathological appearances which he observed maintained that it was due to inflammation and ulceration in the umbilicus - other writers assert that it was due to the phlebitis of the umbilical veins. In children of Prague, however, in 46 cases of inflammation of the umbilical vessels which ended fatally, found enrolling in only 3 of these while no case presented any resemblance to tetanus. On the other hand, phlebitis of the umbilical vein is often absent. In some cases of tetanus it has appeared when infection has taken place, Marson Simo considered it a disease of certain origin depending on mechanical pressure of the medulla v & its nerves from an upward displacement of the occipital bone. Most authorities however consider it as having some relation to the state of the umbilical wound. Among the negroes especially, the wound is neglected, allowed to fall into a state of gangrenous ulceration which
A. American Comm. q Dobstt: Nov 1871

B. Revue de Chimie 1885 p1022.

was often aggravated by the application of irritating dressing. Bailey believes the existing cause to be a nutrid condition of the umbilicus produced in most of these cases by improper dressing and want of cleanliness. He also believes that the general condition prevalent conducive much to the production of a defective ventilation and uncleanness.

There can be no question here as to the cause being an inflammation of nerve-trace or reflex irritation from the umbilical wound as the cord is entirely destitute of nerves or stimuli while on the other hand its vascularity and the nature of the Whitman's jelly make it an exceedingly capable absorptive agent.

Few records are in existence of the disease in general hospitals apart from those mentioned above. A large aggregate of cases occurring among patients in private houses are comparatively rare. Harper quotes the case of a woman who had abscesses in her horses had died of the same disease some time previously: in 1881-82 in the village of Camiers, Poissy, with only 400-500 people, 3 cases occurred at l'hôpital de Poissy; but none had ever been observed. Two of these cases were admitted one in April and the other in July 1881; two other cases broke out in the hospital one in August and the other in October, both during fall. Belmore says two small epidemics in one at Zurich, seven cases occurred in one week when the weather was very hot the barometer

B. Veterinary Surgery p. 450.


extremely high and storms most frequent.

Olschewski mentions in a table of 24 cases of

roatitis after varicotomy that one operator had

7 cases out of 29 from the disease.

In veterinary practice the disease is not

uncommon. It attacks usually the horses. It is known

frequent among lambs after birth when they are kept

hygienic surrounding. It is especially common after

castration and in certain seasons, even skillful

operators lose 20-25% or even 75% in 100 cases. In

Egypt, Spain and warm countries generally, it has so

often followed castration that the operation has been

largely abandoned. It is a well known fact that in

Veterinary clinics cases always occur in two or three

isolated cases being rare. Withers in speaking

of its epizootic nature mentions the occurrence of ten

cases within a fortnight. Davids reports six cases

taking place within four months in the Danube basin,

where it is a rare disease. 3 horses, 1 cow were affected. 2

the horses belonging to the same owner. Douglas, again,

describes nine cases taking place at a stable in

Yorkshire in almost three years time.

Rotaritis preauricularis is very rare in this

country. Withers relates his cases after abortion in one which

part of the placenta was retained. Sir J. Simpson details eleven cases

in those tropical climates it is on the other hand extremely

common. Thus in Bombay between the years 1851-1853

233 human died of purpuric rotaritis, while during the same

period there were only 41 cases of fatal purpuric fever - 29 belong

to pleuritis congestive disease forming a very suggestive substitution.
Pathological Anatomy

Post mortem examinations were made in Case 7 and Case 15 (1885) and on T-R who died in the Union Hospital. Some parts of the spinal cord from over the 1885 cases were examined about twelve months after, the cord being having been preserved in weak spirit. It was, however, impossible to obtain a portion of more than the anterior horn of grey matter.

The naked eye marked appearance were limited to congestion of the internal organs. The cerebellum and spinal meninges were much congested, but no haemorrhage were observed. The cord in the last case seemed after them natural. Two of the cords were hardened in chromic acid and placed for three to four weeks while the other was kept treated in Milled's fluid - some putresces for six weeks others for ten weeks. The medullary horns and eochellum of this last case were also hardened and sections made of them. Sections were stained with carmine, album carmine, Bismarck brown, spruce carmine and mounted in Canada Balsam or Tannic.

Microscopic Appearances

Spinal Cord

I shall allude more particularly to the changes met with in T-R's cord as they are more marked and refer to the points of difference in the others later on.
It shows a portion of a branch of the central artery of the cord supplying the anterior horn.

A - colorless capsular, mostly granular, partly fibrillar, with some lymphocytes. (The arrow in the original makes it darker than was originally intended)

B - Wandering lymphocytes

C - Isoliating nuclei

The engorgement of the vessels, the partial proliferation of nuclei in its sheath, as well as the irregular involvement of the vessel are well seen.

Drawn by Dr. Jetham Thompson.
vessels were seen - the change long and marked in the central artery and its branches - these vessels are seen as huge ramifying trunks about three times the normal size - in some places where they have fallen out, large gaps are left - the vessels entering the cord from the periphery are also enlarged and dilated, marking off the white columns into bundles. In a transverse section of dilated vessels, considerably empty space is seen surrounding it where the vessel has sloughed from its attachment. The central canal is filled up with fluid for some distance around it. There is an enormous number of nuclei.

Under the high power (250) looking just at the vessels they are seen crowded with red blood cells - greatly dilated. Within the sheath of the vessel is an enormous number of lens-shaped and some red cells. All along the track of the vessels, surrounding them, is the granular material which Lockhead Clarke first pointed out in 1864. These undulations are seen in relation even to the smallest vessels. They are however apically marked in the central artery and its branches and in the arteries of both commissures while the anterior and posterior root arteries exhibit them as well. In close relation to some of the terminal branches of the central artery and within the outer margin of the gray matter are small granular patches granular in appearance which hand not take in the carmine staining. Near all the vessels are surround ed by many lens of this.

