pages 143 and 144 I have recorded another (Fig. 170) in which there was likewise no trace of locomotor ataxia. It seems that the hypoglossal nucleus is not very liable to the degenerative processes of this disease.

Cerebral disturbances of the most manifold variety appear in the course of tabes, and in the first place attention must be called to the paroxysms of vertigo which come over the patient when he looks up or makes quick movements of the head, and which impel him to seize the nearest object to prevent himself from falling. There may also be found psychical depression and a feeling of dread and anxiety, which in some cases may be followed by well-marked psychoses. Among the not very rare forms of psychoses in this disease we may mention paranoia, melancholia, and simple dementia; but far more frequent and important than all these taken together is general paralysis, which very frequently accompanies tabes. But here we must try to make out which of the two affections was the first to develop, for in some instances the tabes precedes the paralysis, while in others the reverse is the case. The process can extend from the brain to the cord or from the cord to the brain, as the case may be, and Westphal was certainly justified in making the statement that "in certain persons there is a peculiar disposition of the nervous system, and that this, under the influence of different exciting causes, the action of which we do not understand, expresses itself in the form of affections either of the spinal or cerebral portion of the nervous system or of the peripheral cranial nerves, the different affections coming on in some cases nearly at the same time, in other cases at varying intervals."

Epilepsy occurring in connection with tabes has already been considered in the chapter on the former disease. On this subject Schlieper, working under my direction, has published an article (Inaug.-Diss., Breslau, 1884).

The cases of hemiplegia which occur in the course of tabes are mostly of the indirect variety—that is, they disappear in a shorter or longer time—and do not owe their origin to the rupture of vessels or to lesions of the internal capsule. The face is usually only slightly affected, and that only for a short time, and the extremities are not wholly paralyzed, but are only in a paretic condition, which usually disappears without any sort of treatment. I have repeatedly seen such cases of hemiparesis come on without any warning and with only a

slight disturbance of consciousness and entirely disappear in a relatively short time. A. Bernhardt (Archiv f. Psych. u. Nervenkrankheiten, 1883, xiv, 1) has recorded instances in which they were accompanied by aphasic conditions.

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So great importance has been attached to the spinal symptoms that they usually occupy the greater part of all descriptions of the clinical history of the affection, and have been allowed to predominate so far that all other symptoms have been treated of as being of little moment, and as if the only lesion was that in the spinal cord. And still, it is not rare to meet with cases in which the spinal manifestations have been for a long period of very little importance, and with a few in which they have never attained to any prominence, while the majority of the troublesome symptoms were due to affections of the brain and its nerves, and the lesions of the peripheral nerves gave rise to more marked symptoms than those of the spinal cord. Observations of this kind, the number of which will be rapidly increased by conscientious examinations, go to show that the entire nervous system participates in the morbid process, and to consider this participation to be the rule is absolutely necessary for a correct comprehension of the pathology of this disease.

The symptoms produced by the spinal lesions concern motility, sensibility, and the reflexes.

The disturbances of motility are manifold; they depend partly on a decrease in the strength of the muscles, partly on disturbances of co-ordination. The first is not very common; on the contrary, one can frequently observe that the mere strength in the extremities has not been at all affected, and yet the motility has suffered. This condition depends, then, upon a faulty co-ordination, and is broadly designated as "ataxia." Movements, such as walking, writing, taking hold of an object, etc., for the proper execution of which the simultaneous working together of several muscles is necessary, are designated as "co-ordinated." For such movements more than a simple innervation of the muscles is requisite; it is necessary that each concerned should receive, so to speak, the proper amount of innervation and at the proper time, so that the contraction of the various muscles may take place at the right moment. It is only when all these various factors are properly combined that the movement is correctly executed, and if one of them be disturbed the entire movement becomes ataxic. Even if not pathognomonic, it is certainly very characteristic of tabes that in the later (rarely in the earliest) stages, certain movements become ataxic, particularly those of the lower extremities, and, above all, the gait. Such abnormities are met with much less frequently in the upper extremities, and the movements necessary for writing, handling a spoon in eating, and the like, usually remain normal.

The gait of a tabetic is readily recognized even by one who has had little experience in that direction; one notices particularly that the patient exerts his eyes almost as much as his feet, that he watches every step, and in passing over small obstacles, as for example a curbstone, determines exactly where he must place his foot. If he ceases to use his eyes in this fashion for any reason, even for a short time, the movements of the legs become uncertain, and he is in danger of falling. But not even with the help of the eyes can he walk without difficulty. He does not step out in the usual way; the legs are thrown out loosely, and in putting the feet to the ground the heels come down first ("strutting gait"). The manner in which the feet are raised, the legs thrown out, the stamp with which the feet touch the ground, readily enable one to diagnosticate the tabetic gait at a distance, and we shall seldom make a mistake if we consider a person who walks in this manner, supported on a stick or by an attendant, as affected with locomotor ataxia.

