CONCLUSION.

I will not insist any more on these points, as time does not permit. I have now to thank the President and the College, who have given me this opportunity of lecturing before an audience so extremely attentive as you have been. I thank you very much for your kind attention to me.

ART. IX.—*Cases of Traumatic Tetanus; with Observations upon the Treatment of this Disease.*^a By HENRY FITZGIBBON, M.D.; Surgeon to the City of Dublin Hospital.

CASE I.—John Nolan, a strong healthy-looking boy, aged about twelve years, presented himself at Clondalkin Dispensary, on Wednesday, the 24th of February, 1871, having walked a distance of over two miles, along with his mother, for advice; the tetanic expression of his face was so well marked that the first glance satisfied me that he had lock-jaw. His mother stated that on the previous morning he complained of severe pain in the small of his back; towards evening she perceived “a queer look in his face,” which increased during the night; and as he now complained of difficulty in swallowing, she had become alarmed. It had not occurred to her mind that he had got lock-jaw, as she was positive that he had received no injury or fall that could induce it, nor had he received any severe wetting or been exposed to any unusual cold. On making more careful inquiry, I elicited from her that on the previous Sunday he had come home very much heated from playing hockey with a number of other boys; in the evening he complained of his feet being sore from having worn a new pair of wooden clogs while playing; this was the only exciting cause I could discover. I made a minute examination of the boy; he also said he had received no hurt or fall; the tenderness of his feet had gone away; he had walked to the dispensary in the same clogs without any discomfort; there were no bruises on his feet or any part of his legs or body; he complained only of pain in his back and a difficulty in swallowing.

He was put to bed on his return home, his parents refusing to take him to hospital. Having recently read the report of one or two cases of tetanus which recovered under treatment by hydrate of chloral, I was induced to treat him with that drug, which was

^a Communicated to the Dublin Biological Club, Tuesday, February 13, 1877.

accordingly given in gr. x. doses in water every hour until it produced sleep, and to be repeated in the same manner upon his awaking. He was given as much fluid nourishment as he could take in the form of beef-tea, eggs, &c. He slept quietly after the second dose of the chloral, for more than two hours, but awoke in a violent tetanic spasm; the chloral was continued steadily, but the disease rapidly increased. On the 26th of February his whole muscular system was rigid; he had constant opisthotonos, and frequent very violent spasms, especially at the time of awaking. His parents conceived the idea that the medicine was making him worse, and refused to continue to administer it any longer. He died upon the sixth or seventh day from the appearance of the first symptoms of the disease. The muscular spasm in this case was general from a very early period. There was violent opisthotonos, but no pleurothotonos or lateral tendency whatever; there was obstinate constipation throughout.

CASE II.—Felix Kearns, a slight but healthy looking lad, aged seventeen years, a labourer, presented himself at the dispensary of the City of Dublin Hospital on the 24th of January, 1876. On the previous day he had received an injury of the right hand, by the falling of the side-board of a cart, which came down catching his hand with a chop upon the wheel. There was a lacerated wound across the back of the hand which exposed the extensor tendons, severing completely that of the extensor communis digitorum to the third finger, the power of extending which was lost. The wound was carefully cleaned with carbolic acid lotion, drawn together with plaster, and covered with a compress of lint soaked in carbolic oil. He kept the wrist flexed, but had the power of extending it at the time of his first visit to the hospital; but on the 27th of January, as he was unable to do so, it was placed upon a splint. The dressing with carbolic oil was continued, and the wound appeared to be healing kindly, without any bad symptom, up to the 6th of February. On this day, which was the 13th after the accident, he eat his breakfast as usual, being in good health but for the injured hand, and went out immediately afterwards.

The morning was frosty and the day chilly and damp, sleet fell in the afternoon, and as he remained out the entire day, he returned home both wet and cold. On his return his mother noticed "a queer look in his face;" he complained of a pain in his back and difficulty in swallowing.

He was admitted into hospital the following morning, the tetanic symptoms having developed themselves very rapidly. His teeth were now clenched; he could not protrude his tongue in the least; he complained of severe pain in the back; all his muscles were rigid, but he had no marked spasms; the risus sardonius was extreme. The wound was clean and healing well; he referred no pain or uneasiness to it. His bowels were constipated, and had been so for several days. His pulse was 72; his temperature 99.5°; respiration 26.