Nerve cells - here there were several well marked alterations: the greater majority of the central and anterior...
lateral groups with a few of the posterior-lateral groups were smaller and not so defined. Thus along the larger vessels, the cells of the central group were small with few processes and appeared as if they were pressed together by the mass of material forced out from the vessels. Around some of these cells, the cell space is filled up with unstained granular matter which looks as if the line had crushed the cell aside. Along the terminal branches of the vessels and especially in the anterior lateral and anterior group cells a number of the cells show granular degeneration. In some the change is seen throughout a great part of the body of the cell; in others, it is confined to one of its processes and the adjoining part of the body.

Initial canal - Surrounding it: many times after an arrow appears as if they were due to proliferative or surrounding tissue. The canal itself is compresses laterally and its lumen filled with proliferated epithelium. In the anterior commissure close to a vessel, there is a great aggregation of leucocytes forming a little bunch.

Throughout the whole of the grey matter, especially the anterior horns - and portions of the white columns, leucocytes were observed in great number.

All these changes are most marked in the cervical portion of the cord.

The changes observed in the others are more advanced. In some I find a dilatation of the vessels and a greater number of nuclei than normal. The change appears as if it could be normal. Even in case IV although they are present to a great extent, the streams of conglutination along the vessels are indefinite.
No changes were observed in the ganglion cells or central canal. In the 1883 case, the cells were certainly swollen considerably but it is probable that such an appearance was due to long preservation in spirit.

It was examined in but one case.

In a section taken through the descending tract, the pyramids stained with carmine or protargol, great distension of the vessels is observed—engorged with red cells; and effusion of lymph into round vessels into plethysm. Changes in the central artery well seen—the mass of gray matter between the central canal and the posterior juxamine is honey combed with engorged vessels. In the same region the granular material surrounding the vessels—great proliferation of nuclei are most marked. The remnants of the anterior commissure present among the changes met with in the cord, but the cells, will meet here exceptions which show yellow granular degeneration, as normal—otherwise the changes are the same.

In section just above the calamus scriptorius, similar changes occur—more marked however at the posterior part where the central and anterior posterior arteries run close to the nuclei of the different nerves. Changes in the cells to a very limited extent, here and there is there a cell seen with granular degeneration. The granular condition is apparent—in one section well marked where a detached branch of the central artery has the colored deposit effused around it. Numerous nuclei apparently more than normal are scattered over the field.

In the Pons, the changes in the vessels are apparent.
A. Lancet: Vol II 1864 p 269


C. Lancet: Vol V 1871


E. Pathol. Soc. Lancet Vol XXX.

F. Soc. Cit.
Cerebellum. In both layers the greatly dilated vessels are seen standing out in a perfect network - no changes are observed in Purkinji's cells.

Most of the changes detailed were first prepared by Lockhart Clarke in 1869. He found the vessels largely congested and surrounded more or less by a granular material. These appearances have since been confirmed by Dickinson, Clifford Allbutt, Coats, Gowers, Ross, etc. The precise origin of the granular matter once has been long in dispute. It was first put forward by Michaud and is now generally accepted that it is an exudation from the vessels; a number of pathological observers hold that it may be looked upon as a degeneration - the result of partial decomposition due to the methods of preparation. Changes in the cerebellar ganglion cells have been mentioned by Anschutz and Hess. The latter has seen the ganglion cells of the greater portion of the medulla as well as in front of the anterior lateral and a few between the anterior lateral and posterior lateral group, as shrunken in their cavities that they are invisible under low powers. Anschutz describes more extensive changes in the cells. Hul-Schultze later exception to these, holding that occurring as they did in a case of 2 days' duration, these changes were due to the method of mounting in glycerin. Alterations of the central canal have frequently been described but similar changes are found in normal cerebros (Coats). Most observers however agree in recognizing a large proliferation of nuclei especially in the gray matter.

Coats has already pointed out that the
Loc. cit.

Veterinarian - 1860

Did. de Med. Veterin.
changes in the medulla were the found in the region of
the hypoglossal nuclei, while these describe changes
in the cells of the nuclei of the spinal accessory and pneumo-
gastic. The medulla presents healthy, but a group of cells anterior
to it was shrunken. In the roots of the 5th nerve proceeding
from the cerebellum, large vessels were observed distended
with red blood corpuscles and the surrounding tissue infiltrated
with nuclear lacunae.

Many pathological have however, entirely
failed to detect any marked lesion in the nervous system.
In few cases, Rawson could detect no changes while
a fine reddish at times a similar lesion. Wilks and
Wadlow have also found nothing.

With reference of the transmission of the
disease from one animal to another, a number of
experiments have been carried on from time to time, and
as not one definite result has been obtained, I may be permitted
to refer to them briefly. They are collected from various sources.

In 1869, A. Alonzo and Leipsen injected blood
and pus into dogs, rabbits, and horses with negative
results. In 1870, Wülff B. transplanted the blood
of infected animals into a healthy one without
transmitting the disease.

In 1882, however, injected some of the cerebro-spinal
fluid from a horse which died after 10 days illness
from tetanus into the spinal causes of the ox and
sheep - into the substantia of the spinal cord in
goats and into the brain of two cats. In another
A. Studio sperimentale sull'etiologia del tetano in the
"Giornale internazionale delle scienze mediche" T.X 1884.

B. Articolo "Ueber Infektorium Tetanos" in Deutsche Medica-
ische Wochenschrift 1884 - No 52 p. 842.
sends of experiment, he inoculated two goats with matter from a horse which died on the 5th day. The results were in all cases negative.

Recent experiment by Carle and Ratton have been more successful. The matter was derived from a patient who died of hemina after three days illness. They seized some infected tissue around a punctured wall and put it into distilled water. They injected some of the extract subcutaneously into 12 rabbits. The injected fluid caused some animals of different sizes. Each rabbit received two-thirds of a fifth of the fluid and put into the muscles of the back or the abdominal area. The expected quantity was 2 cm. 2 cm into each cavity. Eleven of the animals presented the following symptoms: 2 or 3 days later. They appeared damaged and refused food and water. They had tremors in the limbs. Next day the muscles of the neck were strongly contracted. Respiration was rapid and accelerated, with elevation of internal temperature. After this period which lasted 3 or 4 days, the beasts exhibited set up contractions, increased gait, tremors, arrested the respiration, the contractions went on increasing until death. Part of the fluid kept in a sterilised jar at 0° kept up its activity for a month. They used for this purpose pieces of matter excised from the food and manipulation of spinal cord. Several animals with blood were not successful.

