pinch, and designates the pain produced by these various agents as simply a burning one. The painful sensation on electrical stimulation may also become abolished, so that we can apply the strongest currents or the faradic brush to the most sensitive parts, such as the inner surfaces of the thighs, the perinæum, or the scrotum, and the patient not give the slightest evidence of pain.

Lastly, delayed sensation is to be considered as a symptom of a paralytic nature. In these cases, when the patient is pricked with a needle, he does not experience pain until one, two, or three seconds later. Goldscheider has attempted a physiological explanation of these phenomena (Deutsche Med.-Ztg., 1890, 43, p. 484). The delay of perception may vary for the different qualities of sensation—for example, for touch and pain—as Osthoff and Remak have pointed out.

We must attribute to disturbances of the muscular sense, which we alluded to in discussing the cause of ataxia, the fact that the patient with his eyes closed is unable to state accurately in what position his extremities are, and if one, for instance, changes the position of a limb, he is not at all certain into what position it has been put. He is unable to estimate the weight of an object placed in his hands, and so forth. All these conditions are to be remembered when one is testing the muscular sense, and at the examination one will have to ascertain what is the minimum change of position which can still be recognized by the patient.

LITERATURE.

3. The Spinal Cord.

a. Motor and Sensory Disorders.

Rumpf. Sensibilitätsstörungen und Ataxie. Deutsches Arch. f. klin. Med., 1889, 1.

Goldscheider. Berliner klin. Wochenschr., 1890, 46.

Binswanger. Ibid., 1890, 21, 22.

Quincke. Zeitschr. f. klin. Med., 1890, 5. (Associated Sensations, etc.)

Wagner, K. Ueber die Beziehungen der Bewegungsempfindung zur Ataxie bei Tabikern. Inaug.-Dissert., Berlin, 1891.

Stanowski. Versuch, die Ursache der Ataxie bei Tabes zu erklären. Internat. klin. Rundschau, 1892, 17. (This author explains ataxia by a diminution in the excitability and conductivity of the motor nerves.)

Dubuc. Des douleurs fulgurantes tabétiques. Thèse de Bordeaux, 1892.

Grasset. Du vertige des ataxiques (signe de Romberg). Arch. de Neurol., 1893, 73, 74.

Of the disturbances of the reflexes, those connected with the skin interest us less than those connected with the tendons; of the latter, the patellar reflex is the most important, the anatomical localization for which is in the so-called root zone (Westphal). This zone is situated at the junction of the lower dorsal portion of the cord with the lumbar enlargement at the level of exit of the second, third, and fourth lumbar nerves (cf. page 422), and constitutes the area which the roots entering to the median side of the posterior horn must traverse in order to reach the substantia gelatinosa of the posterior horn. If this field is degenerated the patella tendon

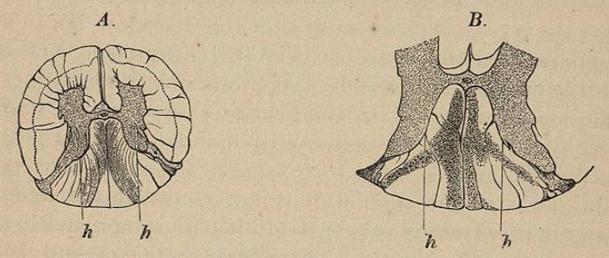

Fig. 172.—Two Cases of Tabes. (After Westphal.)

A. The lines *h h* show the limits of the so-called "root zone." The degeneration is progressing from within toward them, but only reaches the border line. The patellar reflexes were retained until death.

B. The degeneration is progressing from within outward, and has extended far into the "root zone." The patellar reflexes were lost five years before death.

reflex disappears, but if it is normal, the reflex is preserved (cf. Fig. 172, A and B). The rare cases in which it remains preserved on one side also confirm the localization assumed by Westphal; at the autopsy it has been repeatedly noted (cf. Berlin. klin. Wochenschr., 1887, 31, p. 586) that there was a degeneration of the posterior columns and of the "root zone" on the affected side, while this zone on the healthy side was intact.

