An essay on tetanus, founded on cases and experiments / by Joseph Swan.

AN

ESSAY

ON

TETANUS,

FOUNDED ON

CASES AND EXPERIMENTS.

BY

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Est enim admirabilis quædam continuatio seriesque rerum, ut alia ex aliâ nexa, et omnes inter se aptæ colligatæque videantur.
CICERO *de Naturâ Deorum.*

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PREFACE.

EVERY one who has seen acute Tetanus, must have lamented his want of knowledge, both respecting its nature and the method he ought to adopt in his attempt to cure it; for although many interesting facts have been published on the subject, and cases are not wanting in which a recovery has taken place, yet, as a different remedy has been employed for almost every case, no conclusions can be drawn from them as to the plan of treatment it is best to pursue.

This imperfect knowledge is, I think, to be ascribed to the insufficient minute-

ness in our examinations of bodies after death.

When the nature of a disease is not understood, I consider any new anatomical facts relating to an alteration in the appearance of important parts to be of infinite value, as they may either of themselves, or by leading to a different mode of investigation, be the means of explaining correctly what appeared before so mysterious.

The opinions I have stated in the following pages, were formed from the consideration of appearances which presented themselves to me on dissection. The first time I had an opportunity of making a complete examination of the body of a person who had died of Tetanus, was in May 1823. I then perceived an unhealthy appearance of many of the ganglia of the

grand sympathetic nerves; as this was quite unexpected, for a similar one had not been recorded by medical authors, I could not form a decided opinion respecting it, as will appear from the following passage.* "In this examination, no part of much importance, except the ganglia of the grand sympathetic nerves, decidedly deviated from the healthy state; and, in the present state of our knowledge, I conceive it difficult to determine whether the appearances were in any way connected with the disease; or were caused entirely by the submuriate of mercury, the opium, or the spirits of turpentine." In the following November, I dissected the body of another person who had died of this disease, and found the ganglia of the grand sympathetic nerves having a similar ap-

* An Inquiry into the Action of Mercury on the Living Body, page 12. Second Edition.

pearance. I now began to think that the altered state of the ganglia might be the cause of the disease; and I soon determined on making experiments with a view of either confirming or refuting this opinion; but I was then prevented from executing what I had proposed. I had, however, in the mean time, the satisfaction of finding that similar appearances had been observed by Dr. Aronssohn,* at Strasburg; and whilst I was making some experiments, a case occurred to my friend Mr. Thomas Macaulay, who very kindly afforded me the opportunity of being present at the examination of the body after death, when I was again enabled to witness appearances in the ganglia of the grand sympathetic nerves very similar to those I had before seen. M. Andral Fils † has

* Lobstein de Nervi Sympathetici Humani, Fabrica, Usu et Morbis, page 152.

† Clinique Medicale, tome i. page 419.

also discovered a great redness of the semilunar ganglia in a patient who laboured under fever, and died with symptoms of Tetanus.

When I had nearly finished my observations on this disease, I read the opinions of Dr. Good, * and also those of Mr. Abernethy.† The latter gentleman says, "When the irritable and sloughing state of the wound shall have gone off, when healthy granulations have formed, and the cicatrix is rapidly advancing, in this state Tetanus may occur. How are we to account for this? I am inclined to think that it is to be accounted for in the following manner. We know that the disposition to disease occurs long before the action of

* Lancet, vol. v. page 72.

† Study of Medicine, vol. iii. page 323.

the disease takes place. In the painful and bad state of the wound, the disturbed state of the nervous system has produced disease of the digestive organs which reacted on the nervous organs; so that the disorders have reciprocally aggravated one another; so that at last, even though the wound is drawing to cicatrization, or has even healed, and there is no longer any local irritation, the disposition to Tetanus, from the established irritation of the cerebral and visceral functions, comes into activity. Perhaps those who know nothing of the opinions I have formed on subjects of this kind, may not thoroughly understand what I mean. I propose this as a question to surgeons, Whether the disordered state of the digestive organs, established during the irritative state of the wound, may not be the occasion of Tetanus when that irritative state has ceased?

If what I have written amounts to the same as is expressed in the preceding paragraph; if, likewise, some of the opinions I have advanced are the same as those advanced by Dr. Good, and there is any merit in the following pages, I shall willingly rest satisfied in having proved by dissection and experiment, what those gentlemen have so ingeniously proposed.

It is a matter of considerable moment to ascertain how the body is usually affected by injuries and diseases; and although I cannot presume on doing this in a way by any means conclusive, yet, as it is impossible to understand the nature of Tetanus without a certain degree of knowledge respecting the changes produced in the body by injuries and diseases, I thought it necessary to premise my observations by an inquiry into the nature of constitutional irritation.

OBSERVATIONS

ON

TETANUS.

CHAPTER I.

ON CONSTITUTIONAL IRRITATION.

When an injury has been slight no constitutional irritation is produced, as the part is of itself fully capable of making a reparation.

When a severe injury has been received, the whole body sympathizes, and the functions of every part become more or less disturbed, especially those of the digestive organs, and the heart and arteries.

There is not only a disordered state of the functions of important parts at a distance from the seat of injury, but a great

change in their appearance is discovered on dissection, as in the following case.

CASE.

Susanna Graham, a stout-looking girl, æt. seven years, was burnt by her clothes catching fire on the 20th of August 1823, at noon. The thighs, and arms and back were the parts affected; but some of them appeared to be burnt deep. The skin of the abdomen was not burnt. She did not appear to suffer much pain. Mild ointment was applied to the affected parts.

21st. At ten A. M. she complained of pain in her belly. She had vomited several times. She wandered a little and was cold, and her face was death-like. She said she remembered me. The pulse could not be felt in either arm. Purging medicines were given her, but they did not remain in the stomach.

In the evening the pulse was perceptible, but she appeared weaker and was quite in-

sensible; the pupils of the eyes were much dilated, and did not contract on the approach of light, but she could see, for she attempted to blow out the candle. Six leeches were applied to the temples. She died at one A. M. on the 22nd.

Examination.

The lungs were very purple and loaded with blood. There were spots of ecchymosis behind the posterior mediastinum on the left side; there was a great vascularity on the outside of the aorta; there was some fluid in the pericardium.

There was an increased redness on some parts of the omentum, but the peritoneum appeared healthy. The liver was generally pale, and especially on its concave surface. There were some spots of redness on the villous coat of the stomach, but I could not decide that they amounted to disease. About six inches of the jejunum were highly inflamed.

All the ganglia of the grand sympathetic nerves in the chest were vascular. On the right side, the semilunar ganglion and all the rest of the ganglia in the abdomen were very vascular. On the left side, the semilunar ganglion and the first in the abdomen formed by the continuation of the grand sympathetic nerve, were very vascular, but the others were not. The nerves of each axillary plexus were very vascular. The sciatic nerves within the pelvis and the anterior crural nerves were vascular, but not near so much so as the axillary plexus.

After every accident in which the constitution sympathizes with the injured part, I believe, the ganglia of the grand sympathetic nerves become irritated, and the functions of the parts supplied by them with nerves are disturbed in consequence. The action of the heart is increased in proportion to this degree of irritation in them, so long as it continues moderate.

Though an injury in the first instance has been slight, or such as does not usually

occasion much disturbance; yet if the constitution be irritable, or the body exposed to cold or other causes of disorder, it will produce a very considerable disturbance, not unlike what arises from a more serious injury, as in the following case.

CASE.