About the same time (1864) B. Reed, using injected under the skin's rabbits and guinea pigs some vegetable earth. He believes that there exist in this earth microorganisms which find their way into deep wounds of mice, rabbits, and other animals. He used them for experiments, injecting the matter into the brains of rabbits and guinea pigs. He observed that they became suddenly paralyzed, with convulsions, and eventually died.
and guinea pigs communicated to animals. The species of
these Bacilli appear to be most prevalent in the most
superficial levels of the soil. Thus 180 specimens of earth
gathered at Böttcher's game house on inoculated 12 positive
results. The same Bacillus were obtained from the earth
gathered in the public way in the streets of Berlin, Leipzig and
Weimar, and kept for years. The symptomatic anatomy of
the artificially induced Bacillus differs, however, accord-
ing to the seat of inoculation. The symptoms first affect
the skin or which seat of puncture is; later at the end of
several hours the contractions extend to the same body or
apparatus situated on until the whole body is affected. During
the Bacillus state, the least excitement produces a contraction
nearly all the animals died. Mischak inoculated other
animals of same species by per os from a Bacillus of puncture
stains demonstrated the transmissibility of the induced
Bacillus of the second generation differed in that it had a
shorter incubation (10-20 hours) and more rapid enceur
Specimens of earth which possessed largely the former
developing induced Bacillus feel. It after an hour's
exposure to a temperature of 190°C. - The pus from the
seat of inoculation a great number of micro-organisms and
Bacilli were found - one form especially was present -
very small, elongated - a little larger and a little
thicker than the peritoneal Bacilli of the mouse.
Staining with Fuchsain showed these heat. They were
found in the tissue around the seat of inoculation as in
the sciatic nerve and brain in the case. 32 cases
inoculated with blood, parts of liver, spleen, muscle, nerves
and organs gave 11 cases of Bacillus with fatal
Deutsche Med. Zeitschr. 1866 - No. 31 p 341
results while 88 injected with pure 64 ended fatally. Both Meslesius, his colleague Thüngge had great difficulty in cultivating the bacilli. They however succeeded by keeping them in coagulated blood serum for 3 or 4 days at the temperature of the room of incubation. Incubations made with these cultures gave positive results even as far as the 4th generation.

Rasumovskij, a Stettinian, has recently arrived at similar results. His material was obtained from a case of acute farce causing gangrene of the foot. He first took the patient's blood from the thigh, which was injected into the thigh of two guinea pigs. The 1st day there was great contraction of muscles; both died the same day. Other inoculations made with parts taken from a certain distance from the point which had yielded the first inoculation were negative in other animals. He succeeded in inoculating in several series of guinea pigs and observed the similarity in symptomatology between his results and those of Meslesius & Thüngge. In his also, the course depended on rate of inoculation. Thus inoculation in the anterior limb of a mouse made the limb immobile, the frontal in an animal, and paralysed at the same time. Paralysis came on—the bacillus infecting; spread gradually from the point of puncture; in 18 hours all that half of the body was covered in a semi-circle and the animal died in 24 hours. In the guinea pig nearly the same results were obtained. The period of time in incubation was however longer (24-36 hours).
and the general tetanic convulsions were marked.

Much remains however to be done in the direction of endeavoring to establish the identity of the "bursting-shape" bacillus of Rosenbach with the pleurotropic factor in the production of true tetanus. The experimentally induced tetanus differs in many important respects from the classic disease — the latter usually selects the deeper parts of the nervous system which are affected early; the former is apparently an extension of the infection (however produced) from the periphery to the centre. Hensel's Rosenbach's results agree with those of Carl's Ratcliffe. In Hem of the latter, the incubation period lasted 3 or 4 days, began with contraction of the muscles of the neck, passed a course of symptoms closely similar acting time tetanus in man — the animal dying at the end of 6 or 7 days. In Rosenbach's, the necrotic period in the guinea pig was about 24 hours and the animal died in about 36 hours, while the course of the tetanic phenomena depended on the point of inoculation.

An interesting point is suggested by Théliez-Hüffer's researches. Military surgeons, following Laney, believed that the chief cause of tetanus was the sleeping of the wounded on damp ground after a very hot day. It is quite possible that such conditions by favouring the propagation of the earth-tetanus bacillus, may indirectly lead to the development of the disease.
The Nature of Tetanus.

From the earliest times, the disease known as tetanus or lockjaw has been quite fully studied and its prominent symptoms fully recognised. One would naturally expect that the speculative opinions concerning the origin of this widely-spread disease would have been exceedingly numerous; but although the explanations of the different symptoms has necessarily undergone a process of change according to the pathological views of the day, it is not necessary that I should refer to more than two theories regarding the nature of the disease — one, old-established, which has held ground for many years — the other more recent and in process of evolution.

The first claims that the disease is one of the nervous system — the result of an irritation which spreads from the periphery — and in traumatic cases from the wound — that this irritation may be conveyed directly through extensions along the nerve structures or more commonly reflexly, leading to an increase in the reflex power of the allied spinal cord. The other which may be called the "humoral theory" looks upon the disease as essentially one of the blood, where owing possibly to the formation of some mucous a definite natural cause is evolved which leads to a general disturbance of the animal economy.

As I do not propose discussing the first view at any length, I shall confine myself
A. That of Thomas M — see page 60.
in the regard to it, to noticing a few of the facts which are brought forward in its support.