The splint was removed from the arm, when the wrist and elbow became forcibly flexed, and the arm pronated; the wound was now dressed with equal parts of tincture of belladonna and tincture of opium. A copious enema of more than a pint of warm water with two ounces of castor-oil, was administered; he was ordered gr. $\frac{1}{4}$ of ext. of belladonna in pill every hour. An ice-bag was applied to the back of the neck and upper part of the spine for half an hour, and re-applied every third hour for the same period during the night.

Feb. 8th.—Had passed a good night; pulse 82; temp. 99.5°; respiration 26; could suck fluids through his teeth, but had a disinclination to take nourishment, owing to the difficulty of swallowing. The large enema given the night previous had been retained, although he passed urine frequently. The pupils were fully dilated, and he complained of dryness of throat. He was given milk and strong extract of beef frequently, but seldom could swallow more than three or four teaspoonfuls at a time. Another enema was given, consisting of castor oil $\mathfrak{z}$ i., tr. assafœt. $\mathfrak{z}$ ss., turpentine $\mathfrak{z}$ ss., water $\mathfrak{z}$ ii. As no discharge came from the bowels for several hours, and he said he could not relieve himself unless he was taken out of bed, he was with difficulty, owing to his rigid state, placed upon a night chair, when a free evacuation took place, from which there was no unusual fœtor, nor was it in any way remarkable except in quantity.

Feb. 9th.—Suffering greatly from the violence of the spasms, crying out that his back was breaking; pulse 90; temperature 100°; respiration 26. Belladonna continued and also the ice-bag to the spine.

11th.—Fifth day of the tetanus; symptoms greatly worse, with profuse sweating, weak pulse, and a miliary eruption all over the body.

12th.—Symptoms generally worse; screaming on the approach of each spasm, with marked pleurosthotonos to the side of the injury,

the spasms appearing to commence in the wounded limb, and to continue longer and more violent in it than in the opposite one. The belladonna was continued; in addition, he was ordered tobacco stupes to the belly.

13th.—He had had a motion from his bowels unconsciously during the night, but there was no change in his condition since the previous day. The belladonna was continued in $\frac{1}{4}$ -grain doses of the extract every second hour, and he was stuped three times during the day with tobacco.

14th.—Had a bad night; hearing morbidly acute; violent spasms excited by the slightest noise. The treatment was continued with the addition of an enema of an infusion of 20 grains of tobacco at night. This was followed by some alleviation of the spasms, but the patient did not sleep.

15th.—The belladonna, tobacco stupes, and ice-bags were continued. He was also given 25 grains of hydrate of chloral at night. He slept for three hours from the effect of it, after which he awoke with the most violent spasm he had yet had, during which he appeared upon the point of death from asphyxia, when the resident pupil on duty, Mr. Edmund Rundle, with great promptness, put him under the influence of chloroform, which most probably saved his life. He slept again after this for some time.

16th.—At 8 a.m. this morning he had another spasm, which appeared to threaten his life, during which he expelled a considerable quantity of bloody froth from his mouth and nostrils. In the afternoon, as he had not slept, he was given 25 grains of chloral hydrate. It was followed by a short sleep, from which he awoke in a very violent spasm. He was given the same quantity of this drug at 6 p.m., which was followed by another short sleep, and a paroxysm of unusual violence upon awaking, so that the further administration of chloral was now forbidden, the belladonna, tobacco stupes, and ice-bag to the spine, being continued.

Upon the 18th February, which was the twelfth day of the tetanus, another spasm of such violence occurred that chloroform was again resorted to, and appeared to avert a fatal termination.

19th.—There was more bloody froth expelled from the mouth; the belly was tympanitic and tender to the touch; the bowels had not been moved for ten days; 5 grains of calomel were given; in a few hours this was followed by an enema of castor-oil and tincture of assafoetida, which acted well, after which the distension of the abdomen subsided, and the tenderness disappeared. He seemed

to mend from this period; and although quite rigid, with constant opisthotonos, and pleurosthotonos towards the injured side, he suffered from no further very violent paroxysm.

On the 21st the ice-bag made him uncomfortable; its use was therefore discontinued.

22nd.—Profuse, constant sweating had set in without any further improvement in his general condition.

23rd.—Sweating continuously; pulse 120; very weak; temperature 98.5° ; respirations 26; the tetanic rigidity undiminished.

24th.—Still perfectly rigid. There was constant priapism, and he complained of retention of urine for the first time, and sweating to an extent that was awful. In this condition he was put with difficulty into a warm bath, temperature 100° . He was like a wooden figure when placed in the warm water; but in a few minutes his whole muscular system became relaxed in a manner that it had not been from a very early period of his illness. He passed urine freely, and felt such relief and comfort that he cried out repeatedly “this is grand.” Having been fifteen minutes in the bath, he was placed upon warm sheets, carefully dried, and put to bed, when he immediately fell into a quiet sleep, which continued for three or four hours.