Mrs. Powel, æt. above 80 years, fell down in the afternoon of the 14th of November 1824. I saw her soon after, and found her complaining very much of pain in the left hip; the limb could be moved in every direction, but this motion produced excessive pain; she lay on her back, with the limb extended, and nothing was ever done except the application of fomentations for the first few days. I believed there was a fracture of the neck of the thigh bone, although the limb remained quite as long as the other, and I could neither perceive any crepitus nor any altered appearance in its position, except a slight inclination of the toes outwards. She had more constitutional irritation than I ever

observed from a similar accident. She suffered much pain in the hip, and was in consequence obliged to take an opiate, but she got very little rest. She generally had much thirst; there was the utmost difficulty in keeping her bowels open, and she had great pain and difficulty in making water. She had no appetite for common food, and for about three weeks appeared so weak that she was under the necessity of taking wine and brandy. For some time all her urine and stools were passed in bed, but not involuntarily, and only because she could not be persuaded to use proper means; in consequence, her back became rather sore. Latterly, she complained of pain in the abdomen, which was very tender on pressure, and made even the weight of the bed-clothes inconvenient. Her tongue became very dry and brown, and in the last twenty-four hours she was insensible. She died on the morning of the 19th December, about five.

Examination.

This took place at seven in the evening. There was some ecchymosis amongst the muscles about the injured part, and in the cellular membrane about the sciatic and anterior crural nerves. The greatest part of the fracture of the neck of the thigh bone, which was entirely within the capsular ligament, was firmly united. A section was made through the fractured part, and a faint white line was perceived in one portion of the union, but the rest appeared to be entirely bone. I sent the specimen of fractured neck of the thigh bone to Sir Astley Cooper, and he had no doubt of its union. It aptly illustrates the exception which he makes, in his Treatise on Dislocations and Fractures of the Joints, of the possibility of union when the reflected ligament is not torn through. I have a preparation taken from a woman who lived about the same time after a similar accident in which almost the whole of the reflected ligament was torn through, and not the least union was produced.

There was violent inflammation of the semilunar ganglia. The viscera of the

chest were sound. The outside of the aorta was very vascular. All the intestines were very vascular, as if a state of excitement bordering on inflammation had existed in them. The bladder was very large, and contained some urine. The uterus was very hard, and had a small ossific tumour in the fundus. The labia were excoriated, and there was a similar appearance on the buttock of one side.

With a view of observing the effects of constitutional irritation in the internal parts, the following experiments* were made.

EXPERIMENT I.

One portion of oxyd of arsenic weighing thirty-nine grains and three quarters, and another portion weighing twenty-six grains, were moistened with water, and inserted into a wound in the back between the shoulders of a very large dog on the 18th of April, 1823, at half past 7 A. M. Soon

* I think it necessary to state, that an animal may be labouring under some disease which produces an increased action in the ganglia of the grand sympathetic nerves, and be made the subject of an experiment; so that unless care is taken to procure healthy animals, the appearances after death may be noted down as the result of the experiment instead of the disease.

after I laid my hand over the wound so as to press the arsenic to the back, and he immediately had twitchings in different parts of the body. He ate with a good appetite. Involuntary contractions of the muscles of the face continued throughout the day, so that the teeth would frequently be brought close together with a snap. He has neither vomited nor purged.

19th. He is much the same as yesterday. Twenty-five grains of powdered oxyd of arsenic were given him on a piece of meat at a quarter before eight A. M. At half past nine he had not vomited. At one he had vomited several times, and, I believe, nearly the whole of the arsenic was rejected, as the symptoms continued just the same as before he took it.

20th. He is much the same. He has not vomited again. He has no appetite. The same twitchings of the face continue.

23d. He is very weak. An abscess broke on the right side, and as it

was presumed no advantage would result from prolonging his existence, he was hanged.

Examination.

All the ganglia of the grand sympathetic nerves were inflamed. The par vagum and nerves about the face, had a greater redness than usual, and a slighter degree of it existed in the axillary plexus. The sciatic nerves were natural. All the thoracic viscera were healthy, but there was an increased vascularity on the outside of the aorta. There appeared more than usual redness on the peritoneum of the stomach, but not on that of the other viscera. The villous coat of the stomach was ulcerated in several places, and that of the small intestines presented an appearance of red spots. There were red spots and bloody mucus on the inner coat of the rectum. Neither the brain, nor the medulla spinalis, nor their membranes had any increased vascularity. The ganglia of the spinal nerves were more vascular than natural, but those

formed by the fifth pair had not any increased vascularity.

The largest piece of arsenic weighed full thirty-eight grains, and the smallest twenty-four grains. There was much inflammation on the skin to some distance round the place where the arsenic was inserted. The abscess had formed near the shoulder.

EXPERIMENT II.

December 13th, 1824, at ten A. M., two portions of oxyd of arsenic, one weighing twelve and the other thirteen grains, were inserted into a wound in the back of a large dog. He soon after began to have twitchings of the muscles, but he otherwise did not appear much affected.

14th. He ate with a good appetite in the morning, but appeared very uneasy and at times as if suffering much pain. He was thirsty.

15th. He seems in every respect as yesterday. He ate some flesh with a good appetite. He was hanged about noon.

Examination.

This took place at one P. M.

All the ganglia of the grand sympathetic nerves were more vascular than natural, but the semilunar were very red.

The brain and its membranes were healthy, except that there was rather more vascularity than usual about the pons Varolii. The medulla spinalis and its membranes were perfectly healthy. The thoracic viscera were sound.

The stomach and intestines appeared very vascular. The stomach contained much half-digested food, and its villous coat was red, but not unhealthy. The small intestines contained much yellow mucus, and the villous coat was very vascular.

Very violent inflammation was produced by the arsenic, which extended for a considerable distance over the skin, and there was much serous effusion in the corresponding cellular membrane.

At nine P. M. one portion of the arsenic weighed eleven grains and a quarter, and the other, twelve grains and a quarter; the latter was broken in removing it from the wound.

The inflammation produced by arsenic does not appear to differ much from that produced by other means, for when it has proceeded to a considerable length, copious venæsection will arrest it, in the same manner it will violent inflammation arising from any other cause. But lest objections should be urged to these experiments because they were made with arsenic, it appeared advisable to produce the same state of inflammation by other means.

EXPERIMENT III.

January 1st, 1825, a flat piece of gamboge, weighing fifty-four grains and a half, was inserted in a wound in the back between the shoulders of a dog of moderate size, at three P. M.

The next morning he had a purging, which continued. He never ate any food, but was thirsty and drank much water. He lay as if he had not the power to move until the 4th, when he appeared rather stronger; and his strength was increased a little more this morning.

Jan. 5th. He was hanged at seven A. M.

Examination.

This took place at half past nine.

There was very great vascularity of the first thoracic ganglion of the grand sympathetic nerve of the right side; the semilunar and the other ganglia of the right

side were more vascular than natural, but not near so much so as the first thoracic. On the left side very few vessels could be observed in the first thoracic ganglion, so that the contrast between it and the corresponding one of the right side was very striking. The semilunar and the other ganglia of the left side were more vascular than natural.

The vessels of the pia mater of the brain were turgid, but not more so than hanging usually causes. The substance of the brain was healthy. On opening the spinal canal, a little fluid was found in the sheath of the dura mater; but the medulla and its membranes were healthy.

The thoracic viscera were sound.

The liver was very dark, and the abdominal viscera in general appeared very vascular.

The stomach was very much contracted, and its villous coat was so red that it could

not be considered healthy. The villous coat of the small intestines was throughout highly vascular; indeed, I may say, inflamed, and there was one small ulcer in the upper portion. The mucous coat of the large intestines was much more red than usual.

All the absorbent glands and vessels appeared in a state of irritation.

The wound was perfectly closed, and no trace of the gamboge was left. There was very considerable inflammation, and also a serous effusion into the cellular membrane to some distance round the wound. The inflammation did not appear to be near so violent as that produced by arsenic.

I thought it probable that death produced by hanging might cause an unnatural appearance in the state of the internal parts, and therefore, in the following experiment, instant death was produced

by shooting * the animal through the head.

EXPERIMENT IV.

February 28th, 1825. At a quarter past four P. M., a piece of gamboge, weighing sixty-four grains, was inserted in a wound in the back between the shoulders of a pointer.