The irritation is said to be propagated from the wound along the nerves, hence the bloodvessels of those structures is looked upon as necessary to the establishment of the disease. The termination of the nervous structures deprived as they approach of the surface of their protective covering are supposed to be more exposed to the evil influences which may spring up in or around a wound. The arguments adduced in favor of this proposition are supported by certain changes which have been observed in the peripheral nerves. Thus Currier says that in like cases, the peripheral nerves appear red and inflamed—often writers make statements of much the same character; but although such changes have undoubtedly been found, the proportion of cases showing them is indeed very small. Most of the cases examined have had their nerves quite normal whilst in those where acute and chronic changes have occurred in the nerves entering from the wound, the disease shows no tendency to develop itself. In his cases, I have obtained from wounds pieces of altered nerve where the patent did not possess at any time the remotest trace of spasm. In one case a secretion from a piece of one of the digital nerves of the foot—this was containing "red and swollen"—acquired sharply there was an increase in the cells of the interstitial connective tissue as shown by the proliferation of nuclei—yet this never ran any side by side with a blame patent and failed to
A. Burned and other injuries of nerves - 1864

B. Buddle "St. Bartholomew's Hosp. Rep." 1853
develop it. The severe pain which was felt in the toes disappeared in sections of the nerve. In another case, where the median nerve was laid bare in cellulitis of the arm, amputated between the bundles of the fibres. W. E. Mitchell reports 50 cases of injuries to nerve structure without tetanus resulting in a single case. In all cases of amputation where bleeding vessels are tied in any number, the presence of this disease might have much more frequent from the numerous occasions in which nerve twigs and even nerve fibres that are enclosed in the ligature. In certain cases where a foreign body has occupied a wound, its presence has been followed by marked improvement or disappearance of tetanic symptoms; irritation by its presence has been assumed to be the cause of the disease; but on the other hand foreign bodies have been removed and even the offending member amputated early without any good result being obtained. W. M. B. Baker found a splinter of iron which had lain in the median nerve for two years without producing tetanus. One can readily understand how any small source of irritation may act to a considerable extent on a delicate nervous system but it is difficult to realize how trivial a cause could produce in strong and healthy muscular or patients the objectionable symptoms characteristic of this terrible disease in weakly individuals, slight irritation may result in localised spasm; thus dental caries has been known to produce a persistent facial spasm or even squint, while in a patient who was admitted here for lambean
A. Micheal Hayett 1833.
...united.

pursuing, I was informed by Dr. Taylor of this town, that six months previously an attack of toothache led to a most pronounced trismus which yielded after twenty-four hours to the influence of a hot bath and an elixir.

Another argument is favour of this view is the supposed cure or relief which has followed section of the implicated nerve. Few well established cases however have been recorded; and if it has succeeded in one it has failed in a very few. Number Murray, who was one of the first who practised this method of treatment, decided the persistent neural for symptoms of trismus which appeared eleven hours after he had put a wooden into the pole of his jaw. The operation was performed early; relief is said to have followed the operation and cure is spoken of on the third day; but may however may be allowed to denote the establishment of his contention as the probability suggests itself that the case was an example of localised spasm following irritation in a mobile nervous system whose much less heroic measures would have sufficed and the results eventually be more satisfactory - other cases are recorded - but many objections may be urged to them, suggesting doubts as to whether nerve section has resulted in any arrest in altering or arresting the course of the disease.

The great difficulty in explaining the localisation of the disease on the 'nervous theory' is an insuperable obstacle to its acceptance.
* HAUSH. MEGAZ. 1961 *

B: Surgery Vol II py 1
it. Thus the different sources of nerve irritation lead to the orderly manipulation of the various phenomena, as one who has attempted to explain.

If tetanus followed a wound of the leg, physiological teaching would require that the irritation should be transmitted through the reflex arc in the cord and show itself in spasm of the muscles of the same leg or in those of the opposite leg. While a direct extension of irritation or inflammation would inevitably exhibit itself primarily in the muscles of that limb and ultimately travel upwards.

Having thus noticed briefly a few of the arguments which are advanced in favor of the view which still is to a large extent held by the minds of the profession, I pass on to point out more fully some reasons why the cause might rather be looked for in the general intoxication of the system by a poison whose predominant action is on the nervous system and whose nature at present is quite unknown.

It was first advanced many years ago by the younger Traeger and upheld by Wilson of St. George's Hospital. In 1861, Heidelberg asserted that tetanus is not a nervous disease but a morbid process localized in the muscles and depending on a blood discharge or blood poisoning. The same idea has been developed and supported by Rose, Parham, Richardson, Billroth and others. As far back as 1856 Sir James Simpson considered that muscular tetanus was possibly due to the development of some special poison. Billroth inclined very much to the
humoral theory of tetanus as a peculiar poison
disease which he supposed may occur entirely
peculiar circumstances be some pressed in the mind
I propose to present next, what appears to me to
be general reasons in support of this view and ex-
amine them somewhat in detail.

Certain diseases such as strychnine poison-
ing and hydrophobia are so closely allied to tetanus
in their clinical features and cause, that frequent
mistakes are made in the differential diagnosis.
In both these disorders the cause of the disease is a
poison circulating in the blood and affecting certain
parts of the nervous system and although their
mode of origin is somewhat different from that of
the analogy of the results obtained from all these is
so striking that I may be allowed to refer at some
length to them.