25th. There was a marked improvement in every respect since the warm bath—his pulse being 100, temperature 98° , respirations 24, sweating but slightly, able to protrude the tongue about half an inch, and wishing to eat an egg. From this period he steadily improved, getting a warm bath every second day, the use of belladonna being continued, so as to keep the pupils fully dilated. He was discharged from hospital, perfectly well, early in March.

CASE III.—William Kelly, aged twenty-one years, by occupation a baker, was admitted into the City of Dublin Hospital on the 24th of August, 1876, having received a severe injury to the left hand and arm, by its being drawn into a pair of biscuit rollers. Previous to the accident he had been generally of temperate habits and had enjoyed good health. When brought to the hospital he was pallid from loss of blood and shock. There was a lacerated wound extending from the base of the index finger to about three inches above the wrist-joint, the radius and ulna appeared to have been forced asunder by the pressure of the rollers, causing rupture of the annular ligament and the anterior radio-ulnar ligament, and contusion and laceration of all

the other soft parts, so that the hand and wrist were regularly burst open, exposing both the superficial and deep flexor tendons at the bottom of the wound. The arm, to within a few inches of the shoulder, was so contused that it appeared almost hopeless to attempt to save it. The hæmorrhage was profuse. Having brought the palmar rent together, and replaced the lacerated tissue, and secured the parts with eight or ten long pins and a continued suture, the whole limb was dressed with carbolic oil. This was not removed until the third day, when the limb had become so inflamed that it appeared almost necessary to make incisions in the upper arm to relieve the tension. The carbolic dressing was changed for *lotio plumbi acetatis*, except at the laceration, which was again dressed with carbolic oil. On the fifth day the inflammation had greatly subsided, the pins were removed, and the hand bandaged with carbolised gauze. Up to September 8th, which was the tenth day after the accident, all went well. He now complained of loss of appetite and constipation, his tongue being slightly coated. He was given 3 grains of calomel, which acted upon his bowels, and these symptoms had disappeared next day.

September 16th.—Complained of having had a sleepless night, which he attributed to the recurrence of constipation. He suffered from pain in the back, and said his jaws were stiff, his throat sore, and that he had difficulty in swallowing. There were twitchings in the wounded arm and general malaise. The *risus sardonius* was marked, the sterno-mastoids and muscles of the abdomen were tense. Any attempt to examine his throat by depressing the tongue brought on a paroxysm of trismus, which clenched the teeth firmly together. His temperature was 100°; pulse 110. He was given 5 grains of calomel, and ordered $\frac{1}{2}$ grain extract of belladonna every sixth hour. The wound was dressed with a lotion containing equal parts of tincture of belladonna and tincture of aconite.

17th.—Still rigid and teeth clenched; the bowels had acted; the pupils well dilated; slight dryness of throat; temperature 99·8°; pulse 90.

18th.—Temperature 98. In other respects no change for the better. There were frequent twitchings of the wounded limb, and the process of dressing it excited painful spasms in it. The local application of belladonna and aconite, with the belladonna internally, was continued daily without any marked change up to the 28th of September, when the trismus and general tetanic condition appeared

somewhat less. On this day he was given a dose of castor oil, which acted well; and the following day his condition was so much improved that he eat a mutton chop, which was the first solid food he had made use of since September 16th. From this date he steadily recovered, and lost the expression of face sometime before his discharge from hospital, which was on November 5th. At this time he was in perfect health, but for an unhealed superficial ulcer upon the upper arm, where the skin had sloughed extensively from the friction of the rollers, his wrist also being permanently stiff.

The want of a certain knowledge of the pathology of tetanus, to indicate the rational treatment of this disease, has led to the empirical use of medicines of the most opposite physiological actions. We have, however—if not positive—strong presumptive evidence that the tetanic condition depends or is, at least, associated with hyperæmia of the spinal cord and medulla oblongata, and in some instances actual inflammation of these parts. Dr. James Copland, in his article on “Tetanus” (“Dictionary of Medicine”), says: “The spinal cord, medulla oblongata, brain, and their membranes, have frequently presented changes more or less decidedly morbid in tetanus and trismus. I believe that these changes are rarely altogether absent, especially as respects the spinal cord, medulla oblongata, the pons Varolii, and their membranes, when the inspection is made within twenty-four hours after death, and when these parts are carefully examined.” He adds—“In no inspection which I have witnessed have inflammatory appearances in one or other of these parts been altogether wanting.” He mentions the names of Larrey, Magendie, and many others who viewed these appearances as the pathological causes of tetanus.