March 2nd. He never ate any thing after, but drank much water, and lay constantly as if in a state of great debility. He was shot at eight A. M.

Examination.

This took place soon after nine.

* Although hanging produces a greater vascularity, resembling inflammation in the internal parts, if life is not almost immediately extinguished, I nevertheless think, that shooting an animal through the head, by causing instant death, induces a greater paleness than is natural; but of the two modes, the latter appears the least objectionable.

The ganglia of the grand sympathetic nerves had a great vascularity.

There was some redness on the outside of the aorta, and this state existed in a considerable degree in the cellular membrane at the superior part of the cavity of the chest. The lungs and heart appeared healthy.

The stomach was contracted and contained some undigested food, which was eaten before the experiment; its villous coat was healthy. There were many red patches on the villous coat of the small intestines.

The gamboge was entirely dissolved, and some very slight traces of it remained near the wound. There was violent inflammation, and a corresponding serous effusion to a very great distance round the part where the gamboge was inserted.

EXPERIMENT V.

1825, January 11th. At a quarter before 10 A. M., a piece of gamboge weighing seventy-six grains, was inserted in a wound between the shoulders in the back of a very large dog. He soon after began to be very uneasy. In the evening he lapped much water, and afterwards vomited. He purged in the night.

12th, at seven A. M. He lies as if he were almost dead. He sometimes moves and howls, and then appears in a state of stupor. He cannot stand. At half past nine he was in the same state. Whilst I was observing him, there was a violent spasm of all the muscles of the body, which lasted about a minute; he vomited at the same time. He died about eleven.

Examination.

This took place at one P. M.

All the ganglia of the grand sympathetic nerves were very highly inflamed.

The pia mater of the brain was rather more vascular than natural, but the other membranes were healthy. The substance of the brain was healthy. There was a small quantity of serous fluid about its base.

The medulla spinalis and its membranes were healthy. There was a very small quantity of serous fluid in the sheath formed by the dura mater. The axillary nerves and the par vagum were more vascular than usual. The sciatic nerves had a natural appearance.

On opening the abdomen all the viscera looked healthy, except the liver and spleen, which had an increased vascularity.

The stomach contained some half digested food, which had been eaten before the experiment was made. Its villous coat near the pylorus was very red; in the other parts there were numerous black spots, at each of which there was an ulcer, and the black part appeared to be coagulated blood. The villous coat of the

small intestines had a very high degree of redness, and was ulcerated in many places. The mucous coat of the large intestines was more red than usual.

The thoracic viscera were sound.

The wound in the back was closed; when its lips were separated, a quantity of gamboge, dissolved in the serum, flowed out, but some of it had insinuated itself amongst the cellular membrane, nearly as far as the elbow. There was a most violent and extensive inflammation of the cellular membrane, and a corresponding effusion of serum.

EXPERIMENT VI.

1825, Jan. 20th. A large bitch received a compound fracture of the tibia and fibula of the left leg, at a quarter past ten A. M.

At half past eight P. M. She does not appear to suffer much, and has eaten with a tolerable appetite.

22nd. Yesterday and to-day she has eaten very little. This morning she was thirsty, and had frequent involuntary contractions of most of the muscles of the body. She was hanged at noon.

Examination.

This took place at one P. M.

All the ganglia of the grand sympathetic nerves in the abdomen had an increased vascularity, but it was the greatest in those of the left side. The first thoracic ganglion of the left side had a slightly increased vascularity; that of the right side was quite white.

The viscera of the thorax were sound.

The viscera of the abdomen appeared too vascular. The stomach was much contracted, and almost empty; its villous coat was red, but not diseased. The villous coat of the small intestines was very highly inflamed, but not ulcerated. The mucous

coat of the large intestines was too red. All the absorbent glands appeared in a state of irritation.

There was a transverse fracture of the bones. The periosteum was separated to a short distance, and much thickened. There was much inflammation of the cellular membrane, and a corresponding serous effusion a little above the wound, and likewise as low as the os calcis. There was a much greater vascularity in the groin on the left side than on the right. The cellular membrane surrounding a small portion of the saphenus nerve near the fracture was inflamed; the remaining part of this nerve, and all the anterior crural nerve, were quite healthy. There was the same appearance in the branches of the sciatic nerve near the fracture, but there was rather more vascularity in the left than in the right sciatic nerve.

EXPERIMENT VII.

1825, January 24th. A large bitch received a compound fracture of the left thigh at half past nine A. M. In the afternoon she had constant spasms in the broken limb, but she ate with a good appetite.

25th. She has the same spasms of the limb. She has eaten with a tolerable appetite, and has not appeared to suffer much. The wound was examined with the finger, and the separation of the muscles was closed, so as almost to exclude the air from the bone. The adhesions were again separated.

26th. At half past nine A. M., she lay as if very weak, and began to have tremblings of the whole body. In the afternoon she was rather better, and ate some boiled milk and broth with a good appetite.

27th. She was hanged about seven A. M.

Examination.

This took place soon after nine.

There was an increased vascularity of the first thoracic ganglion of the right side; and also in the corresponding one of the left, but in a much less degree. The right semilunar ganglion was more vascular than natural, but the left was so in a very great degree. There was an increased vascularity of the other ganglia of the grand sympathetic nerves.

The brain and its membranes were perfectly healthy. There was some fluid in the lateral ventricles.

There was a small quantity of fluid in the sheath of the dura mater of the spine. The pia mater had an increased vascularity, but the medulla was healthy.

The thoracic viscera were sound.

There was an appearance of great vascularity of the abdominal viscera. The stomach was contracted, and its villous coat had some dark spots on it. The villous coat of the small intestines was very highly inflamed. There was a slight redness of the mucous coat of the large intestines.

There was a serous effusion in the cellular membrane of the leg and foot. The periosteum of each end of the bone was separated to some distance; the inferior broken extremity was pressed backwards against the sciatic nerve. The sciatic nerve had some blood effused into the cellular membrane investing it: there was besides much redness of the nerve as high as the sciatic notch, and as low down as the ham.

EXPERIMENT VIII.

February 12th, 1825. A large dog had a compound fracture of the tibia and fibula,

at eleven A. M. He ate with a tolerable appetite soon after, and did not appear to be in much pain.

13th. He is the same as yesterday, except that he is rather thirsty.

14th. His appetite continues tolerable; he is thirsty and appears dull.

15th. He is not so thirsty, but he is still dull and looks thin.

18th. He appears much better, and is not so thin.

21st. He continues better, and has a good appetite.

22d. He was shot through the head at a quarter past eight A. M.

Examination.

The semilunar ganglia had a very slight vascularity, but there was no appearance of blood-vessels in the rest of the ganglia of the grand sympathetic nerves.

There was a considerable redness of the villous coat of the stomach, and many patches of redness on that of the small intestines.

The thoracic viscera were healthy.

All the nerves of the leg were free from vascularity. The fibular nerve had a slight connection with the wound, but nothing particular was observable in it. The periosteum was separated a short distance. Granulations were shooting from the external surface of the superior portion of bone, but not from that of the inferior portion. Granulations were likewise shooting from the cancellated structure.

When a very serious accident has happened, and particularly if any of the vital organs have been injured, there is frequently no reaction in the system, and especially if venæsection has been much employed for the purpose of diminishing the quantity of circulating fluid, and we then do not find any alteration in the appearance of the nerves, as was exemplified in the following case.

CASE.

William Howard, æt. fifty years, received a kick from a horse on the left side of the chest, on the 15th of April, 1824, at one P. M. The greatest violence appeared to have been inflicted on the seventh, eighth, and ninth ribs, and the skin covering them was very much discoloured. A great crepitus was felt by just placing the hand on the side. There was Emphysema. He was very faint. At four he was bled to about twelve ounces, he then appeared very faint and almost sinking. A bandage was put on the

side, but it increased the pain so much, that it was very soon removed. At eight he appeared so sinking and had so much difficulty in breathing, as to induce me to make an incision through the integuments and muscles at the lower part of the side, when I readily discovered an opening which communicated with the chest. Bloody serum and air escaped, and he soon after appeared much relieved.