The disappearance of the patellar reflex, "Westphal's sign," was formerly considered as pathognomonic of tabes, and whenever the knee jerk could not be obtained, the diagnosis was made without hesitation. This was the standpoint taken in the earlier works of Westphal, Erb, and others, and it must be confessed that "Westphal's sign" is observed in by far the greater number of cases of tabes, and usually early in the course. However, it began to be doubted that the rule was

without exceptions, and toward the end of the seventies several undoubted cases of tabes were reported (Berger, Fournier) in which the patellar reflex was retained to the end of life, and, since then, other similar cases have been added. Westphal himself pointed out that the knee phenomenon might persist with degeneration of the posterior columns (Arch. f. Psych. und Nervenkrankh., 1886, 17, 2), and precisely at this time I myself reported two such instances (Berlin. klin. Wochenschr., 1886, 10). Accordingly, it is an undeniable fact, and one which, anatomically, can be readily explained, that under certain circumstances—that is, whenever the "root zone" remains free from degeneration—the patellar reflex may continue to be present during the entire course of the disease. By repeated and accurate examination, in which Jendrassik's method of re-enforcement should not be forgotten, one is sometimes able to follow up the gradual disappearance of this reflex, and to observe that the time of its diminution and final disappearance may differ in the two legs—for example, the reflex may still be well marked on one side, after it has completely disappeared on the other. Among others, Goldflam has reported observations on this point (Neurol. Centralblatt, 1888, 19), and has supposed that interference with conduction, produced by pathological changes in the peripheral nerves, may also be the cause. Eichhorst has reported a case in which, although the patellar reflex had been absent, the autopsy revealed no changes in the root zone, but a parenchymatous neuritis of both crural nerves. The patellar reflex which has once disappeared in the course of tabes can never reappear, since destruction of the corresponding portions of the cord has taken place, but in traumatic neuroses this may very well happen, and in doubtful instances it may become an important point in the differential diagnosis. The patellar reflex can only be increased in tabes when there is a coincident degeneration of the lateral columns.

While, then, for the reasons we have given, "Westphal's sign" can not be regarded as pathognomonic, there are still others which should warn us against laying too much stress on the condition of the patellar reflex in the diagnosis of tabes. Unquestionably it may also disappear under certain circumstances in the course of other affections—as, for example, in certain diseases of the brain—if the muscular tone necessary to its production has been lost; also in neuritis, poliomyelitis, diabetes, chronic alcoholism, and in affections of the knee joint

when the movements of the tendon are interfered with. When we add that it can not be demonstrated in all healthy persons —a small number being entirely without it, as Berger and others have stated—and moreover consider the fact that in old age and in conditions of marked nervous exhaustion it may entirely disappear without any apparent reason, perhaps from a diminished tone in the muscles, we shall have sufficient grounds for not overestimating its significance, important as it may still be for the recognition of tabes. The measurements of its strength, which have lately been made a good deal of, may for the present be omitted in practice without disadvantage for the diagnosis.

LITERATURE.

3. Spinal Cord.

b. Reflexes.

Rosenheim. Arch. f. Psych. u. Nervenkh., 1884, xv, 1. (Experimental Studies on the "Tendon-phenomena.")

Zenner. The Knee-phenomenon in Locomotor Ataxia. Journ. of Nerv. and Ment. Disease, N. S., April, 1884, ix, 2.

Delprat. Nederld. Tijdschr. voor Geneeskunde, 1886, 51. (Three Cases of Tabes in which the Patellar Reflex persisted until within a Few Hours before Death.)

Westphal. Ueber Fortdauer des Kniephänomens bei Degeneration der Hinterstränge. Arch. f. Psych. u. Nervenkh., 1886, xvii, 2.

Mitchell, Weir, and Morris. Tendon-jerk and Muscle-jerk in Diseases, especially with Reference to Posterior Sclerosis of the Spinal Cord. New York Med. Record, 1886, xxx, 1.

Krauss, E. Beitrag zur Localisation des Patellarreflexes bei Tabes u. s. w. Neurol. Centralbl., 1886, v, 20.

Hirt. Ueber Tabes mit erhaltenen Patellarreflexen. Berliner klin. Wochenschr., 1886, xxiii, 10.

Westphal. Zwei Fälle von Tabes mit erhaltenem Kniephänomen. Berliner klin. Wochenschr., 1887, xxiv, 5.

Minor. Zur Frage über die Localisation des Patellarreflexes bei Tabes. Centralbl. f. Nervenhk., 1887, x, 6.

Westphal. Anatomischer Befund bei einseitigem Kniephänomen. Arch. f. Psych. u. Nervenkh., 1887, xviii, 2.

Goldflam. Ueber die Ungleichheit des Kniephänomens bei der Tabes. Neurol. Centralbl., 1888, vii, 19, 20.

