ART. VIII.—*The "Patellar-Reflex" Phenomenon, with Illustrative Cases.*^a By JOHN W. BYERS, M.A., M.D.; Physician to the Hospital for Sick Children, Belfast.

IN the year 1875 two celebrated German observers, Westphal and Erb, directed the attention of the profession to the great value, from a medical point of view, of a phenomenon long known as a schoolboy's trick. I refer to the peculiar jerk of the leg which takes place when the patellar tendon is struck. Charcot may have used the patellar-reflex in diagnosis before this period, but undoubtedly the profession at large was first made aware of its importance by the appearance of the papers of Westphal and Erb.

Since then the phenomenon has been studied with extraordinary care in its physiological, pathological, and clinical bearings by Westphal, Erb, Tschirjew, Burckhardt, Fürbinger, Schultze, Berger, Eulenburg, Charcot, Brissaud, and Franck on the Continent, and in this country by Grainger Stewart, Hughlings Jackson, Waller, Buzzard, and Gowers; so that, I think, no one will accuse me of exaggeration when I say that there are few symptoms of greater importance in the diagnosis of diseases of the nervous system than this patellar-reflex phenomenon, especially when it exhibits deviations from its normal condition.

The phenomenon has received many different names; it has been called "the patellar-tendon reflex phenomenon," "the knee-jerk," "the kneec-reflex," the "knee phenomenon."

In this paper I shall—First, describe the phenomenon as it exists in a healthy individual, and mention several methods that may be employed to elicit its presence. Secondly, I shall state and examine the different views that have been propounded as to its physiological causation. Thirdly, I shall read the notes of a series of cases in which this phenomenon exhibited deviations from its normal condition, and I shall attempt in each case to account for such alteration.

First. You see in my friend [one of the hospital pupils] who is sitting with his right leg crossed over the left, and bent at an angle slightly greater than a right angle, that when, with this stethoscope, which has an india-rubber ring round the pectoral piece, I strike the right leg just below the patella, immediately the foot is jerked forwards. Such is the phenomenon, and such is the ordinary method of testing for its presence.

The following plan is suggested by Buzzard if it is desired to

^a Read before the Ulster Medical Society, January 31, 1882.

ascertain the mere presence of the "patellar-reflex:"—"The patient, who is seated, plants his foot firmly down at such a distance that the leg forms a little more than a right angle with the thigh. Whilst the observer rests the palm of his left hand upon the patient's thigh, he strikes with some implement held in the right hand several blows upon the ligamentum patellæ at about an eighth of an inch or so below the knee-cap. The quadriceps muscle can be felt, and (if the patient is in masculine garments) can be seen to contract more or less vigorously in response."

The side of the hand can be employed as a percussor. If no response follows the blow the leg should be bared, and the observer should test most carefully by striking in the usual place, or on the patella, or the tendon above the patella, or the muscle itself, before assuming that the reflex is absent.

In children, in whom there is often considerable difficulty in examining for the sign, I usually place them on a table with their legs hanging over the side, and while their attention is occupied in looking at a toy, a light tap on the patellar tendon is usually sufficient to demonstrate the presence of the phenomenon. The patellar-reflex is almost always present in health, although the amount of the contraction of the quadriceps muscle may vary at different times even in the same individual. Berger has examined 1,409 soldiers for this phenomenon, and has found it absent in 22, or 1.56 per cent. of these cases.

Although I have seen the patellar-reflex slight in several individuals, and absent in one—while in none of these when examined was there any evidence of disease—still I think that such cases are exceptional; and I am inclined to believe that the greater the care that is taken in testing for the sign the fewer will be the number of those in whom it is found to be naturally absent. With reference to those cases in which it is stated that the phenomenon is normally absent, it is of little importance, as Westphal thinks, to note in the case of any one that at a given time the patellar-reflex is absent, more especially if we know nothing of his history. The observation would be of much greater value if we could show that the phenomenon *had* disappeared. In some of these cases the absence of the patellar-reflex may be a premonitory sign of a spinal affection of which other symptoms will appear in the future. Again, in certain individuals the absence of the phenomenon may be owing to mechanical causes, Westphal having shown that it is difficult to develop the patellar-reflex in those in whom the tendon

is very short, in those in whom there is a thick pad of fat under the tendon, and in those who are very stout.