The symptoms of strychnine poisoning and tetanus
are so strikingly similar that very few careful
enquiry and observation are necessary to distinguish
them. In both we have spasm as a prominent feature
when taken in quantities just sufficient to produce
perceptible physiological effects, strychnine induces
feeling of restlessness, perhaps accompanied by
tracing in the limbs and some stiffness of the neck
and jaws - when a somewhat larger amount is
given there may be general muscular twitchings
and straining with stiffness and structure of the
throat and chest.
A. Wood "Therapeutics" p. 255.
produce the pâne paralysians." and "trémus
finally, on in severe cases. A between the spasm
these may be slight rigidity of the muscles. Magnesia
was the first to show that this action of the alkaloid
is primarily on the spinal cord while van den
has since demonstrated that the motor centres of the
cord are specifically excited. Thus the resemblance in
the clinical features of the two affections is very
striking. In both, the stiffness and spasm of jaw is
an early prominent feature. The general spasms
the condition of acute spastic atonia, the hyperacuteness
of some of the spinal senses e.g., hearing, the clearness of
the intellect all though the course of the general sp.
paralysis and the muscle of death are common to both
diseases. Stiffness of the limbs in rigidity of muscles
remains for some time after recovery in amyotonia tal-
annus as in the classic disease. The only point of
difference are that in the case of the alkaloid
after the convulsion is over the jaw drops and
the muscles relax although in some cases slight
rigidity may be perceptible between the parasites
muscles and the muscles of the jaw are affected
late. The difference in the order of the various
parts affected suggests that in the common disease
the medulla and higher centres are affected early
as a rule, whereas in amyotonia perennis the
motor areas of the cord are primarily involved
in irritation ultimately retarding, in large doses, to
the medullary centres.

In order to compare the mental appearances
to be met with in both diseases and if possible to throw some light on the varying appearances of the malady in its amnios. At first, strychnine in amnios was induced in a number of animals. The animals used were cats and rabbits and the mode of intaking the alkaloids was the usual anurous one. I selected three different periods of experiments. In the first class of cases a grain of strychnine was injected into a rabbit and a cat — very scarce operations were followed and the animals died within two hours. In the second series two rabbits and one cat were let amnios by 1/10 of a grain of strychnine and the convulsions kept up by 2/50 grains every twelve hours for two days and then killed. While in the third class of cases two rabbits were similarly treated but with smaller doses for three and a half days. After death, the cord and medulla were removed in all the cases — some parts of them were handed in chloroform and water — others in Wolfgan's solution (composed of solutions, 1 part; sulphate of copper 1, and water 200) but in the greater portion, Müller's fluid was used. The sections were stained with carmine, alum carmine and bismarck brown and mounted in Canada balsam.

Under these appearances, all the internal organs showed signs of congestion. There was intense angiose of the cerebellar part of the brain and spine and the cerebrospinal fluid was deeply blood stained. In the first class of cases — scattered throughout the brain were minute red spots — in the cord there was no apparent change beyond a slight softness, here and there.
Straining takes 2 days duration

Transverse section of spinal cord of cat in cervico- cervical region - stained with canina. X 250.

It shows branch of the central artery of the cord running to the anterior horn.

A - Colcemis granular reaction with a few leukocytes
B - Leucocytes diffused into the tissue vessels sheath
C - Nuclei

Drawn by B. Hathorn Thompson.
Microscopical appearance

Taking the second class of cases as typical—

Sural Cord

Low Power: Vessels of the pia mater large and filled—on one side of the central canal, the central artery is enormously enlarged—increase in the surrounding tissue—its posterior branch is much enlarged with a number of nuclei surrounding it—several deeply stained and yellowish spots are scattered through the white columns.

High Power: Small hemorrhages observed underneath the pia mater—the central canal is partially filled by its proliferated epithelium—the central artery on both sides is much altered—on one side it has shrunken away from the tissue around and by a large cavity, while its main branches are engorged with red cells—small hemorrhages occur along it here and there—along the course of the vessels are numerous branching, while in the central canal is the medulla of the gray matter close to the posterior lateral group of cells. A transverse section of a small vessel is seen surrounded by numerous phagocytes, some having apparently migrated into the tissue beyond. There are no changes in the ganglion cells—no shrinking. Some of the branches of the central artery, show a the empty spaces surrounding them a granular material which does not take on the staining. In a section stained with Weigert solution the dilated blood vessels do not cause through the white matter of the centre with small hemorrhages to their course are well seen.
In the medulla with a

Low Power — the vessels of the pia mater are large and

dilated — some vessels which run in from the periphery

are seen in sections to be considerably larger than

normal. In the sections, the median posterior artery

supplying the vago-saccusatory nuclei is greatly dilated

a small swelling on it — a similar condition is seen in

the anterior part artery.

High Power — vessels are filled with red corpuscles much

enlarged — swelling of median posterior artery is a small

haemorrhage — considerable number of nuclei in the region

of the vessels — no changes in the ganglion cells.

In the first series, the changes in the vessels

are well marked while a great number of small haemorrhages

are seen. They are not however so evident as

in the second series. In the third series where the

specimens were kept up three or four days, the changes

were with a the anterior horn are very marked — the

arteries are enormously enlarged, appearing as large

red lines in a dense network under the low power —

with the high power they are seen filled with red cells

while along their course small haemorrhages are seen.

In some places, some granular material appears along

the side of the vessels. The ganglion cells show little

alteration — along the cellular mass a few does not

fatten on the staining as well while the nucleus is of a

dark colour. Throughout the grey matter there is pro-

liferation of nuclei.

In the medulla the changes are not nearly as

marked as in the cord where the entire artery is
N.B. For the purposes of comparison, the diagrams on page 93 and page 90 may be consulted.
much affected as well as the median process—no hemorrhages observed here—nuclear proliferation slight in excess of normal.

In comparing the microscopic appearances presented in the medulla and medullated nerves, a close resemblance is found in the results. In both, we have the similar changes in the vessels and tissues generally such as increase in leucocytes, and proliferation of nuclei with deposition of granular material in some cases, thus suggesting that the factors in the production of these changes are closely related one to another. In artificial laminas we know that the cause of these changes is the action of the alkaloids—opiumine, and it seems probable that some poison—perhaps a chemical one—is the agent whose action on the nervous system in laminas leads to the irritative appearances which we have already described.

The difference in the appearance of the cord in artificially-induced laminas of various durations suggests an explanation of the variety of results which have been obtained in ordinary laminas. We have seen that during the longer periods the changes have been more marked and it is probable that a case of laminas which lasts but thirty-six hours would yield an examination any more changes in the vessels. Most of the cases where any variations of any note have been obtained, had lasted about

\[ \text{until 3 pm on day 6.} \]
while Case I (1885), whose symptoms were chiefly
restricted to the throat and death took place in 36 hours,
presented no the spinal cord merely some slight
vascular changes.