16th, at nine A. M. I was informed he had passed a more comfortable night than was expected. He has much pain. Sixteen ounces of blood were taken from the arm. In the evening he was rather better.

17th. Early in the morning he continued to appear better, but about eleven he trembled and had much pain, and a death-like appearance. The abdomen was tender. He complained of a most oppressive pain about the ensiform cartilage. Eight ounces of blood were taken from the arm, which afforded him some relief.

At nine P. M. He appears worse. Opening medicines which he had taken have not operated. He purged several times in the night. He continued nearly in the same state until five A. M. on the 17th, when he died rather suddenly.

Examination.

This took place at noon on the same day.

On removing the skin from the left side nothing remarkable was observed, but ecchymosis and the opening into the chest at a short distance from the wound made in the operation. The sternum was removed, and the inferior lobe of the left lung was found adhering at the opening in the chest just mentioned. The lung had been torn at this part. The whole pleura of the left side had a thin coating of coagulable lymph. No fluid was contained in the chest, except a small quantity amongst the adhesions of

the lung to the side. All the ribs of the left side were broken, except the two first and the twelfth; and the broken points projected through the pleura into the chest.

On opening the abdomen, a quantity of fluid blood was found in every part of it. On the left side there was much coagulated blood, and the spleen was found to have been extensively lacerated. There did not appear to be any distinct opening through the diaphragm, but it had the appearance of having been lacerated in several places. There was some fluid in the pericardium, but the heart was sound. In the right lung there was a considerable thickening, the result, I suppose, of some former disease, and there were likewise some earthy concretions.

All the ganglia of the grand sympathetic nerves in the chest and abdomen were examined, but they had a pearly appearance, and were entirely free from any appearance of vascularity.

EXPERIMENT IX.

A flat piece of oxyd of arsenic, weighing thirty-nine grains, was inserted into a wound on the left side of the middle of the back of a puppy, on the 17th of April, 1823, at a quarter before eight A. M.

18th. He did not appear affected, and had a good appetite.

19th. He was very uneasy.

20th. He had no appetite, was very uneasy, and could with difficulty walk.

21st. His hind legs were nearly paralytic.

He was drowned at half past seven A. M.

Examination.

Inflammation extended from the wound to some distance round, but did not pass the middle of the back to the right side. The piece of arsenic weighed thirty-eight grains and a half, an hour after it was taken from the wound.

The whole cellular membrane of the left side was loaded with serum. Much fluid was contained in the chest, but principally in the left side. The pleura of the left lung was highly inflamed and covered with coagulable lymph, but the right lung was not so. The abdominal viscera were sound. The ganglia of the grand sympathetic nerves were not in the least inflamed. The brain, the medulla spinalis and their membranes, and the ganglia of the spinal nerves, were natural.

In consumptions and complaints attended by hectic fever, I have not found an increased vascularity of the ganglia of the

grand sympathetic nerves; but if any thing happens to bring on acute inflammation, the symptoms change, and may cause an increased action in the ganglia, as in the following case.

CASE.

Robert Norris, æt. ten years, began to be unwell at midsummer, 1822, and kept gradually declining. For some time before he died, his pulse was 120. He had a purging, but no cough, and his tongue was red. He made much urine. He ate voraciously, and always vomited after. He had profuse perspiration. He complained of much pain in his head, which began ten days before he died. For the last three or four days he was quite insensible. He died on the 25th of April, 1823.

Examination.

The tunica arachnoidea over the whole surface of the brain was opaque, and fluid was contained between it and the dura

mater. At the base of the brain the tunica arachnoidea was much thickened, and especially about the infundibulum. Much fluid was in each ventricle.

The lungs felt quite solid, and when cut into were found to be full of tubercles in a state of suppuration. The glands at the roots of the lungs were much enlarged, and one behind the right par vagum, just where this nerve passes behind the lung, was in a state of suppuration, and to this the nerve was firmly attached, and was very vascular.

There were several white spots like the pustules of small pox behind the pleura in each cavity of the chest, and these contained purulent matter.

The ganglia of the grand sympathetic nerves in the chest were very vascular, and the semilunar were vascular, but not so much so as those in the chest, and the others in the abdomen were less so than the semilunar. Each par vagum, where it gives off the recurrent, was vascular.

The stomach was healthy. The liver was enlarged, and contained many yellow substances of the size and appearance of mustard seed; one of them was particularly examined, and was found to contain bile. There were some small white spots in the spleen. Several ulcerations existed in the intestines, and the mesenteric glands were enlarged.

Although I am well convinced, from numerous dissections, that the ganglia of the grand sympathetic nerves have a great vascularity, induced only by several medicines and diseases, yet some are inclined to think that this appearance is present in a state of health. In answer to this opinion, I beg to observe, that I examined an executed subject immediately after it was cut down, and found the ganglia of a pearly appearance, and free from any mark of vessels carrying red blood. I have found one ganglion very red from a number of vessels filled with blood, and the corresponding one nearly white; and I have so often observed this difference, and in such a marked degree in the same subject, as to leave no more doubt

in my mind of its being the effect of a state of inflammation, or something bordering on that state, than there is of similar appearances constituting the inflamed conjunctiva of one eye, and the uninflamed state of the other. If a judgment is formed from the appearances presented by an injected subject, it will be erroneous, for it is always impossible to speak decidedly of the natural degree of vascularity of any part of a subject which has undergone such a preparation. The ganglia may be made red by injection, and so may the conjunctiva of the eye; we may therefore fairly conclude, that if the injection fills numerous vessels of the eye, which could not be observed during life, that this appearance is equally foreign to the ganglia during health.

It may be asked, how can an almost similar appearance of increased vascularity of the ganglia of the grand sympathetic nerves be caused by different medicines and diseases, and produce such various symptoms? I cannot at present give a positive

answer to this question. More experience may decide it to a certain extent.

I shall not at present add more on this important subject than the following words of one of the most laborious anatomists of the present day: — "*Certe non vilipendendæ sunt illæ nervi sympathetici morbosi notæ, et non levis momenti judicari debet istius inflammatio, qua nimirum vires vitæ, in summum intensitatis gradum evectæ, phænomena producunt plus minusve gravia.*" *

* Lobstein De Nervi Sympathetici Humani Fabrica, Usu et Morbis. Page 153.

CHAPTER II.

ON IDIOPATHIC TETANUS.

Tetanus is divided by nosologists into Idiopathic and Traumatic. The one arises from cold or some other cause that disorders the general health; the other may arise from the same cause, but is complicated with a wound or injury of some part of the body. I am not aware that there is any difference in the symptoms of the two species, but it will be convenient to make a distinction between them, as the former appears the most simple, and may therefore tend to a more easy comprehension of the nature of the disease in general.

As it is my intention to keep to a statement of facts as much as possible, I shall begin by relating the following case, for which I am obliged to my friend Mr. Thomas Macaulay.

CASE.

November 30th, 1824. Richard Ward, æt. ten years, who had hitherto enjoyed good health, first perceived a stiffness in his neck this morning. It gave no pain, and the inconvenience was so trifling as to be a matter of amusement to himself and his companions, inasmuch as he could not walk about, except in a perfectly erect posture. In the course of the day he went out of doors, and was for some time exposed to a very bleak air. Shortly after his return to the house he was suddenly seized with a violent tetanic spasm of the greater part of the body, amounting at first to a convulsion, accompanied by violent pain in the back and shoulders. A quantity of rum and water was given him hot, and in the evening some gruel, both of which he swallowed without much difficulty, although he complained that the pain was increased by the exertion. No assistance was sought for until the following day, during which interval the spasm never

relaxed, and the symptoms were evidently on the increase. During the night he got no sleep.