Secondly. We shall now consider the physiological causation of the phenomenon. Two views have been suggested to account for it. According to one it is purely reflex—that is to say, that at the point where the observer strikes the leg, impulses are generated which travel up the sensory nerves to the cord, at about the level of the second and third lumbar nerves, and there undergo certain changes, of whose nature we are ignorant—except that as a result efferent impulses descend the anterior crural nerve to the quadriceps muscle, causing it to contract and to jerk forward the foot. According to the other theory the phenomenon is a local one, due to a direct irritation of the quadriceps muscle.

In support of the first view, advanced originally by Erb, and according to which the reaction is of the nature of a spinal reflex, evidence is forthcoming from two sources—(a) the experimental, and (b) the pathological.

(a.) As a result of experiments on animals (Fürbinger, Schultze, Tschirjew, Senator), in many of whom the patellar-reflex exists, it has been found that destruction of the portion of the cord in the lumbar region, with which the anterior crural is connected, or of the anterior or posterior roots of the spinal nerves in the same situation, or of the nerves to the muscle, is followed by a disappearance of the phenomenon.

(b.) In any disease in which the reflex nervous arc, at the situation mentioned, is injured, in either its sensory or motor portion the patellar-reflex is lost. This is exemplified in *tabes dorsalis* (Case I.), and in *poliomyelitis anterior acuta* (infantile paralysis) (Case III.)

In favour also of the reflex theory is the fact that drugs which increase the irritability of the cord—*i.e.*, strychnia, cause an exaggeration of the patellar-reflex; thus Eulenburg, in some cases in which the phenomenon seemed entirely abolished on one side, succeeded in making it reappear for some time by the hypodermic injection of strychnia, made in the neighbourhood of the *nervus cruralis*, or into the substance of the extensor muscles. On the other hand, medicines, such as bromide of potassium and opium, which diminish the irritability of the cord, lessen the activity of the phenomenon. Admitting, then, that the contraction of the quadriceps is of reflex origin, the question naturally arises—From what point do the sensory impulses arise when the leg is tapped;

is it from the skin, the patellar tendon, or the muscle? That they do not begin in the nerves of the skin is clear from the following facts:—1. A light tap or push over the patellar tendon will not give rise to the knee-jerk. 2. If the skin is lifted up in a fold, so as to be quite separate from the tendon, and is then tapped, no contraction of the muscle follows. But, on the other hand, if the skin is divided and the blow struck on the exposed tendon the leg is immediately jerked forward; this experiment seeming to show that the irritation starts from the tendon—a view that gets additional weight from the circumstance that Sachs has demonstrated the existence of nerves to the patellar tendon. But this view—viz., that the impulses arise in the nerves of the patellar tendon, is disproved by an experiment of Tschirjew. This observer divided all the nerves to the tendon patellæ in an animal, and, notwithstanding, a blow on it caused the muscle to contract. Further, in all cases in which a blow on the patellar tendon causes the muscle to contract, it must be in a condition of passive tension, and in some cases, as Erb has shown, *sudden* tension alone, as by quickly pushing down the patella, so as to make the quadriceps tense, will cause the appearance of the knee-jerk. Dr. Gowers has also shown that in certain cases in which the “tendon reflexes” are in excess a tap on the front of the leg will cause a movement of the foot. Here the stimuli do not act on the tendon but on the muscle.

So then we are compelled to believe that the stimuli arise in the muscle. But if this be granted Westphal's view that the contraction of the muscle is a local one may, after all, be the correct explanation of the phenomenon; and this theory is supported by the fact that Burckhardt, Brissaud, Tschirjew, Gowers, and Waller, who have examined the matter with great care, believe, as the result of their investigations, that the time which elapses between the blow on the tendon and the contraction of the muscle is shorter than it should be if the phenomenon was a purely reflex one. At the recent meeting of the International Medical Congress, in a discussion on his paper, Eulenburg gave his adhesion to the view that it might be a peripheral phenomenon. But if we adopt this explanation, how can we account for the absence of the phenomenon in those diseases which cause destruction of the reflex nervous arc?