In seeking an analogy from hydrophobia
we find a similarity existing in the occurrence of
spasms chiefly confined to the pharynx but sometimes
becoming general. These pharyngeal spasms which
from one or two chief features of rabies are brought on
in the great place of in attempts at swallowing
especially fluids. In tetanus similar spasms are so
pronounced. In Case I (1885) spasms confined to the
throat were so frequent after attempts at swallowing
that the unfortunate man was in intense misery from
the inability to quench his thirst. The retraction of the
head and predominance of the laryngeal symptom
undoubtedly classified his case under Cthrophagric
tetanus or "tetanus hydrophobos." Before the spasms
come on in hydrophobic, stiffness of the head and neck is
observed which is followed shortly by pharyngeal
spasms. As the case goes on, however, the resemblance
of these diseases is to a large extent lost. Great rest-
lessness, extreme sensitiveness, delirium and even
mania show that in rabies there is a grave involve-
mment of the higher centres - death usually comes.
In tetanus on the other hand, consciousness is retained
until the last and the intellect is clear while death
follows from exhaustion.

The pathological changes bear a great resemblance
to those of tetanus. In both disorders, the chief

B. Reynolds' System of Medicine Vol I p 504

Lesion affects the blood vessels. coats have shown that it takes the form of a collection of round cells or leucocytes around the larger or medium sized vessels of the cord and medulla. It does not affect the vessels uniformly at intervals, the vessel appears quite normal at all, though in some cases it is seen to extend quite throughout the whole length of the vessel - the change is seen principally in the middle of the grey matter although it is also in the white columns as well. This may well marked in the medulla and is more generally observed than in cisterns. In the convolutions where it affects the capillary sized arteries, the extension is often so marked that Benedict gave the name 'miliary abscesses' to the condition.

These appearances indicate strongly the presence of some irritant circulating in the blood leading to production of leucocytes along the vessels.

Epileptic cerebral spastic meningitis often presents some close resemblance to the disease now under consideration. Thus, "some degree of the muscles of the jaws (masseter) and gullet and of the limbs and trunk may also occur giving rise to the quiet spasms, semi-paralyses or general tonic rigidity of the trunk and limbs". It is sometimes known as "titanoid jerk" and in an epidemic observed in Michigan in 1874 several cases exhibited marked locked jaw. While D. Baker reports aid shows that the reaction following atmospheric cold is a powerful precipitating agent to the malady. The influence of overcrowding and other insanitary states where many individuals are crowded into small sleeping rooms insufficiently.

B. Hemmstic Imped. Bio. p. 34.

ventilated upon the production of the disease is well known.

Injection of putrid fluids such as decomposed blood and pus has been followed by clinic symptoms of the muscles, especially those of the posterior straitness. Weber found that in small animals such as rabbits and small cats small quantities of such fluid were sufficient to produce violent spasm and rapid death. Koch has observed similar phenomena after injecting the inoculation of mice with the anthrax virus.

The results of the inoculation, occasioned probably by a putrid serum, are more confined to the vessels of the nervous system. The kidneys as a rule are much congested and the intestine with the process of excretion suggests the presence in the circulation of such an agent. Later in his cases in which he examined and analyzed the urine found the quantity of urine much diminished — in the first case 500-600 c.c. in the second 485-870 c.c. while the urine was diminished on an average 1 to 3 grains and 21.8 grains. It was then observed that at the days when the convulsions were most severe and numerous and consequently at the days of the most violent muscular action, that the quantity of urine eliminated was not the greatest, the small quantity is as much as the more remarkable inasmuch as the convulsions were accompanied by a high fever temperature (103°-104° and 98.6-101°) creatinuric as well as uric acid was present in small quantities. These results have been confirmed by Karsch, Hippius and Bawon (Johnson Cyclopede).
A. Dictum de med et de cliv in Vol. 36.

B. Archiv. der Heilk. 1867

C. Romex Vol. 4 1872 p. 820

D. Page 32
Lemier records a remarkable diminution in the amount of urea while LaBbé found the reduction to be considerable. He found that taking 23 per litre given by Vogel as the normal, there was a peeling off from that amount to 15 and 14.6 per litre respectively although the temperature was 103°. Albuminuria occurs although not frequently. Virchow details a case where he found a great number of pale casts with albumin until the last day when there was a trace. There was severe fever accompanying (101.4–103.4). Meanwhile in the same journal records the presence of albumin in the urine and a few pale casts and blood corpuscles. Rose and Schmikr have also found albumin in the urine with shedding of the epithelial cells.

Changes in the lungs although brought about secondarily through affection of the nerve centres have been observed in the lungs. Wendt in 1872 drew attention to lesions observed in these organs in cholera apart from the lesions produced by stasis and ulceration from hyperplasia or asphyxia from contraction of the respiratory muscles, lesions such as pneumonia and capillary hemorrhages occur which he believes, be the result of some hypertrophic disturbance of the nerve centres caused by medullary irritation of the cord.

In Case I (1888) a remarkable condition of the tongue presented itself very early. It became within 12 or 18 hours very much enlarged, swollen and edematous to such an extent that it resembled the condition of acute glossitis, nearly filling up the cavity of the mouth while its movements were much impeded. The patient...

An increase in bodily temperature is as frequent an accompaniment of the toxic state and often attains such a height as to suggest the action of a virus through the blood. Some observers have denied however that such is often the case. Dr. Beebe asserts that in the Peninsular War he met with 200 cases without any rise. It is difficult to believe that such was the case; he, however, possessed no knowledge of the clinical thermometer and it is possible he may have failed to detect even considerable alterations.