Warren, Plymton, Lombard. The Variations of the Normal Knee-jerk and their Relation to the Activity of the Central Nervous System. Amer. Journ. of Psychol., 1887, i, 1.

Meyer. Berliner klin. Wochenschr., 1888, 2. (Influence of Physostigmine on the Tendon Reflexes.)

Benedikt. Qualitative Veränderungen des Kniephänomens. Neurol. Centralbl., 1889, 17.
Eichhorst. Virchow's Arch., 1891, cxxv, 1. (Patellar Reflex in Cervical Tabes.)
Goldflam. Berliner klin. Wochenschr., 1891, 8. (Reappearance of the Patellar Reflex.)
Vučetič, Marie. Inaug.-Dissert., Wien, 1893.

The reflex centres for the functions of the bladder, rectum, and sexual apparatus, which are situated in the lumbar portion of the cord, are naturally also greatly disturbed in the course of tabes. The reflex processes, which come into action here, are but little understood, but their pathological condition has been studied with great care. Much attention has been directed toward the bladder troubles of tabetics, and attempts have been made to distinguish between the different kinds of affections. They are motor or sensory, or both, according as only the one or the other or both centres have been destroyed by the degenerative process in the cord.

Among the motor disturbances there are symptoms of irritation as well as of paralysis, which may affect equally the sphincter and the detrusor, so that the will may have but little influence over them, or finally none at all. According as one or the other condition is the more prominent, the complaints of the patient differ: sometimes he is obliged to strain for a long time before the bladder will begin to empty itself, and even then the stream is often interrupted; sometimes he is unable to urinate at all in the erect posture, but must squat down or sit on the closet to bring the abdominal muscles into action in order to expel even a few drops of urine, and the act of micturition may take so long that the patient feels ashamed to use the public conveniences. In other cases, where there is not only paresis of the detrusor, but at the same time a spasm of the sphincter, the patient can not urinate at all, and the retention must be relieved by means of the catheter; in other instances, again, where there is a paresis of the sphincter, he has to urinate very frequently. Long before the bladder is full—every hour or two—he feels an irresistible desire to empty it, which he must satisfy or run the risk of an involuntary passage of urine. He is unwilling to undertake railroad journeys, to go into society, to lectures, or to the theatre, for fear that he will not be able to reach a convenient place in time where he can urinate in peace. Paresis of the sphincter is often a

reason why the patient sleeps poorly, because he has to get up so often to urinate, and if he sleeps soundly he does not appreciate the calls of nature, and will pass his urine in bed. When he coughs or sneezes the under-garments are moistened with urine, and, despite his utmost efforts, he is unable to prevent it. In the more marked degrees of weakness of the sphincter there is an involuntary trickling or an occasional discharge of urine, which the patient is unable to predict; this necessitates the constant wearing of some sort of receptacle; otherwise the patient is surrounded by such an ammoniacal odor that the incontinence is recognizable without any examination. If there is a combination of retention and incontinence, it manifests itself in the following manner: After long straining the urine is passed in a moderately strong stream, but this suddenly ceases, and can only be started again after renewed efforts. Sometimes, after the patient has strained in vain for a long time and has given it up in despair, the urine is passed involuntarily. These and many other facts of the same description are only to be discovered after careful and repeated questionings and examinations.

Sensory disturbances may manifest themselves (1) by more or less intense pain before and during the act of micturition, which may distress the patient greatly and make him dread to relieve his bladder (the "*crises vésicales*" of Charcot). The pain may be situated either in the hypogastric region or extend down into the urethra (*crises vésico-uréthrales*). Painful strangury, forcing the patient to urinate every half hour, when he only passes a few drops, has also been observed. On the other hand, (2) there may be a diminution in sensibility, so that, in consequence of the anæsthesia of the mucous membrane of the bladder and urethra, the flow of urine is not noticed, and the patients, especially when there is a weakness of the sphincter at the same time, do not know whether they are urinating or not, and only become aware of the fact when they feel the chilly sensation proceeding from the damp clothes. A rather rare manifestation, which may be observed after violent bladder crises, is the appearance of hæmaturia, which must be attributed to capillary hæmorrhages into the bladder or urethra; the bloody character of the urine may be a source of new anxiety and worry to the unfortunate patient, already greatly broken down by the agonizing pains. These hæmorrhages may be considered as analogous to the ecchymoses in

the skin occurring after the intense lancinating pains, which we mentioned above on page 645.