Is there, then, any hypothesis which will reconcile these two opposing views, which will account equally well for the contraction

of the muscle being a local one, and will yet explain the circumstance that any lesion which destroys reflex action causes a disappearance of the knee-jerk? The following explanation is given by Dr. Gowers:—"If," he says, "we regard the contractions as local we have still to account for the irritability which permits the local stimulus to cause a contraction. This irritability is developed by passive tension. Hence I have suggested that the tension excites, by a reflex influence, a state of extreme irritability to local stimulation—such as that of a tap on the tendon, or such as the vibration from a tap near the muscle, or from a tap on the bone to which the tendon is attached—which thus excites a visible contraction."

I have endeavoured to give a full and fair account of the various views that are held as to the cause of this very remarkable phenomenon. Whatever view will eventually be found to be correct, the fact remains that this patellar-reflex phenomenon is of great value in disease, examples of which I shall now give in this the third part of my paper.

CASE I.—*Tabes Dorsalis ; characteristic Ataxic Gait ; Argyll-Robertson Pupil ; absence of Patellar-reflex in both Legs ; previous history of Pains in the Legs, attacks of Indigestion, and Diplopia.*—In Sept., 1881, I was consulted by a gentleman, aged forty-two, who gave the following account of his illness:—He was in perfectly good health until the year 1878, when he suffered from attacks of indigestion, accompanied with flatulence, especially after food. These attacks were not attended with vomiting, but during one of them he was much surprised one day, in looking out of the window, to find that each person passing along the street seemed to him to be double. This double vision was merely a temporary annoyance, but the attacks of indigestion have recurred at intervals up to the present time. In 1879 he had pains in "the lower part of his back," of a dull, heavy character, and in the spring of the following year he had also pains in his legs, specially in the back of the right leg, but also, though to a less degree, in the left. These pains have not been of a shooting character, but more like "rheumatic" pains. In the beginning of the year 1881 he first became unsteady in walking, and this unsteadiness was always worse at night. This was noticeable even to his friends at this time, for he states that one evening in coming out of the Turkish baths into the street his walk was so peculiar that a gentleman who was with him said, "You are like a drunken man, or are falling into paralysis." From this time his heels in walking always touched the ground first. In the mornings, while washing his face (his eyes being then closed), he has a tendency to fall forward. Even before

his movements became unsteady he had difficulty in going up and down stairs, and was obliged to keep a firm hold of the baluster. For some time he has had a curious feeling in his feet, "as if there were two or three folds of the sock under the sole of each foot." He never noticed anything peculiar about his eyelids or eyes, with the exception of the double vision which I have mentioned.

Present Condition.—He is a very intelligent, large, well-developed man. He walks in the most characteristically ataxic manner, lifting his feet high, and bringing his heels down on the ground with a thump. He has great difficulty in starting to walk and in turning, his movements at these times being very unsteady. When he brings his feet together, and closes his eyes, he begins to sway from side to side, and would fall if not supported. In both legs, from the knee downwards, he feels the prick of a pin, and a heated knife when in contact with the skin, merely as tactile sensations. There is no wasting of the muscles of the legs, and when lying on a sofa he moves the legs freely in any direction. That the tabetic incoördination has extended to his upper extremities is shown by the apparent difficulty he has in buttoning his waistcoat. His pupils are very small; they do not respond to light, but act during accommodation (Argyll-Robertson symptom). There is no ptosis or strabismus. He has great difficulty in distinguishing blue from green wool. There is no visceral mischief of any kind to be detected in the chest or abdomen. Patellar-reflex absent in both legs.