December 1st. At one o'clock P. M. I saw him. The symptoms had been in existence about twenty hours, and about thirty hours had elapsed from his first perceiving the stiffness. He now lies upon the bed in a state of perfect rigidity. The whole body is as one piece, and may be turned over in bed with as much facility as a log of wood, or at least in a similar manner. There is complete opisthotonos, so that the only parts of the body which touch the bed, are the crown of his head and the legs. He has scarcely any power over his limbs; he can move the left leg, and draw it up a little with great exertion and very considerable pain, but has not the same power over the right. The arms are also affected in the same disproportion. If desired to put out his hand, he always makes the attempt with the left. The right arm is permanently contracted and totally useless. The susceptibility of the

whole nervous system for conveying irritation and receiving impressions is excessive. Touching any part of his body will frequently produce a spasm. Blowing upon the face has a similar effect. Any attempt to swallow fluids produces most violent spasms of the throat, neck, and jaw, and the fluid is invariably returned. The jaw is not permanently closed, but the attempt to protrude his tongue produces a violent spasm, and in one instance it was severely bitten, and the jaw remained closed for some time. The face is much flushed, and the countenance anxious and rather wild. The pulse 90 and sharp. There is no delirium; on the contrary, his answers to questions are rather acute and intelligent. He complains much of pain in his back immediately at the commencement of the dorsal vertebræ, and this is the only fixed pain he has; pressure increases it, and seems also to accelerate the spasms and render them more severe. The spasms produced by an attempt to swallow are always more violent and distressing than those which occur spontaneously. The pu-

pil of the eye dilates and contracts naturally. He has passed urine, but no fæces. The tongue is white, and he has much thirst, but liquids get no further than the mouth. Twelve ounces of blood were taken from the arm.

Two o'clock. He expresses himself as being relieved in regard to the pain, and altogether more comfortable. The pulse is eighty, and softer. The countenance is not so flushed, and is less anxious. The spasms are not so frequent, and he can swallow liquids, but with much distress. He is to have twelve leeches applied to the back; gruel and tea for drink, and one of the following powders in a little sugar every two hours until he is well purged.

℞ Hydrarg. Submur. gr. iij.
Pulv. Jalap, gr. v. m. f. Pulv.

Half past nine P. M. He thinks himself better, but the countenance is altered for the worse. There is more anxiety. The teeth are exposed in consequence of the

lips being continually drawn back, and there is a most distressing grin. The pain of the back is diminished, and he swallows without much difficulty. The spasm continues, and affects the jaw more than in the morning. He has taken three powders without any effect. The leeches have bled freely. The blood drawn from the arm is not inflamed, but on the contrary, the coagulum is remarkably loose and thin. He has more power over the left side than the right; in fact, he cannot move the right leg and arm in the slightest manner. The breathing is rather hurried. The pulse is 150, but not sinking. The opisthotonos is still perfect, and has continued so all the time. He is quite sensible, and in the absence of spasm makes no complaint.

℞ Hydrarg. Submur. gr. vi. statim sumend.

After this he vomited, and it was then repeated with the addition of one of the powders prescribed for him in the morning. Twenty-four leeches were ordered to be applied to the back; and a purging clyster to be given every two hours.

About one o'clock, before the leeches could be procured, and whilst the people about him were in the act of administering an enema, the spasm suddenly relaxed, and he lay quite still. On looking they found him dead.

December 2nd. Permission having been obtained to examine the body, it was done the same day at noon, precisely eleven hours after death.

Examination.

On opening the abdomen a considerable volvulus was found in two portions of the small intestines. The intestinal canal was laid open through its whole extent. The stomach exhibited nothing remarkable, and contained only a little fluid and a few portions of the submuriate of mercury. The villous coat of the small intestines throughout had marks of having been in a state of great irritation; many very vascular patches were observed on it, and it was loaded with green and yellow slime and mucus; at the

superior extremity of each volvulus, several lumbrici were lodged, and others were found in different parts of the canal. The colon was irregularly distended with air, and presented rather a curious appearance; its mucous coat was healthy, and contained a few ascarides; the rectum contained fæces which had not an unhealthy character. All the absorbent glands were enlarged, but those in the abdomen were very vascular, and the mesentery throughout had the same appearance of undue action and irritation. The bladder was thicker than usual, but was not otherwise unhealthy, and contained urine.

The lungs were florid and loaded with blood, but not unhealthy. A patch about the size of a shilling, and having the appearance of effused lymph, was found on the pericardium covering the apex of the heart.

The ganglia of the grand sympathetic nerves were examined with very minute attention. In all of them there existed de-

cided marks of irritation. The vessels usually pale and colourless were injected with red blood, and the same was observed in some of the intermediate portions of nerve. The vascularity could be distinctly traced before their removal from the body, and immersion in cold water for some time did not diminish it. The left semilunar ganglion exhibited a few vessels, but the right was injected in a beautifully minute manner, quite as much so, when seen through a magnifying glass, as the conjunctiva in a state of high inflammation. The same distinction, though not in the same degree, was observed between the two sides in all the portions of the grand sympathetic nerves which were examined.

On opening the head, every part of the pia mater was found to be minutely injected with blood. The substance of the brain had a healthy appearance. Some fluid was in the ventricles and at the base; on the removal of the brain a quantity was found, equal to about two ounces. On hanging

the head over the edge of the table the same fluid kept dribbling from the spinal canal.

The spinal canal was laid open through its whole extent. The sheath of the dura mater seemed to be distended with fluid, but on being divided, was found to contain only air. The pia mater presented exactly the same appearance as that of the brain. The medulla itself was perfectly healthy.

After death the limbs of the right side remained quite stiff, but those of the left were in a considerable degree relaxed.

From the quick termination of the violent symptoms, the following case may not be regarded as one of tetanus, but the spasms were exactly the same as I have ever witnessed in the most violent form of the complaint.

CASE II.

December 25th, 1823. Frederick Allen, æt. 30 years, had complained of a slight pain at the stomach for several days, but before he had always enjoyed good health. This morning the pain extended from the stomach over the abdomen, and violent spasms came on, which made the whole body completely stiff, and were attended by intense pain. He complained of pain in the head, especially on the left side. He was not at all insensible. His face was now and then suffused with blood, and he had difficulty of breathing. A vein was opened, but he fainted when about six ounces of blood had been taken away, and continued in this state for several minutes. He was for some minutes more free from pain. He drank some warm water and took fifty drops of laudanum, and seemed further relieved. Violent spasms of the whole body and pain at the stomach again attacked him. He was then seized with

vomiting, when another spasm came on and shut his mouth so forcibly that the contents of the stomach were partly forced through the nose; the spasm then left the jaw, when he vomited with great violence. The matter ejected from the stomach was chiefly warm water tinged with bile and mucus. Saliva kept constantly running from his mouth as if he had been salivated with mercury. I pressed the left side of the neck without giving any pain; I then pressed the right side in the same manner, and he complained of great pain in the situation of the superior cervical ganglion. I then pressed both sides with each hand at the same time, and no pain was produced on the left side, but it was in a very considerable degree on the right. Some minutes after I pressed the right side of the neck without producing pain. The pulse was languid, and he complained of much pain at the back of the neck.

After vomiting several times the violent pain did not return, neither did the tetanic spasms. He was ordered to take four

grains of submuriate of mercury and a purging mixture.

26th. He had not been purged freely. He was ordered five grains of submuriate of mercury, and the same quantity of the compound extract of colocynth, and to continue the mixture. He has not had any return of the spasms, but still complains of some pain at the pit of the stomach. He soon got quite well.

I take the liberty of introducing a translation of the following cases.

CASE.