Acts of politeness, such as greetings and stopping to talk on the street, do not afford these persons much pleasure, for they distract their attention, which has to be kept undivided if they would walk in safety.

The uncertainty and insufficiency of the innervation of the different groups of muscles is apparent not only in the walk, but even while the patient is standing still. He is not able to stand up straight without tottering, particularly when he closes his eyes, and he sways to and fro and falls unless some one is at hand to support him ("Romberg's sign"). The smaller the supporting basis—that is, the nearer together the feet—the more pronounced does the phenomenon become. In some cases it may be accompanied by irregular contractions of the calf muscles.

The much rarer ataxia of the upper extremities produces inability to write, to play the piano, to sew, etc. With closed eyes the patient is unable to describe circles in the air with his arms, to bring the tips of the index fingers together from a distance, or to touch the end of the nose quickly with his finger. All such movements are carried out with more or less irregularity. It is exceptional for the upper extremities to become affected at an early period or severely; as a rule, we can not detect ataxic movements in them in the earlier stages, and when they do occur they can, at least in some instances, be traced to some special cause. In the case of Bernhardt (Zeitschr. f. klin. Med., 1888, xiv, 3, p. 289) they were due to the occupation of the patient. Remak (Berlin. klin. Wochenschr., 1880, 22) has also published a similar case of ataxia affecting only the upper extremities. It was associated with ephidrosis unilateralis. The helplessness of the patient reaches the most extreme degree when the ataxia affects all four extremities, as in the case of Fort (Dublin Journal of Medical Science, 3d s., 1886, clxxiii).

But we must also distinguish between spinal and cerebral or the so-called cortical ataxia (page 186). A conclusion important for the differential diagnosis may be drawn from observing the influence which the eyes exert over the co-ordinated movements. In spinal ataxia these become better regulated and more certain when they are under the control of the eyes, while in cortical ataxia this factor has no influence.

The physiological cause of ataxia is not as yet positively known, but even to-day is a source of contention and still the object of continued investigations. While some, as Benedikt,

Cyon, and Jaccoud, consider that we have to do with a disturbance of the reflex activity in the cord, others, with Friedreich, and after him Erb, are of the opinion that there is a disturbance in co-ordinating fibres, the course of which they confess can not as yet be made out. Thirdly, others, with Leyden at their head, consider disturbances of sensibility to be responsible for the ataxia. According to these, interruption of conduction in the sensory tracts of the gray matter causes a break of the reflex arc between the sensory nerves of the muscles and the motor nerves. "Owing to this interruption, the unconscious regulation of the movements, which adapts them to the state of contraction or relaxation of the musculature, disappears" (Wernicke), and ataxia is the result. This "sensory ataxia" has always had many opponents, for one was obliged to confess that ataxia often occurs when no sensory changes are found; but in spite of this fact some one is constantly returning to this theory, which has found a strong advocate in Goldscheider. In a comprehensive article (Zeitschr. f. klin. Med., 1888, xv, 1, 2) he subjects the meaning of the term "muscular sense" to a fresh examination, and comes to the conclusion that four factors are combined in the formation of the muscular sense, viz.: (1) the sensibility to active, (2) to passive movements, (3) the perception of position, and (4) the perception of weight and resistance. He then states that in all cases of ataxia in which the sensibility had been tested the examination had been imperfect in some detail; he points out that, for example, in the otherwise admirably conducted observations of Friedreich, the examination of the sensibility to movement was omitted. According to his view, therefore, it is only necessary to perfect the examination of the sensibility in order to come to the conclusion that sensory disturbances are responsible for the ataxia.

When one considers that we are ignorant of the origin of the normal co-ordination, and remembers that it is not congenital but must be learned by practice, in which controlling and correcting influences, which arise from the periphery, come into play, it is not difficult to agree with Strümpell, who considers that the ataxia takes its origin from the disappearance or insufficiency of those regulating influences, because "the possibility of successfully transferring them to the motor apparatus is removed." We should then have to regard the gray substance and the ganglionic cells as the place where this

transfer probably occurs. Which of the theories above mentioned will at last be recognized as the correct one, and whether or not other factors, which have not yet been considered, play a part in the production of the ataxia, it is at present impossible to state (cf. Rumpf, Sensibilitätsstörungen und Ataxie, Leipzig, Hirschwald, 1889).