In the above case, when seen by me, the diagnosis was so clear that the absence of the patellar-reflex was of assistance principally in corroborating the other symptoms; but the great value of the symptom is in the early stages of tabes dorsalis, before the ataxic gait has become developed, and then it is frequently associated with the lightning pains. Of the very great importance of the absence of the patellar-reflex in tabes dorsalis, Dr. Buzzard, one of the most recent writers on that disease, thus speaks:—"Let me say then at once that, in my judgment, we may take it that Westphal's test, the absence of the knee-phenomenon, provided that this is associated with good voluntary power and ideo-muscular contraction of the vastus internus—a provision which Dr. Erb has most strongly and justly insisted upon—is a nearly certain sign of tabes dorsalis. I am prepared indeed, from something which I lately saw, to meet with the absence of the knee-phenomenon as possibly representing the only symptom of tabes in a certain case."

In fifty cases examined by Erb the patellar-reflex was absent in all but one, and he thinks that it is probably always an early

symptom. In his experience it is never absent in young or middle-aged people in health, and hence he thinks that its absence may be regarded as almost pathognomonic of tabes in its earlier diagnosis.

The lesion in tabes dorsalis is sclerosis of the posterior columns, or, to state the matter more correctly, of that portion of these columns known as the "posterior root-zones" (Charcot), involving the posterior roots on their way to the posterior cornua. This lesion causes an interruption of the sensory impulses in their passage to the spinal centre, and so the patellar-reflex is lost. Even without our knowledge of the morbid anatomy of tabes, we would almost be warranted in concluding that the motor portion of the reflex arc was intact, from the fact that good voluntary movement of the lower limbs is preserved, and absence of any wasting of the muscles; while, on the other hand, that the sensory portion of the loop is affected, is apparent from the lightning pains and the anæsthesia.

Westphal thinks that there is a particular part of the posterior columns which, when diseased, causes the disappearance of the patellar-reflex; and, as bearing directly on this question, I will give a short *resumé* of a case, an account of which he brought before the Medical Society of Berlin.

A man, thirty-two years of age, in whose family there were numerous examples of different kinds of nervous affections, was brought in 1877 to the Charité Hospital, Berlin. He had been blind for six months, being merely able to tell, and that only with his left eye, day from night. He was a pronounced hypochondriac, with all sorts of hallucinations. He had no symptoms of tabes, neither irregular movements, nor anæsthesia, nor lightning pains. In October, 1879, the patellar-reflex disappeared on the right side. He gradually got worse, and died in January, 1880. A few days before his death the "patellar-reflex" was gone on the left side—it continued absent on the right.

At the autopsy, in addition to very advanced degeneration of the optic nerves, optic tracts, and corpora quadrigemina, a yellow zone or strip of degeneration was seen in the centre of the posterior columns of the cord distinctly marked off from the neighbouring parts. The situation of this region of degeneration in the posterior columns was altogether peculiar. It attained its maximum on a level with the lumbar part of the cord. The cornua, columns of Goll, and posterior roots, were intact. Westphal infers from this very unique case that the loss of the patellar-reflex in tabes dor-

salis is due to a lesion involving a definite zone in the centre of the posterior columns of the lumbar part of the cord. This observation of Westphal is particularly interesting as probably representing in some cases of tabes the first pathological change in the spinal cord, and as explaining the early absence of the patellar-reflex. Charcot had previously been led to assume that the sclerosed bands in tabes are slender and narrow so long as the lightning pains are the only symptoms present; as these areas of degeneration enlarge both outwardly and inwardly, the tabetic incoördination is observed. If there is marked anæsthesia, the posterior roots and posterior gray cornua are involved; while, finally, if the sclerosis extends to the posterior part of the lateral columns, the clinical picture is represented by paralysis (with or without contracture), the advanced stage of the malady. As to those case of tabes in which the patellar-reflex is said to be present, Westphal thinks that some of them are not genuine cases of tabes, while in the case of others it is possible that the patellar-reflex may disappear late in the course of the disease, indicating that the central portion of the posterior columns has also been involved at a late period.