A man,* æt. 47 years, had a fibro cartilaginous tumour removed by amputation, which adhered loosely to the spine. After an interval of two years he came a second time to the hospital, requesting to have another tumour removed, which had made

* Lobstein De Nervi Sympathetici Humani, Fabricâ, Usu et Morbis, page 152.

its appearance, and the highest part of the skin of which was inflamed and ulcerated. Having first taken a purgative, and at the same time caught cold in the rainy season of October, he was immediately seized with trismus and opisthotonos, which in the space of two days destroyed him, after every medicine had been tried in vain.

On opening the body, nothing was found but a vascular network filled with blood on the surface of the medulla spinalis, and a quantity of serum effused within the sac formed by the dura mater; and a very distinct inflammation of the semilunar ganglia.

CASE.

* In two individuals, who died in 1819, with very decided ataxo-adynamic symptoms, we found the semilunar ganglia

* Clinique Médicale, par G. Andral, fils, tom. i. page 419.

having a remarkable redness, which appeared throughout to be produced by a very minute injection of the cellular tissue interspersed between the small grains of which the ganglia are composed. One of the individuals had presented, during the last forty-eight hours of his life, violent trismus and a tetanic rigidity of the superior extremities.

EXPERIMENT I.

October 18th, 1824. At eight A. M., I gave a small bitch, fourteen months old, a grain of the alcoholic extract of nux vomica. About a quarter past nine, she began to have spasms which became very violent in the course of the morning, but at two P. M. they had nearly gone off.

At four P. M. I gave another grain of the extract. About six she attempted to bark and could not, and appeared to have slight spasms.

19th. At half past seven A. M. she was nearly the same as on the preceding evening. Two grains of the extract were given, which produced violent spasms, and she died about nine.

Examination.

This took place in the afternoon.

All the ganglia of the grand sympathetic nerves were more red than usual. The par vagum was healthy, except where the branch goes off to the first thoracic ganglion, and there it was red. The sciatic and axillary nerves were healthy.

The pia mater both of the brain and medulla spinalis was more vascular than natural.

The stomach was contracted and its villous coat was red, but not unhealthy. The intestines were natural.

The thoracic viscera were sound, except that the lungs had purple patches on them, and were rather more firm than usual.

EXPERIMENT II.

October 21st. At nine P. M., one grain of alcoholic extract of nux vomica was given to a large bitch.

22d. At half past seven A. M., another grain was given. At nine she had slight spasms, and when she attempted to bark her mouth was shut involuntarily.

At half past five P. M., another grain was given. She has appeared more dull throughout the day.

23d. She is rather dull. One grain was given at eight A. M. At nine she has spasms and appears unable to bark.

At five P. M., she had another grain.

24th. At five P. M., she had a grain and a half.

25th. At half past seven A. M., she had two grains. At a quarter before two P. M., two more grains were given; a quarter of an hour after she appeared to have some difficulty of breathing, and had her tongue constantly out of her mouth. At four she had a most violent paroxysm of tetanus, in which I thought she would have expired. In the morning she was much recovered.

26th. At half past nine A. M., two grains were given.

27th. She appeared quite well. At two P. M., she had two grains. She had spasms in the evening.

28th. At two P. M., she had two grains. At five she was rather dull, when two grains more were given. Half an hour after she had a violent paroxysm of tetanus, and appeared as if she would expire.

29th. She appeared quite recovered. At half past one P. M., I gave her two grains

more. At five, her limbs were quite stiff, when she had three grains more. At six, she was rather heavy, and this state continued until eight, with a slight stiffness of the limbs. I then gave her three grains more. About a quarter before nine she did not seem more affected than she was at eight. About eleven she had a violent paroxysm.

30th. At eight A. M., she appeared better, but walked as if her limbs were stiff. At this time she had three grains more. At nine she had a violent paroxysm. At six P. M., she had nearly recovered, when I gave her three grains more.

31st. At a quarter before ten, she appeared nearly well. I then gave her four grains. At a quarter before two P. M., she continued the same, when she had four grains more. At seven she had five grains.

November 1st. She is very stiff. At eight A. M., I gave her five grains. At nine she had a violent paroxysm. At half past

one she had six grains. She had another violent paroxysm. She was found dead at seven P. M.

She always had a good appetite.

Examination.

This took place on the second at nine A. M.

All the ganglia of the grand sympathetic nerves, and especially those of the right side had a considerable redness. The lumbar ganglia were less red than any of the rest. The par vagum was unusually vascular. The axillary plexus, especially of the right side, was rather more vascular than usual, and the same was observed respecting the sciatic nerves.

The pia mater both of the brain and medulla spinalis was very vascular. There was a little fluid within the sheath formed by the dura mater near the cauda equina. The substance both of the brain and the medulla spinalis appeared healthy.

The absorbent glands were unusually vascular. The stomach contained much food. Its villous coat was red, but I could not consider it diseased. The small intestines contained food, and their villous coat was quite natural. The large intestines were full of fæces, and had considerable very red patches on their mucous coat, which appeared to have been produced by the pressure of the fæces.

The lungs were very purple, but not diseased. The heart was sound. There was an increased vascularity on the outside of the aorta.

The ganglia were kept in cold water, and a considerable redness was observable in them forty-seven hours after the examination.

EXPERIMENT III.

November 22d. At a quarter before three P. M., I gave a bitch of moderate size a grain of alcoholic extract of nux vomica.

23d. At a quarter before ten A. M., I gave her another grain. At eleven I could not perceive any decided effects from it. At half past two I gave her a grain and a half. At six she had stiffness of her limbs and difficulty of breathing.

24th. At eight A. M., I gave her a grain and a half. At two P. M., she had two grains.

25th. At half past nine A. M., she had two grains, and at two P. M., three grains.

26th. At a quarter past eight A. M., she had three grains. At a quarter before ten, she had one of the most violent paroxysms of tetanus I ever saw. At half past four P. M., she had three grains.

27th. At ten A. M., she had three grains. She did not appear so much affected as yesterday. At half past eight P. M., she had four grains.

December 2d. She appears quite well. Two grains were given at half past eight A. M. At half past nine, she had spasms.

3d. Two grains were given at half past eight A. M., and at a quarter before three P. M., three more grains. At six, she had a violent paroxysm.

4th. She appeared quite recovered. At a quarter past eight A. M., I gave her three grains, which seemed to affect her very little. At half past one P. M., she had three grains. At six, she had two grains. At this time she was very dull.

5th. At half past eight A. M., I gave her three grains. She appeared better than she was on the preceding evening. At two P. M., the whole body was in a state of slight spasmodic action. The eyes looked red. Two grains more were given, and a quarter past nine, three grains more.

6th. I gave her four grains at half past eight A. M. She died at noon.

Examination.

This took place at half past one.

There was an increased vascularity of the semilunar ganglia, but especially of that of the right side. In many of the other ganglia of the grand sympathetic nerves, there was a slightly increased vascularity.

The vessels of the pia mater of the brain were numerous, and there was some fluid between the dura mater and the tunica arachnoidea. There was a little fluid in the ventricles. The brain was healthy.

There was a slightly increased vascularity of the pia mater of the medulla spinalis, and there was a quantity of fluid within the sheath of the dura mater. The

medulla itself was healthy. The stomach was contracted, and its villous coat rather red, but not diseased. The villous coat of the small intestines was very red in patches. There was a slight redness in the mucous coat of the large intestines.

The appearance of the thoracic viscera was healthy, except some spots of ecchymosis in the lungs.

CHAPTER III.

ON TRAUMATIC TETANUS.

If Traumatic Tetanus always followed a very painful or extensive wound, there would be an apparently satisfactory reason for its violent symptoms, but as it likewise supervenes on a trifling injury, or a wound that is nearly or entirely healed, there is the greatest difficulty in comprehending how it is produced.