The most troublesome rectal symptom is the very obstinate constipation. Incontinentia alvi and anæsthesia of the rectal

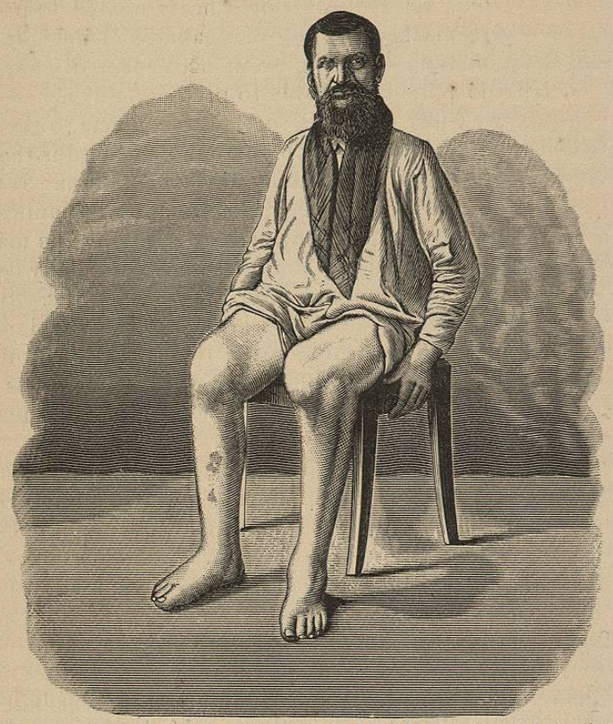

Fig. 173.—A Case of Charcot's Joint in a Tabetic (personal observation).

mucous membrane, in consequence of which the patient is not aware of the act of defecation, and so soils himself unconsciously, are among the rarer occurrences.

The centre for the sexual functions, the seat of which is also in the lumbar enlargement, is under the control not only of reflex but also of cerebral influences. If the path coming from the psychical centres is interrupted, the performance of the function is faulty; if the path from the inhibitory centres is disturbed, the sexual reflex activity is increased and priapism may occur. Pitres (Progr. méd., 1884, xii, 37), under the name of "*crises clitoridiennes*," has described in women conditions

which consisted of periods of voluptuous excitement accompanied by secretion, analogous to the violent erections and spermatorrhœa found in men in the initial stages of tabes. Such cases are, however, at least in Germany, exceptional. Not infrequently tabetics have been known to preserve their virility, and even after the beginning of the disease to beget one or even several healthy children. Only later does the sexual power, and with it the desire, become diminished, and coitus lose its charm, so that it is undertaken more rarely, the act being sometimes incomplete. A normal condition of the nerves necessary for the erection of the penis, associated with a paralysis of those going to the ejaculator seminis, so that while coitus and orgasm are normal, the semen is not emitted till later, and then very slowly—a condition which Bernhardt has observed after injury (Deutsch. Med.-Ztg., 1888, 48)—has been known to occur also in the course of tabes.

The vaso-motor and trophic centres in most cases are not affected. In the majority of instances, symptoms of this character are entirely absent during the whole course. In some, however, peculiar symptoms attract our attention, as, for example, a local hyperidrosis, which Ollivier (Gaz. hebdom., Septembre 7, 1883, xxx, 36), Raymond and Arthaud (Revue de méd., 1884, 4, 5), and others have observed on the hands and feet. In a case of tabes we have also seen the sweat secretion on the hands so increased that we were able to note the formation of small drops and watch them unite to form a steady dripping. In another case there was unilateral sweating, the hyperidrosis appearing after every meal on the left half of the head, face, and neck. I do not care to risk an opinion as to how far an assumption of an affection of the sympathetic would here be justifiable.

Greater practical importance must be attributed to the changes which are observed in the nails and teeth of those affected with tabes. The nails are either deformed, becoming twisted or marked by deep furrows, or fall out entirely from the fingers as well as from the toes, as Joffroy (L'Union, 1882, 106), Bonieux (Thèse de Paris, 1883, No. 237), Hay-Margirandière (Thèse de Paris, 1883, No. 75), and others have observed. The loss of the nails ("*la chute des ongles*") is not rare in tabes, and is in some cases to be attributed to the temporary cessation of growth of the nail matrix. In others an ecchymosis under the nail may be the exciting cause. Under certain cir-

cumstances the nail of the great toe falls off altogether, without pain, with only a slight itching sensation, and the newly formed nail, which is often rough and irregular, soon shares the fate of its predecessor.