CASE II.—*Diphtheritic Paralysis ; absence of Patellar-reflex ; complete Recovery, and subsequent return of the phenomenon.*—On August 24th, 1881, a lad, aged fourteen, was seen by me in the out-patient room of the Children's Hospital. He stated that about six weeks before his legs became weak and unsteady in walking, and at times "seemed to give way under him at the knee-joints." There had been no pains in the legs, but for a time his feet had been "numb and dead," and in walking at first he could not tell whether the ground in contact with his feet was smooth or rough. There had been no symptoms referable to the bladder or rectum. He was now, he said, much better, and had been improving for the last two weeks. The numb feeling had quite left his legs, and he had no difficulty in walking.

Present Condition.—He can move his legs with perfect freedom; there is no wasting or flabbiness of the muscles, and no anæsthesia. The patellar-reflex is absent in both legs. There is no loss of the power of accommodation, or any other eye symptoms. The condition of the palate is normal, and there is no evidence of any form of paralysis to be detected. On questioning him more closely I learned the following facts, which explained the nature of the case:—Three months before I saw him he had a "very bad sore throat," and was so ill and weak that he was obliged to remain in bed for a fortnight. Soon after getting up again his mother noticed that his voice had become altered, and "was as

if he was speaking through his nose." At this time he began to have difficulty in swallowing, and he says that frequently, on taking milk, part of it would return through his nose. After having been up for a week he went back to work, but did not remain long, as, owing to a pain in his side—due, he thinks, to exposure to cold—he was obliged to take to his bed a second time. During all this time the difficulty in swallowing continued. While lying in bed the second time he was very much surprised to find that in reading the newspaper he was obliged to hold it at a much greater distance than usual from his eyes, because when he brought it closer "the letters," as he puts it, "seemed to run into one another and to become indistinct." He mentioned this circumstance to his friends, but they could see nothing wrong with his eyes. After being in bed for a week he got up, and sometime afterwards his legs began to get weak. His arms have never been affected.

I did not see him again until January 26th, 1882, when I found that the patellar-reflex was present in both legs. He said he was quite well, and at work every day as usual.

It is plain that this boy suffered, in the first instance, from a diphtheritic sore throat, which was followed by paralysis of the muscles of the soft palate and pharynx (shown by the nasal tone of voice, the difficulty of swallowing, and regurgitation of milk through the nose); of the eye (in this case the ciliary muscle was involved, as was evident by his inability to read the paper when held close to his eyes, the letters being then indistinct, while he could manage to read it when it was held further off); and of the lower extremities (indicated by the weakness of the legs, the difficulty in walking, the anæsthesia, and the absence of patellar-reflex).

In connexion with this case the following remarks of Buzzard are, I think, very apt, when, in speaking of *tabes dorsalis*, he says:—"There is one pathological condition, however, which may possibly give rise to some doubt—indeed, I have met with an instance in point. In diphtheritic paralysis there is often a tottering gait, accompanied by numbness in the extremities. If there should be, as sometimes happens, no difficulty in deglutition, and no failure of the power of accommodating the eyes, a strong superficial resemblance to a case of *tabes dorsalis* is presented. In such a case the patellar-tendon reflex will, in all probability, be absent, and the vastus internus muscle may contract as freely as in health to direct percussion. The acuteness of the symptoms, however, the absence of the characteristic lightning-pains, and the

history of preceding sore throat should be sufficient to distinguish this condition from tabes."

In this case, when first seen by me, the only symptom present was the absence of the patellar-reflex. The previous history, however, showed that it had been a case of diphtheria with paralytic sequelæ—a diagnosis which was confirmed by the ultimate return of the patellar-reflex phenomenon.

Several observers have noticed, within the last two years, the absence of the patellar-reflex in cases of paralysis following diphtheria. Any explanation, however, of the cause of this strange occurrence would involve, *in limine*, a discussion of the causation of diphtheritic paralysis itself, which is still, I am afraid, far from being settled. Some recent pathological researches, however, throw very considerable light on the subject. Thus, Dr. Abercrombie examined very carefully the spinal cord and medulla of seven fatal cases of diphtheritic paralysis. The only pathological changes detected were in the gray matter of the anterior cornua, and they consisted in a swollen condition of the large motor cells. "The margins of these are very ill-defined, and the processes have in most instances entirely disappeared. The contents of the cell have a granular aspect, and the nuclei have disappeared, or, where still visible, are highly granular." These changes occurred in limited areas.