Later on in the course of tabes there is a diminution in the actual strength of the voluntary muscles, particularly in those of the lower extremities. This first manifests itself by weariness on walking, which gradually increases, and finally ends in total paralysis (paraplegia). The patient first notices that he has to rest in the course of walks which he previously was in the habit of taking without any feeling of fatigue, that

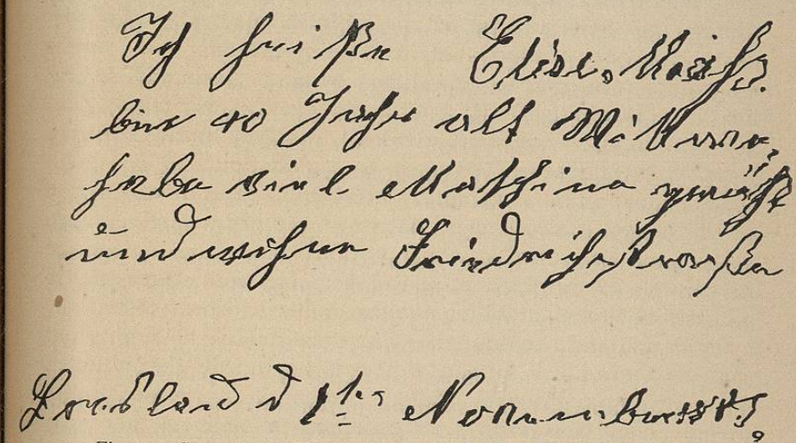

Fig. 171.—Specimen of Handwriting in a Case of Tremor in Tabes (personal observation).

it takes him much longer than formerly to cover a particular distance, and that he is in general unable to take the exercise to which he was formerly accustomed. As the disease advances, the power of locomotion becomes more and more diminished, and the patient is only just able to drag his legs along, and at last, becoming unable to move at all, or even stand without help, is obliged to spend the rest of his life in the invalid's chair.

Signs of motor irritation are rare and are limited to paroxysmal twitchings in the fingers and toes; sometimes, however, involuntary movements occur in the limbs which the patient

has absolutely no intention of moving. Stintzing (Centralb. f. Nervenheilk., 1886, 9, 3), for example, observed an involuntary flexion of the hip joint when the patient coughed. Similar associated movements in the fingers or toes have been described by Strümpell (Neurol. Centralblatt, 1887, vi, 1) and Oppenheim (Sitzung der Charité-Gesellschaft, 20 März, 1884).

The athetoid and choreiform movements described by Andry (Revue de méd., 1887, 1), sometimes found in tabetics, are to be regarded as due to simultaneous disease of the lateral columns, and accordingly rather as complications. We must regard the tremor as one of the signs of motor irritation, although we are at present unable to localize its anatomical seat. This symptom is sometimes observed either in the initial stage or in the further course of the disease. If the upper extremities become affected by it, the handwriting is altered, in the manner represented in Fig. 171.

The disturbances of sensibility in tabes are either experienced subjectively by the patient, or can only be discovered by an objective examination. Their number is exceedingly large, and it is safe to say that in almost every case some interesting observation of this character may be made. Symptoms of irritation alternate with those of paralysis, and one also meets with other different disturbances of sensation which belong to neither of these groups, and which are more variable in tabes than in any other affection.

Among the subjective symptoms we shall consider first the symptoms of irritation, more particularly the pains, which in the life of tabetics play such an important part. They, too, are of a changeable nature, and vary considerably in their situation and intensity. In the first place we desire to direct attention to the muscular pains, which, if they occur at all, come on very early in the course of the disease, and affect sometimes the shoulders, sometimes the legs, and recall the well-known muscular pains which follow severe exertion in the gymnasium, mountain climbing, rowing, etc. As a rule, it is true, they are not very intense, but when they come on suddenly, without any appreciable cause, the patient is obliged to remain perfectly quiet for several hours, for every motion is difficult to him, and if he persists in his attempts, movement becomes impossible on account of the feeling of weakness and fatigue which at last overcomes him. Pitres calls these pains "crises de courbature musculaire" (Progr. méd., 1884, xii, 28), and considers that they are precursors of tabes.

We must separate from these the nervous pains of tabetics which are dependent upon irritation of the posterior roots. They are usually situated in the lower extremities, and manifest themselves either as dull, boring sensations, or as sharp pains which last for hours and then disappear for a time; they may also be felt in the back and sacral region, and for years be attributed to rheumatism, lumbago, etc. As long as only these pains exist, the life of the patient is bearable, although it may be marred and his occupation interfered with, but there is a second class of nervous pains which, appearing and disappearing like lightning, are known as shooting or lancinating pains, "*douleurs fulgurantes*." It is these that make the existence of the tabetic most miserable, and make him wish that he were dead; it is these, again, that can reach an intensity which causes the most resolute sufferer to lose his energy, and converts him into a complaining and whining weakling. They also occur paroxysmally, and may continue for minutes, hours, or even days, and then disappear for variable periods, sometimes for months. In many cases they recur often, sometimes every week, but they then usually only last for a few moments.