Clifford Allbutt published (Path. Trans. XXII., 27) notes of four cases of tetanus, with an examination of the spinal cord in all. Lockhart Clarke and Dickinson, report on the same specimens, and the pathological results are as follows:—1. Diminution of consistence of various degrees and situation in the cord. 2. Hæmorrhage in two of them visible to the naked eye. On microscopical examination—1. Great distension of the blood-vessels in both white and gray matter, with occasional exudation and disintegration of tissue around them. 2. Isolated patches of disintegration of various shapes and sizes in both gray and white matter; and in the gray matter numerous vacuities, having, on transverse section, circular

or oval outlines, and resulting from disintegration of the nerve-fibres.

There are many other cases reported, in which the *post mortem* examinations revealed either hyperæmia of the medulla oblongata and spinal cord, or a condition that was probably consequent upon hyperæmia having advanced to actual inflammation of the upper portion of the cord.

Dr. Robert M'Donnell has recently examined the cords of several persons who had died of tetanus, and although no such extensive lesions existed as are stated to have been found by many other observers, yet, under the microscope, the sections presented appearances which probably depended upon distension of the blood-vessels from hyperæmia of the cord in various parts.

That this is the pathological condition of the spinal cord which produces tetanus in many cases, is, I think, borne out, not only by the foregoing, but by every case which recovers. The fact that a great number of cases of the greatest severity have recovered rapidly as soon as the disease began to abate at all, shows that it cannot depend on any serious lesion of substance in the cord or elsewhere, but upon some condition such as hyperæmia, which is capable of rapid subsidence, and which leaves little or no *post mortem* appearances in the majority of cases—unless, as Dr. Copland recommends, the examination is made within a few hours after death.

In the first of my cases the exciting cause was such as would induce hyperæmia of the cord or even myelitis—great mental excitement of the game, over-exertion kept up to exhaustion, very violent perspiration, which was probably injudiciously checked.

A case of intermittent tetanus, which has been reported by Reigle, also appears to me to point to the same cause. The primary source of the disease in this case was the irritation of worms in the bowels; but the tetanic condition could be brought on at once by pressure upon the large vessels and nerve-trunks. The probable result of this proceeding would be hyperæmia of the cord, caused by obstructing the circulation to the rest of the body.

Dr. Charles Philips, in his *Materia Medica*, states that he has seen three cases of persons who were thrown into a state of "complete tetanic rigidity" by the administration of opium. The well-known antagonism of opium to belladonna makes this fact an additional proof that the physiological action of belladonna is to produce an opposite condition of the nerve-centres from that upon which tetanus depends.

Professor Brown-Séquard writes—"This most powerful remedy has been employed quite blindly in the various forms of paraplegia by the French and Italian physicians."

An eminent author of a very learned work on Therapeutics and Pharmacology, declares that—"It is quite obvious that it (belladonna) should never be employed in cases dependent on congestion, inflammation, or organic lesion of the nervous centres until this condition should have ceased entirely and nothing be left but inertness." The truth is, that it is precisely in cases of congestion or inflammation of the spinal cord or its membranes that belladonna should be used against paralysis. He (Brown-Séquard) sums up the indication for its use or non-use as follows:—"First, belladonna is one of the most powerful and reliable remedies that we may employ in cases of paraplegia with symptoms of irritation of the motor, sensitive, or vaso-motor, or nutritive nerve-fibres of the spinal cord, or of the roots of its nerves; in other words, in cases of congestion, meningitis, or myelitis. Second, belladonna is a most dangerous agent, able only to increase the paralysis if employed in cases of paraplegia without symptoms of irritation, such as cases of white softening or of the reflex paraplegia."

In 1843, a volume, entitled "Posthumous Extracts from Veterinary Records," was published by a veterinary surgeon named Field. This book gives the *post mortem* appearances found in the cases of animals which had died of tetanus. It contains also a report of a case occurring in a young man, which Mr. Field treated by administering extract of belladonna in doses of $\frac{1}{8}$ th of a grain every fourth hour. The patient recovered steadily under this treatment. It is reasonable to conclude that the selection of belladonna in this case was the result of experience of its effect in veterinary practice.