M. Déjérine has described the changes met with in three fatal cases of diphtheritic paralysis. They were the same as those described by Abercrombie, but more advanced. These observations seem to indicate that the paralysis may be due in part to the subacute myelitis. If the cord is affected in the lumbar region the reflex arc would be interrupted, and accordingly the patellar-reflex would be lost. It is very difficult, however, to explain the return of the phenomenon, as one would expect, if the cord was affected by a myelitis, that the patellar-reflex would be permanently absent, as we know it is in poliomyelitis anterior acuta.

Another view as to the cause of the paralysis which follows diphtheria is that which is suggested by Buhl. He found in a case that the spinal nerves were thickened at their roots, and that the sheaths of the nerves were infiltrated with lymphoid nuclei and cells. "His view is that in certain cases these infiltrations lead to thickening of the connective tissue, which in turn contracts, and so compresses the nerves. According to him the nerve symptoms appear when the constricting effect of the

thickening of the connective tissue begins, they remain while it lasts, and disappear finally when the thickening diminishes." This hypothesis of Buhl would account for the disappearance as well as the subsequent return of the patellar-reflex in diphtheritic paralysis.

CASE III.—*Poliomyelitis Anterior Acuta ; Wasting and Paralysis of certain Muscles of Left Leg ; absence of Patellar-reflex.*—A lad, five years of age, was brought to the Children's Hospital in December, 1880. The relatives said that two years before he had been "hot and sick for a few days." On recovering from this illness they noticed that his left leg was "useless." They had tried various remedies, with little effect.

Present Condition.—The left leg is smaller and colder than the right. There is also wasting of the muscles of the leg, and partly of those in front of the thigh. When he walks the leg is dragged, and there is a tendency to talipes equino-varus. The left knee-joint is very movable, and the bones of the left side seem smaller than the corresponding ones on the opposite leg. The patellar-reflex is present in the right side—absent in the left. Sensibility is retained.

In this case the absence of the patellar-reflex is due to the destruction of the multipolar ganglion cells in the gray matter of the anterior cornua (the essential anatomical lesion in poliomyelitis anterior acuta), interrupting the impulses in the motor portion of the reflex arc. The wasting of the muscles and their paralysis show that it is the motor part of the loop which is involved, especially as the absence of any loss of sensation indicates that the sensory part is intact.

The absence of the patellar-reflex in poliomyelitis anterior acuta is of great diagnostic value, as it distinguishes that disease from paralysis depending on cerebral causes, the patellar-reflex in the latter being either exaggerated or not altered at all.

CASE IV.—*Right Hemiplegia ; Contracture of Right Arm ; increased Patellar-reflex of Right Leg, and exaggerated "Supinator-reflex" of Right Arm.*—I have at present under my charge, at the Ulster Institution for the Deaf and Dumb and the Blind, a girl, thirteen years of age, who was paralysed at the time she was admitted into the Institution. I have not been able to ascertain the previous history.

Present Condition.—She is deaf and dumb, and is hemiplegic on the right side. There is no rigidity in the leg, but the arm is kept close to the side, the elbow-joint is bent at a right angle, the wrist-joint is flexed, and the fingers are firmly closed. The arm can be extended only after some force is used. The patellar-reflex is very much exaggerated

in the right leg. On tapping the tendon of the right supinator longus, the hand is immediately jerked toward the shoulder. There is no paralysis of the face or tongue.

In cases like the above the exaggeration of the patellar-reflex may be due to the withdrawal of the normal inhibitory action of the brain, owing to rupture of the pyramidal tract, but against this explanation of the phenomenon is the fact that the exaggeration of the patellar-reflex is not, as a rule, noticed immediately after the lesion in the brain, but seems to require some days to elapse before it can be observed. Seeing that the exaggerated patellar-reflex is often associated in these cases with late rigidity (a phenomenon depending on descending degeneration of the pyramidal tracts in the lateral columns), some think that the increased tension of the muscles under such conditions may give rise to a condition of irritability in the terminations of the nerves, which, in turn, increases the excitability of the spinal centre. But this is clearly not the real explanation of the exaggeration of the patellar-reflex in these cases, as the phenomenon appears long before there has been time for the occurrence of degeneration in the cord. No explanation thoroughly satisfactory has yet been given to account for the exaggerated patellar-reflex in these cases.