In the 17 cases recorded in this paper, every one showed an increase in body heat. 8 had a temperature above 100° but below 102°; 6 had a range up to 102° while in the remaining 3 a body heat varying from normal up to 104° was registered. Several explanations may be given for the alternations of temperature. Thus Murray showed as the result of experiments on dogs a rise of the rectal 1° or 2°C from its usual artificially induced by staphylococcus and considered that the heat was due to the contraction of muscles. A similar rise takes place when the circulation is excited by electricity and spasm induced (Ball and Pick). Verney (loc. cit.) denies that the rise of temperature often observed towards the end of a case is

written
a. med. woman p. 425.
b. page 12
c. page 42
d. page 10
due to pulmonary complications — while others hold that it is due to a lesion of the heart producing centre in the card or medulla. All these three causes may be brought about by the presence of a poison while the disturbance produced on the system in general would considerably add to the increased heat and would explain some of the extraordinary rises of temperature observed in some cases — such as the one quoted by Wunderlich. 112.6°.

The great emaciation and exhaustion observed in tetanus tends to confirm this view. Most of the cases after the first few days show a considerable loss of flesh even when the true tetanus has been very long sustained, as in Case IV (1883) in which considerable emaciation was evident, although there was no rise in temperature except on two occasions for a short time also in Case VI (1883), the wasting was extreme and very general affecting the subcutaneous tissue as well as the muscles while towards the third week delirium set in which was relieved by increasing nourishment and stimulation. In Case III (1883), a patient apparently rank from pure exhaustion, the spasms having largely disappeared. Most of the cases die from the extreme exhaustion which is nearly always present.

The occurrence of the disease in several of its cases together taking the form of an epidemic outbreak points strongly to some poisonous element probably of a communicable nature. I have already drawn attention to several of these outbreaks and no better here and elsewhere and need only now refer.
There are no readily ascertainable data to proceed upon in estimating the period from the absorption of the disease as it is impossible to say at what stage such absorption may begin. Carle and Rattana found the incubation period to vary from 4 to 5 days while Nicolas and Rosenbach got periods varying from 10 to 24 or 36 hours according to the animals used. Nicolas found the period to shorten when the bacillus was isolated and cultivated before inoculation. Taking the length of period which elapsed from the infection of the injury and appearance of the typhoid symptoms as possibly giving a rough indication of the incubation period, the average of the 17 cases in this period is 9 days. In the 1885 cases a period of 6 to 7 days elapsed in four and the remaining cases were twice that period time—12 to 16 days. In the 1886 cases all the cases showed themselves on the 9th day. This is all the more remarkable as much as that period is often the same time which elapses in cases of typhoid hemorrhagia which is also called "nine days fits" which we know to be caused by insanitary conditions. The 1886 case appeared on the 13th or 14th day.

I have already pointed out that the disease is frequently associated with others of an infectious nature: how it ran in camp and alternated with cutaneous eruptions and sore throat. This institution: how it appeared and carried off wounded troops among battle and among the insanitary surroundings, various infections...
A. Treatise on Meteors

B. Treatise on Combined Theory - Munich, p. 96.
disorders, typhus, smallpox, dysentery, carries, hospital gangrene etc. were ripe; and to this great extent it was in children it was dependent on insanitary conditions. Although it is a disease found in all countries and climates, the larger amount of it falls to countries within the tropics. In the West Indies, South America, Central Africa, and India it presents as an endemic disease affecting less numerous extent the colored races, especially the negroes. Negroes, colored men, Caribs, Hindoos, and Brazilian Indians all display a marked predilection for this affection; these races being likewise the most susceptible to the many epidemic influences which are inseparable from a tropical climate.

Great majority of cases has been supposed to originate from the theory of nervous origin. In this point, the late Professor Robson's case, where a negro was seized with symptoms of a man and a month after he had cut his hand with a large knife, Kurz's relates three cases— one (Dr. Wernicke's case of encephalitis) 7 hours ago, another 2 hours and 30 minutes ago, the last one hour ago. The last may be looked upon as a doubtful case. Even supposing that the incubating period was as mentioned above, it is in no way excludes the action of a blood poison; for examples are on record where infected fever had had a period of incubation of only an hour or two.

Nature of the poison

All opinions concerning the nature of the nature of the matter must be purely speculative.
at present, we have not gone quite to quite us. The
very frequent association of the disease with an open
wound points to the probability that the absorption
of the specific element takes place through a broken
surface. Cases of idiopathic tertians where no wound
is discoverable would preclude the limitation of a
wound surface as the only channel of entrance and
made it reasonable to suppose that other means
such as absorption from mucous surfaces are avail-
able unless we assume that there are minute lesions
by which such absorption may take place.

The condition of the wound has probably some
relation to the development of the disease: certainly in
a large number of cases, it is found to be unhealthy and
unhealthy. Bichat supposed that the special poison
was possibly formed in a peculiar state of the wound.
In the 1843 series of cases, in nearly eight out of ten
healthy state of the wound, which in 1845-1846 persi-
ant of seven showed a similar condition. In three
or four of these, a peculiar sticky exudate from the dis-
charge was observed. Repeated microscopic examination
failed to reveal anything definite cause in the shape of
microorganisms and I do not know that there is
much importance the attached to it. In case IV, V,
1843, the wound was nearly healed when the first symp-
toms appeared; but septic disorders appear sometimes
even when the wound is healed as seen in a case
which occurred here in 1846.

Considering the frequent association of the
disease with an unhealthy state of the wound,
A doc. cit.

That it occurs in cultures in hospitals where it has seldom occurred before, and that it shows itself under conditions which are conducive to the occurrence of diseases of known specific nature, such as syphilis, puerperal fever, etc., it is probable that there is a microbe firm, whose action is greatly enhanced by an unhealthy wound and through whose surface the specific element readily enters. We have already seen that tubercular developed into acute symptoms by injecting putrid fluids into rabbits. Further experiments which he made by injecting sulphuratic hydrogen, sulphide of sulphur, ammonium, etc., which are the results of the decomposition of pus and blood, gave similar symptoms followed by death. Injections of three dead cats of plasikins into which are putrid hydrogen and injected into rabbits followed by various premonitions and death.