With a view of removing as much as possible this obscurity in the production of Traumatic Tetanus, I have been induced to enquire how the body is usually affected after accidents. From that enquiry I have been led to state, that when a severe injury has been received, the ganglia of the grand sympathetic nerves become irritated, and consequently the parts to which they distribute nerves. When the constitution is

healthy, I believe the irritation of the ganglia goes off in a few days, and then the parts supplied by them with nerves return to a state of quietude, and again perform their healthy functions.

When the ganglia of the grand sympathetic nerves have been thus affected, and the irritation has subsided, an unhealthy action in the wound may excite a fresh irritation in them. Or even if the wound be healed, the passions, improper food, and other causes, may continue, reproduce, or increase the disordered state of the organs receiving nerves from the ganglia, and thereby excite a fresh irritation in them.

When the ganglia of the grand sympathetic nerves have once been in a state of irritation, I believe they are very susceptible of its renewal. When they have become again irritated, we can readily conceive that the irritation may be communicated to many of the cerebral and all the spinal nerves, and from these to the me-

dulla spinalis, and we can then easily comprehend how tetanic spasms may be produced.

CASE.

November 5th, 1823. Master John Patrick, æt. 12 years, had some serpents in his pocket, which caught fire and burnt the upper and fore part of the right thigh, the penis and scrotum, and a portion of the skin of the abdomen, extending above the navel and a short distance on the left side, but on the right, nearly as far as the spine. He had some fever, but never had vomiting nor any unfavourable symptom until the 14th.

Mild ointment was applied to the burnt parts; he took saline medicines, and his bowels were kept open with a mixture containing sulphate of soda and senna. His appetite had returned, and the greatest part of the sloughs had separated, and the vacuities caused by them were nearly filled up by healthy granulations.

On the 13th, he had not any appetite.

On the 14th, he complained of pain at the stomach and a sore throat, but he could open his mouth very well.

On the 15th, the jaw became very much fixed, and he had some slight spasms. He had very great difficulty in swallowing. His head was bent backwards. He did not complain of pain. The sore continued to look well. He took musk, and the following ointment was applied to the sore.

℞ Pulv. Opii ʒ ij.
Ung. Cet. ʒ iv. M.

16th. The sore appeared quite dry. He was much the same as yesterday. The head was bent towards the right side.

He died at two P. M.

The spasms were almost entirely confined to the face and neck. His breathing was much affected. The functions of the

brain were never disturbed. He was well purged on the 13th, but after that no evacuation from the bowels could be produced. He would not allow an enema to be used. Mercury was not given.

Examination.

This took place on the 17th, at half past two P. M.

The dura mater adhered to the skull with unusual firmness. When the dura mater was removed, at the top of each hemisphere of the brain, there was a granular appearance, which felt rough. The vessels of the brain were much loaded with blood. The pituitary gland was unusually soft. Every other part of the brain was perfectly healthy.

In the spinal canal within the sheath formed by the dura mater, there was a small quantity of fluid. The vessels of the pia mater, and especially near the cauda equina were much loaded with blood.

The medulla itself felt rather firmer than usual, but it had not the least unhealthy appearance.

All the ganglia of the grand sympathetic nerves in the chest were very vascular. The right semilunar ganglion was rather more vascular than usual, the left had a pearly appearance, and was entirely free from any mark of blood vessels. There was a little redness in a few of the other ganglia in the abdomen.

The right anterior crural nerve had a singular vascular spot on it. The left anterior crural nerve; the right sciatic and several of the dorsal nerves, which were particularly examined, appeared natural.

The lungs and heart were sound.

The peritoneum was quite healthy. The villous coat at the cardiac extremity of the stomach was exceedingly vascular, and on this part there was a large spot of ecchy-

mosis. The bowels contained very little fæces, and had not an unhealthy appearance.

Many of the absorbent glands in the abdomen had a remarkably red appearance.

The burn had not destroyed the whole substance of the skin in some parts, and the fat underneath looked perfectly healthy.

We may fairly presume that the ganglia of the grand sympathetic nerve were nearly in the same state soon after the accident in Master John Patrick's case, as in that of Susanna Graham.* We may fairly presume too, that the irritation was subsiding, as the sore looked well, and his appetite had returned. On the 13th we find him complaining of want of appetite; a proof that the digestive organs had been by some means or other disordered: on the 14th this disorder had increased, and he complained of pain at the stomach. At

* See page 12.

this time I conceive it probable the irritation in the ganglia might be renewed. The disorder did not apparently take place from a change in the sore, for it continued to look well after the tetanic symptoms had manifested themselves. This fresh irritation of the ganglia, no doubt modified by some peculiarity, was communicated to the cerebral and spinal nerves, and by them to the muscular system.

CASE.*

May 9th, 1823. Richard Burton, æt. 37, a strong healthy man, had the misfortune to pierce with a spike the joint between the metacarpal bone and first phalanx of the little finger, about three weeks ago. I did not see him before this evening. The hand is not much swoln, and the wound not very painful. On the sixth he first perceived an uneasiness in his face. This

* I briefly related this case in the preface to the second edition of my Inquiry into the action of Mercury on the Living Body.

evening he has opisthotonos and spasms of the muscles of the face; but I understand he is not so much affected as he was in the morning. He can open his mouth considerably. The pulse is natural. The bowels are open. The tongue has not an unusual appearance. He has taken half an ounce of spirits of turpentine twice; and as he appeared better, he was ordered to repeat the same quantity to-morrow, and to take two grains of submuriate of mercury and one grain of opium every four hours.

10th. He appeared better this morning. He is much troubled with wind. He has taken the spirits of turpentine twice.

In the evening he was worse. The finger was amputated at the middle of the metacarpal bone. There was no hemorrhage at the time, but it came on soon after, and he lost a great quantity of blood.

11th. He was worse, and had a considerable degree of fever. The spasms were very violent.

12th. When I saw him at noon he appeared nearly exhausted, and he died very soon after.

Examination.

This took place about sixteen hours after death.

After opening the spinal canal, the sheath formed by the dura mater was divided, and was found to contain a small quantity of limpid fluid. Many adhesions were found between the loose tunica arachnoidea and that lining the dura mater. On the loose tunica arachnoidea there were a few small spots of cartilaginous matter. The veins of the pia mater were much loaded with blood. The medulla spinalis was divided in many places, and appeared perfectly healthy; but in the beginning of the dorsal portion there was a spot of coagulated blood of the size of a small pin's head in the midst of the medullary substance; many of the ganglia of the

spinal nerves were examined, but they did not exhibit any altered appearance.

There was an effusion of bloody serum between the tunica arachnoidea and pia mater of the brain at the situation of the squamous portion of each temporal bone. The veins were turgid, but there was not any diseased appearance in the brain.

The lungs were very purple, and in a state of expansion, and were much loaded with blood. On the pericardium covering the heart, there was a patch of coagulable lymph as big as half a crown, and there was another about the origin of the aorta. There was an increased vascularity of the outside of the aorta through the chest.

The villous coat of the stomach, especially at the cardiac extremity, was exceedingly vascular. There was not any unhealthy appearance in the intestines. The mucous membrane of the bladder was very vascular. The rest of the abdominal viscera were sound.

Both proæ muscles had blood effused into their substance in a manner similar to what happens in cases of fracture.

The par vagum in the neck was quite healthy, but at the root of the right lung the nerve had an increased vascularity, which did not exist in that of the opposite side.

There was an enlargement and a greatly increased vascularity of all the ganglia of the grand sympathetic nerves in the chest, and also of the semilunar ganglia; in several of those in the abdomen, the same appearance existed only in a less degree, but in some there was neither the least redness nor enlargement.

The nerve of each arm and the sciatic nerve examined, appeared perfectly healthy.

I shall now proceed to make a few observations on some of the symptoms of

Tetanus, and the parts which appear to be implicated in the disease; and then inquire what inferences may be drawn from them as relating to the most probable method of cure.

The cause of the spasms, or at least the cause of their continuance, seldom exists in the injured part; for if this be removed, a slight alleviation sometimes ensues, but the spasms generally return with the same violence.