BIBLIOGRAPHY.

Westphal.—*Archiv für Psychiatrie und Nervenkrankheiten*, Band V., 1875. "Ueber ein frühes Symptom der Tabes Dorsalis" (*Berliner klinische Wochenschrift*, January, 1878). *Berlin. klin. Wochenschr.*, Nos. 1 and 2, 1881. Reference is made to this communication in the *Archives Générales de Médecine* for April, 1881.

Erb.—"Sehnenreflexe bei Gesunden und bei R-M-Kranken" (*Archiv für Psychiatrie u. Nervenkrankheiten*, Band V., 1875). *Ziemssen's Cyclopaedia*, Vol. XIII., American translation. "Diseases of the Spinal Cord and Medulla," by Erb.

Charcot.—"Diseases of the Nervous System," New Sydenham Society, 1881.

Brissand and Franck.—*Le Progrès Médical*, March, 1880.

Grainger Stewart.—"Tendon Reflex," a Clinical Lecture, *Medical Times and Gazette*, Feb. 2nd, 1878.

Hughlings Jackson.—"Eye Symptoms in Locomotor Ataxy," *Lancet*, Dec. 18, 1880.

Gowers.—"The Diagnosis of Diseases of the Spinal Cord,"

Second Edition, London, Churchill, 1881. "A Study of the so-called Tendon Reflex Phenomena," *Medico-Chirurgical Transactions*, Vol. LXII.

Ross.—"A Treatise on Diseases of the Nervous System," 2 vols., London, Churchill, 1881.

Buzzard.—"On Tendon Reflex as an Aid to Diagnosis in Diseases of the Spinal Cord," *Lancet*, Nov. 27th and Dec. 4th, 1880. Clinical Lecture "On Cases of Acute Atrophic Paralysis in Infants and Adults," *Lancet*, Dec. 11th and 25th, 1880. "Absence of Patellar Tendon Reflex in a Case of Paralysis following Diphtheria," *Lancet*, April 17th, 1880. "On certain little-recognised Symptoms of Tabes Dorsalis," *Transactions of International Med. Cong.*, London, 1881, Vol. II.

Waller.—*Brain*, July, 1880.

Abercrombie.—"On Diphtheritic Paralysis in Children," *Transactions of International Med. Cong.*, London, 1881, Vol. IV.

Supplement to *Ziemssen's Cyclopædia*, edited by Peabody, 1881. Article, "Locomotor Ataxia."

Eulenburg.—"On Graphic Tracings of Tendon Reflexes," *Transactions of Intern. Med. Cong.*, London, 1881, Vol. II.

Tschirjew.—*Archiv für Psych.*, Band VIII., Heft 3.

Berger.—*Centralbl. für Nervenheilkunde*, Nov. 4, 1879.

Oertel.—"Diphtheria," *Ziemssen's Cycl.*, Vol. I.

Déjérine.—"Recherches sur les Lésions du Système Nerveux dans la Paralysie Diphthérique," *Arch. de Phys.*, X., 1878.

ART. IX.—*Excision of the Shoulder-joint.* By P. J. HAYES, F.R.C.S.E.; Surgeon to the Mater Misericordiæ Hospital; Lecturer upon Surgery in the Catholic University School of Medicine; Consulting Surgeon to St. Michael's Hospital, Kingstown, &c.

CASES demanding excision of the shoulder-joint do not frequently present themselves to the practising surgeon; therefore, as I have been called upon to perform the above-named operation twice during the past year, I publish brief details of my cases, in the hope that they may be found to possess some features of interest.

CASE I.—M. S., female, aged thirty-three, married, admitted to hospital May 26, 1881, suffering from extensive suppuration about the left shoulder. The patient states that sixteen years ago she was treated by