In some cases, in connection with these attacks, cutaneous ecchymoses may develop, which are to be noted in the portions of the body subjected to the pain, and may attain a considerable size, so that one who does not know their significance, on examining the patient, may come to the conclusion that he has been injured by a blow or a fall. In still rarer instances swellings have been observed instead of the ecchymoses, which in the same manner as the latter disappear in a few days.

Along with these pains the patient may suffer with hyperæsthesias of the skin to such an extent that in certain parts of the body—very frequently, for instance, on the back—he can not bear the slightest pressure, and even his clothes will be a source of annoyance to him. These cutaneous hyperæsthesias may persist for months unchanged without being affected in the least by the paroxysmal pains.

Among the symptoms of sensory irritation the so-called girdle sensation may also be reckoned. This likewise occurs paroxysmally, at which times the patient experiences a feeling

as if a belt were being drawn around his chest and abdomen, which interferes with his breathing.

Manifestations of sensory paralysis may also be subjectively perceived by the patient. Not infrequently he will say that he does not feel the contact of the clothing on certain portions of the body, or that the soles of the feet are without sensation. In a case under my observation the patient complained of a widespread loss of sensation in the perineal region, which on objective examination proved to be anæsthetic as well as the inner surfaces of both thighs. To the anæsthesias, which are particularly unpleasant to the patient, belong those affecting the mucous membranes—as, for example, that of the rectum—owing to which the bowel may empty itself without the patient being conscious of it. Again, there may be anæsthesia of the testicle, often associated with atrophy (Pitres), and loss of sensation in the mucous membrane of the sexual organs—as of the vagina, for example—owing to which the pleasurable sensations attending coitus are either absent or greatly diminished.

Among the perverted sensations which are experienced subjectively may be mentioned the alterations of feeling in the soles of the feet, owing to which it appears to the patient that he is not walking upon solid ground, but rather upon a soft yielding surface, such as moss, cotton, etc. To these may be added the sensation as of ants crawling over the skin, a feeling of numbness, which usually appears in the lower extremities, but sometimes also in the hands. In the latter case it may become impossible for the person to write, sew, etc., in spite of the fact that he may be suffering from no disturbance of motility whatsoever.

Many anomalies of sensation in tabes can only be discovered by means of objective examination. They constitute the second group of sensory disturbances to which we referred above.

We would here insist upon the necessity of making the examination as carefully as possible, and of remembering in the first place that when the patient is repeatedly examined he ceases to give us his attention and makes careless answers to the inquiries made of him; and in the second place that there are certain sensations, the so-called spontaneous sensations, which the patient experiences without any external irritation whatever. Rosenbach (Deutsche med. Wochenschr., 1889, 13) holds that accumulations of weak sensory stimuli occur, the

intervals between which vary according to the strength of the stimuli and the better or worse condition of the patient. If one remembers this and the fact that the so-called after-sensations must also be taken into account when making the test, one will be able to avoid gross errors. B. Stern (Arch. f. Psych. und Nervenkrankheiten, 1886, xvii, 2) has not been able to confirm the statement of Belmont (Gaz. méd., 1877, 19) that points of predilection exist for the disturbances of sensation in tabetics, as, for example, in the soles of the feet, the areas about the malleoli, and the lower extremities in general. Were it true, it might constitute a new source of error in the examination of the anomalies of sensation. The methods of examination are as simple as possible, and the necessary instruments are an induction apparatus, Weber's æsthesiometer, needles, mounted brushes, and test tubes filled with hot and cold water. With these one is able in most cases to obtain all the necessary information.

Among the symptoms of irritation, hyperæsthesias, as we stated above, are not of very frequent occurrence, but when they do occur they can very easily be recognized. They are frequently quite transient, so that a point, which yesterday was sensitive to the slightest touch, presents to-day a perfectly normal condition. The exaggerated sensitiveness is probably always confined to the perception of pain, but is not found associated with the other qualities of sensation. We recognize another symptom of irritation in the so-called double perception of painful impressions, polyæsthesia (Fischer), by which is meant that from one external irritation, as the prick of a needle, the patient experiences two painful sensations in succession.

In the objective examination of the sensibility the symptoms of paralysis play, without doubt, the more important *rôle*. In the first place there are the anæsthesias, which may affect all qualities of sensation, the sense of pain, touch, and temperature. The most interesting is an analgesia, to which Berger first directed attention, who demonstrated that while the patients reacted normally to slight stimuli, they scarcely did so at all to stronger ones. We must consider it as an anomalous analgesia, when a patient experiences only one kind of pain in response to the most varied kinds of painful stimuli. It sometimes happens that the tabetic can not tell the difference between the action of the thermo-cautery, the simple prick of a needle, or a violent