The muscles implicated in the disease are supplied by nerves both from the brain and the medulla spinalis. Is it, therefore, to be presumed that both these organs are in the first instance affected, or only their nerves?

The functions of the brain are seldom disturbed except towards the close of the disease, and sometimes they remain perfect throughout. In one of the worst cases I have recorded, the patient was quite sensible to the moment of his death. On dissection we find increased vascu-

larity of the pia mater, but we find it likewise at the termination of many other diseases; and I think it can only be looked upon as an effect of the general disturbance.

The muscles connected with mastication and deglutition are generally first affected, and the nerves distributed to them are principally derived from the brain; but as this organ does not appear to suffer until the end of the disease, it is difficult to conceive how the parts of it, from which the affected nerves originate, can be disordered and produce such violent symptoms, whilst the functions of the organ in general remain undisturbed, and no particular morbid appearances can be discovered on dissection.

We find an increased vascularity of the pia mater of the medulla spinalis; and this I cannot help considering as an effect. This appearance certainly shews that great irritation existed there. There cannot have been inflammation, or we should more frequently see its consequences, viz. an

effusion of coagulable lymph, and purulent matter, and more or less of paralysis; moreover, it would not be possible for so speedy and so complete a recovery to take place, either from the disease in the human subject, or after leaving off the extract of nux vomica, when violent tetanic spasms have been produced by it.

As the disease attacks the muscles supplied with nerves both by the brain and medulla spinalis, and neither of those organs appear in the first instance to have their functions disordered, we may fairly conclude that the cause resides in some other part.

No other parts except the ganglia of the grand sympathetic nerves have a similar, or so free, a communication between the nerves supplying the muscles usually affected; and in all the examinations after the death, both in the human subject and the animals killed by the extract of nux vomica, I have found an increased vascularity of some of those ganglia.

I do not mean to assert that Tetanus is a specific complaint entirely seated in the ganglia of the grand sympathetic nerves, but that the ganglia are the important parts of the nervous system to which the first irritation tends, and from which it proceeds to the rest of the nervous system. The validity of this statement is, I think, most satisfactorily confirmed by the case of Richard Ward.* On dissection the marks of irritation in the ganglia were most decidedly greater on the right side than the left; and during life the tetanic spasms were so violent in the limbs of the right side that the patient had not the least power over them; and though the spasms were very considerable in the limbs of the left side, they were evidently much milder than they were in those of the right; and even after death there was a much greater rigidity of the muscles of the limbs of the right side, than existed in those of the left.

From the appearances on dissection in this case, it must be sufficiently evident

* See page 51.

that the proximate cause was in the worms, and unhealthy fæces irritating the villous coat of the intestines. The irritation thus produced was undoubtedly conveyed by the nerves of the intestines to the ganglia of the grand sympathetic nerves; and from those essential parts of the nervous system to the cerebral and spinal nerves, and thence arose the tetanic spasms of many of the muscles to which these nerves are distributed: the irritation was communicated lastly to the membranes of the brain and medulla spinalis, as was evident from the congestion of the blood-vessels and the effusion of serum.

We learn from the experiments with the extract of nux vomica, that when only a few doses had been administered, and its influence went off, the spasms ceased, even when they were so violent as almost to extinguish life; and after having ceased, they did not resume their violence until more of the extract was given. It would appear from this, that in the human subject, the cause continues to operate so long

as the disease is violent, and therefore that the spasms can only be regarded as a symptom. There, nevertheless, seems to be a gradual accommodation of the body to the medicine, and in the human subject, to the spasms, for larger doses are required to produce the same effect produced by smaller ones at first; and if the spasms do not destroy the human subject in the first few days, it seems capable of withstanding their shocks.

From the complete manner in which the spasms go off, and the health is restored after their production by the extract of nux vomica, and likewise in many cases in the human subject, we may fairly conclude, that for some time no material change is produced in the structure of the body, and therefore that the disease is not irremediable.

According to the violence or mildness of the disease, I conceive the irritation is confined to the ganglia and some of the cerebral and spinal nerves for a certain space; it is then communicated to the

membranes of the brain and medulla spinalis, and sometimes causes so great an effusion of fluid as must add to the danger, and may produce sudden death.

No very important anatomical facts relating to this subject have been recorded by medical authors; there are few complaints, therefore, in which the method of treatment has been more empirical, and few in which the termination has been more generally fatal.

The facts I have adduced are both curious and important, and therefore are, perhaps, entitled to some notice; but I cannot presume on their being sufficient of themselves to enable us to form any decided rules of practice, and it is therefore with much reluctance I offer any observations on this part of the subject.

From the appearances on dissection of patients who have died of this complaint, I cannot help concluding, that there is a state of parts bordering on inflammation,

and therefore that general blood-letting is indicated. Fever, and other decidedly inflammatory symptoms, may not generally be present, yet they sometimes exist in a very great degree, as was most particularly exemplified in an interesting case * related by Mr. Earle.

With a view of removing this congestion of the vessels of the medulla spinalis, blood should be taken from the back by leeches or cupping.

The functions of the digestive organs are very frequently disordered, and as this state must aggravate all the other symptoms, every possible attempt should be made to restore them.

I propose it as a question, Whether an emetic should not be given after general blood-letting has been employed, if the mouth be sufficiently open to allow of the ejection of the contents of the stomach?

* Medico-Chirurgical Transactions, vol. vi. p. 93.

In the second case, the spasms ceased and never returned after vomiting took place. Nothing particular was ejected from the stomach, and therefore we cannot but suppose that the action of vomiting had a salutary effect on this organ; a circumstance very often witnessed, when every other medicine has failed to restore its disordered functions.

After the emetic, or if this has not been used, the patient ought to be purged as soon as possible. A few doses of submuriate of mercury may be given, and any other strong purgative, until the bowels are freely emptied.

In experiments on animals, I have found decided marks of inflammation of the ganglia of the grand sympathetic nerves produced by mercury. As there is a similar appearance of the ganglia in Tetanus, I cannot help supposing, that the use of mercury is very doubtful, if not altogether hazardous; and so many cases on record, in which it has failed to restrain the

disorder, show that it cannot by any means be depended on. I am willing to believe that practitioners may have thought it beneficial, because a patient who has used it has recovered. I have seen it administered in chronic Tetanus, and the patient has got well; but the recovery was very slow; and whether it had any influence over the disease is most difficult to determine. These observations on mercury may well apply to constitutional irritation.

When the patient has been well purged, it appears reasonable to suppose that quieting and relaxing medicines may be of use, as the pulvis ipecacuanhæ compositus given in frequent doses.

Whether the meadow saffron would have any influence over Tetanus, I cannot determine; but from the appearances on dissection, I do not despair of a discovery of some similar medicine, which has a powerful influence in allaying irritation of the nervous system, for the removal of this dangerous and painful disease.

We are informed by Sir James Macgrigor*, that patients are never attacked by this disease after twenty-two days have elapsed from the receipt of an injury; and by Dr. Dickson†, that since the bowels have been properly attended to, its prevalence has been comparatively rare in the public service in the West Indies. May I therefore be allowed to suggest, that surgeons should take care that the digestive organs are assisted to discharge their functions properly by opening medicine, attention to diet, &c., and that cold is particularly guarded against, after all accidents and operations? Injuries of the fingers and toes appear so trifling as to require but very little attention. And I conceive Tetanus is frequently the consequence of the slight regard which is so generally paid to them.

When a person goes on well for some days after an accident or operation, and

* Medico Chirurgical Transactions, vol. vi. p. 453.

† Medico Chirurgical Transactions, vol. vii. p. 454.

begins to complain of stiffness of the neck, or, as I have heard it expressed, of soreness of the throat, immediate alarm ought to be taken by the surgeon, and the remedies I have before recommended made use of.

THE END.

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