Cases of tetanus are supposed to have been caused by the absorption of putrid flesh, either through the mouth or through a wound. There is a very strong belief amongst the inhabitants of the Swiss Plate that the disease in man is often produced by the eating of flesh of animals who died of tetanus. Carne relates five cases of cannibals from among the heads which were supposed to have been poisoned by putrid flesh. In the manner—two were of the arm, two of the hip, and one of the scalp. Two of these took tetanus on the 6th day—one died on the 8th day; the other on the 9th. In the 6th case the wound was slightly and unhealthy, the three others healed.
A. Acturus de Med. et de Chir.

B. Iturich Vol III p.622.
well and rapidly. Carrying the question as to the absence of products of decomposition further, Armand Gautier has discovered a normal urine in alkalois which possesses the power of putrification - it has a toxic power and when injected into animals it produces and determines them, killing them with the heart in vessels. We know to what extent the disease especially the infantile form is dependent on conditions where the products of decomposition are allowed to exert whatever influence they possess upon the patient. Watson in his account of the endemic prevalence of the disease among the negroes of Tennessee says: "When called to see these children we find their clothes wet around their hips and spots upon their armpits and urine. The child is thus presented to us, when an examination not only wet with urine but soiled likewise with passing feces, frequently giving off an offensive urine and fecal odor embalmed at times with a gangrenous matter arising from the decomposition, not destruction of the case."

It is difficult as yet to estimate the rôle which the bacilli of Rosenbach play in the pathogenesis. The identity. It is impossible to say whether the organisms may produce the disease from direct action on the nervous system or whether they act secondary to the production of a poison which affects the system. The difficulty which Nicolaus Hesse found in transferring the cultivated bacilli from one medium to another suggested, an idea that observation, some other organism, probably acts their growth. Whether may be the precise manner the in
which the virus is produced, it seems probable that it is closely related to atypicalia - in other words, that it is a chemical poison nearly allied to that alkaloid, which may be produced in the wound, hammed by certain stasis of it, and possibly due to the action of a bacillus, as which may result from such act as the circulatory.

The clinical course of lethamn is partly, the eventment more particularly of the 5th 7th and 11th period of cerebral nerves as well as of the motor areas of the spinal cord. The poison has apparently a selective action on the medulla and appears part of the spinal cord as shown by the early appearance of tremors, sensory parasthesia and difficulty in swallowing as well as stiffness of neck.

In lethamn the symptom point is an impairment of the motor areas of the cord especially and microscopical examination confirms this by the appearances which the grey matter presents. In lethamn we find these changes not only in the motor areas of the spinal cord but also in the higher areas earlier which may be regarded as a continuation of the grey matter of the cord. Thus is a somm level just above the decussation of the pyramids of the medulla we find on microscopical examination in a case of lethamn that the vessels which supplied the grey matter immediately behind the spinal canal were particularly affected. This grey matter, well known, gives rise to some of the parts of the spinal accessory (11th nerve).

Mayr - in Stricker's histology - in describing some which he calls the "reticular mixed system of the medulla," says that it is made up motor and sensory nerves - the 9th, 10th and 11th pairs. One cluing nucleus forming the
The anterior column of origin of this system represents in the medulla the processus lateralis of the anterior horn of the spinal cord—i.e., motor and gives rise to the upper poles of the spinal accessory nerve (the lower ones from the processus lateralis) and according also to Negrin's cornua of the facial and motor nucleus of the 5th nerve. The posterior column of origin is composed of the Vagus and Glossopharyngeal nuclei, and is mostly sensory. How it is this system—especially the motor part—and the structures which Negrin regards as its homologues by the anterior cornua of the cord and the facial and motor nucleus of the 5th, which are constantly affected in tabes. These nuclei are supplied by the median posterior and central anterio nerves which we have seen are affected to a very great extent, the latter especially showing signs of irritation in both cord and medulla. We may go further and assume that the sensory portion of the system is affected: for if we accept Negrin's contention that the lungs often display evidences of trophic disturbance, we can readily account for them by the appearance met with around the vagus nuclei, while those around the nucleus of the glossopharyngeal would produce a trophic lesion in the parts over which it presides and explain the condition of the larynx and throat mentioned in case I (1885). The state of the pulse during the spasms may be explained by the action of the virus on the medulla. Between the spasms it is but slightly accelerated, while during the course of a convulsion it rises considerably in frequency. All the cases here in detailed showed an
increased rapidly during a spasm — sometimes as many as 15–20 per minute. One case (VII. 1883) had a pulse of 150 before death. In Case II (1883) and in Jim caso in 1886, the pulse was completely arrested in some spasms. The inhibitory movements of the heart are derived from the medulla through the spinal accessory nerves, and it is quite possible that a very powerful irritation of that nucleus would lead to stimulation of the cardio-inhibitory centre and arrest of the heart. This is supported by the fact that the heart often stops in chylothorax. Each time I observed the pulse stop, there was a very severe commotion of the muscular system, and it may be that although in ordinary spasms the pulse is increased by the excessive muscular action, in very severe spasms its irritation may extend to the higher centres. The respiration is often arrested during a spasm. This may be due to contraction of the diaphragmatic muscles pulling the chest, increased blood pressure, and consequent state of the blood. The action on the heart and glands is some extent; but the enormous stimulation of the structures suggests also a direct irritation of the medullary centres of the cord. The origin of the spasms is doubtless the result of the action on the grey mattering the cord. It is probably direct on the nerve cells as suggested by the tonic nature of the spasms — while the periodic discharge of motor energy resulting in the production of movements may be explained on Paré's Theory of lessened resistance or an Römer–Bumm's doctrine of the alteration in wave rhythm. Anaemia may account to some extent for the increase met
will in the deep reflexes during the convalescence of the two cases (VT 1888 and some in 1886). But this long delay, time during which they were apparent, indicates rather, possibly, some interference with the functions of the lateral columns.