In thus stating the grounds of my belief—that to treat tetanus by means of belladonna is not merely empirical but based upon a reasonable theory as to the pathology of the disease—I do not, for a moment, mean to imply that all other remedies ought to be discarded for its sake; on the contrary, I think that tobacco, nicotin, curara, cannabis, and chloroform may be valuable in conjunction with belladonna.

Nicotin produces paralysis of the voluntary muscles, which, by relieving the violence of the spasms, gives time for the subsidence of the excited condition of the cord. Curara causes paralysis of the peripheral motor nerves, but has no action whatever on the brain, spinal cord, or its membranes. It, therefore, seems to me that it

would be perfectly rational to combine the internal administration of belladonna with subcutaneous injections of curarine or nicotin; but, as the latter has at first a tendency to produce an excited and irritated condition of the cord before it causes any paralysis of the muscular system, I should be disposed to employ curarine in preference.

Constipation, which is, I think, constant as the result of spasm of the sphincter muscle, is best relieved by calomel and enemata. Warm baths, as in the case of Kearns, may give great relief, and produce marked relaxation of the muscular spasms, and by doing so stop exhaustive sweating, if it depends on active muscular contraction.

The local application of aconite and belladonna to the wound is very important, as it diminishes the irritability of the wounded nerves.

Perhaps the most important point of all is to recognise the premonitory symptoms before the disease has actually declared itself; if we could always do this, I think a great proportion of the cases, which become severe, would run a mild course, as in the case of Kelly.

In all the foregoing cases these symptoms were the same. The "queer look in the face" first caused the mothers to ask if anything was the matter in the first two. And in the third, the brother of the young man told me he had noticed a "frown on his face" before any idea of tetanus had occurred to me or the nurse who attended him. Pain in the back, a feeling of soreness about the throat, and constipation, include all the other premonitory symptoms which existed in these cases before the occurrence of trismus, which at once indicated their true character.

I have not alluded to the use of physostigma, although I am aware of the favourable reports of those who have employed it, because I think its physiological action, in some respects, would render its administration in conjunction with belladonna incompatible. There are, however, quite rational grounds for the treatment of tetanus with this drug. It is known to depress the excitability of the ganglionic elements of the cord; it especially affects the groups of cells in the anterior horns of gray matter; by its action on the gray matter of the cord generally it diminishes its motor and reflex activity. So far the action of this medicine would indicate its use, and that based upon most rational grounds, especially if tetanus depends upon hyperæsthesia of the cord, whether depending on hyperæmia or accompanied by it.

In publishing this paper, I do not wish to appear dogmatically to advocate the use of belladonna in every case of tetanus, because I can conceive the possibility of some cases depending upon an opposite condition from that in which it would be useful, such as arterial anæmia; this, by a venous congestion of the cord and its membranes, might produce an excitement of the motor nerves and produce tetanus; in such a case belladonna, by its action on the vaso-motors, would diminish the arterial supply to the cord and increase the disease.

The constitution of the patient and the previous history of the case must be taken into consideration, and will afford ample means for forming a reasonable opinion as to whether a condition of arterial anæmia or the reverse exists.

To support the strength by every possible means of nutrition, attention to the bladder and bowels, and constant watching, so as to meet every emergency that may arise, complete the rational treatment of tetanus.

SUBCUTANEOUS INJECTION OF COLD WATER FOR THE RELIEF OF PAIN,
AND ESPECIALLY IN ACUTE ARTICULAR RHEUMATISM.

MANY years ago subcutaneous injection of water was recommended, particularly by Dieulafoy, in rheumatism of the extremities. The injection was inserted in many parts round the affected joint, ten drops being the quantity employed. The results were most remarkable. The pains diminished, and the patients were able to use the affected limbs; nay, even by this treatment alone and after a single operation, the rheumatism was entirely got rid of. Even against muscular rheumatism, sciatica, &c., it has proved to be a means of very great value.—*Gaz. des Hôp.*, 1876, No. 99, and *Centralb.*, No. 53, 30th Dec., 1876.

J. M. F.

USE OF AROMATIC SULPHURIC ACID IN NECROSIS.

THE history is recorded of a case of necrosis of the alveolar process, which was cured by the daily injection of aromatic sulphuric acid, in the proportion of a drachm to the ounce of water, into the substance of the spongy swelling that surrounded the diseased bone. The teeth were very loose, and the case was one that apparently called for operation. Under the above treatment, combined with the use of tonics and an animal diet, the teeth gradually tightened, and in a year the cure was complete.—*Boston Medical and Surgical Journal*.

K. F.