It is occasionally observed that the teeth become loosened without any pain and fall out without the appearance of any symptoms of inflammation, the tooth itself being intact. This arises from some disturbance in the nutrition of the jaw, a rarefying ostitis which is connected with a lesion of the nucleus of the trigeminus (Vallin and Demange). In this way the patient may lose all his teeth in a few months. It is very interesting to note that this may be connected with laryngeal crises, a fact which would indicate that there may be some truth in the view advanced by Buzzard (British Med. Journal, February 19, 1886), according to which the centre for bone nutrition lies quite close to that of the vagus.

The so-called *mal perforant du pied* (perforating ulcer), which begins with the formation of a bleb and leads to abscess formation and necrosis of the tendinous and bony portions of the feet, is due to some trophic disturbance, and may become a source of great discomfort to the patient.

Affections of the bones and joints, which are also of trophic origin, belong to the more frequent complications of tabes.

Fig. 174.

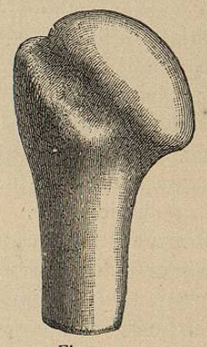

Fig. 175.

Fig. 174.—Erosion of the Head of the Humerus in Tabes Dorsalis. Fig. 175.—Normal Humerus. (After Charcot.)

The bones become extraordinarily brittle and fractures frequently occur without pain, and one could almost say without the knowledge of the patient. The seat of such fractures is most commonly in the femur, and, more especially in old

women, in the neck of that bone. This remarkable fragility is of especial moment when it occurs, as it sometimes does, in the bones of the spinal column, and particularly in its lumbar portion, and gives rise to spondylolisthesis without it being possible to decide whether or not the cartilages and ligaments were first affected and the disease of the bones was only secondary (Kroenig, Zeitschr. f. klin. Med., 1888, xiv, 1, 2).

Among the joint affections which are not essentially different from those produced by arthritis deformans, the "*arthropathie des ataxiques*" or "Charcot's joint," because it was first described by him, deserves particular mention. According to his description, there develops in the course of one night, without any appreciable cause and without pain or febrile movement, a swelling of a

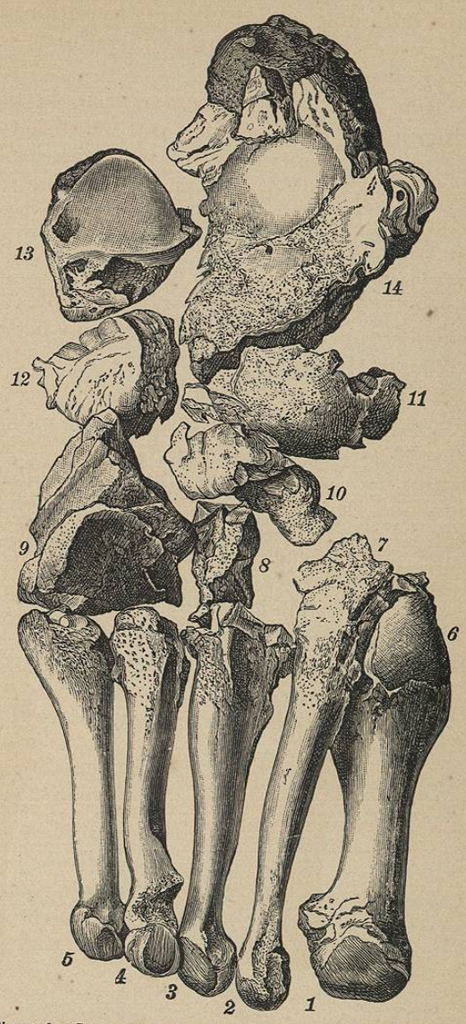

Fig. 176.—Skeleton of a Tabetic Foot. (After Charcot.) (The original is in the pathological museum of Charcot's department in the Salpêtrière in Paris.) 1–5, metatarsal bones. 6, internal cuneiform bone. 7, middle cuneiform bone. 8, fragment of the external cuneiform bone. 9, cuboid bone. 10 and 11, fragments of the scaphoid bone. 12 and 13, the astragalus. 14, the cs calcaneum.