

Citation:

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Physiology. — "*Cerebellar ataxia as disturbance of the equilibrium-sensation.*" By Dr. D. J. HULSHOFF POL. (Communicated by Prof. C. WINKLER.)

(Communicated in the meeting of Jan. 26, 1918).

In a former paper¹⁾ I explained, that the ataxia which a patient, suffering from tabes, shows, while walking, is nearly quite abolished when he has by means of his hands contact-sensation with the persons walking to his right as well as to his left side.

The reason for this improved walking has to be looked for in the fact, that as long as the affliction resides in the lower part of the spinal cord, it enables him to make use of the equilibrium-sensation of the upper limbs (afferent-propriceptive stimuli), and in this way he can orientate himself better in space.

If this latter happens to be, then all the efferent impulses, necessary for the regulated movements, can run down along the motor paths to the trunk and the lower limbs, through which the ataxia becomes abolished, respectively ameliorated.

I expressed myself thus, that where an ordinary person walks by his eyes and the equilibrium-sensation of the vestibular apparatus, the trunk and the lower limbs, a tabes-patient does it by the equilibrium-sensation of the vestibular apparatus and the rests of that which is still left in the trunk and lower limbs.

If such a person therefore has contact-sensation with people walking alongside of him, he moreover walks by the equilibrium-sensation of the upper limbs.

If one examines, not a tabes-patient, but a sufferer from the vestibular organ, then, as I wrote, such a patient will walk by his eyes, the equilibrium sensation of the trunk and legs and the rests of the equilibrium impulses which are obtained through the vestibular apparatus. If one therefore gives to such a patient contact sensation through persons walking alongside of him, then it also appears that he is enabled to walk normally again or at least nearly normally.

As the ataxia, which both these patients show, are both almost totally abolished through the same influence, viz. contact sensation

¹⁾ Our equilibrium-organ. These Proceedings p. 626.

by means of the upper limbs, I thought I had to accept the involved afferent-proprioceptive impulses in those cases as being of the same sort.

The vestibular apparatus therefore has to be considered, *as far as our walking function is concerned*, as a modified and higher developed organ for the equilibrium-sensation of the head.

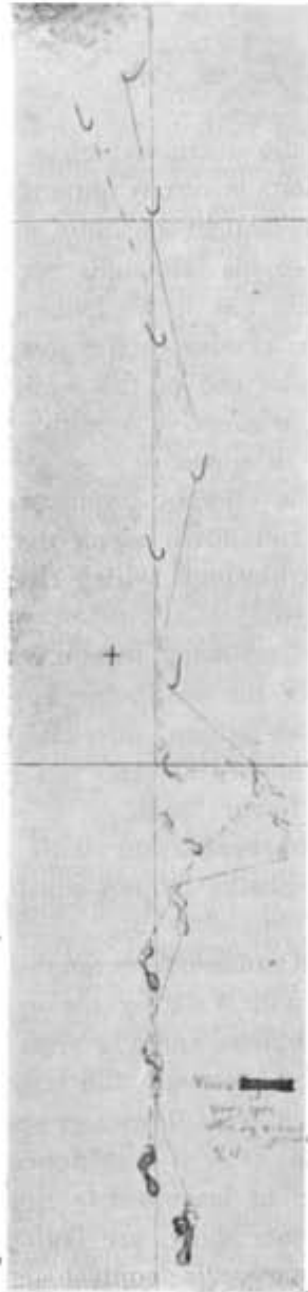


Fig. 1.

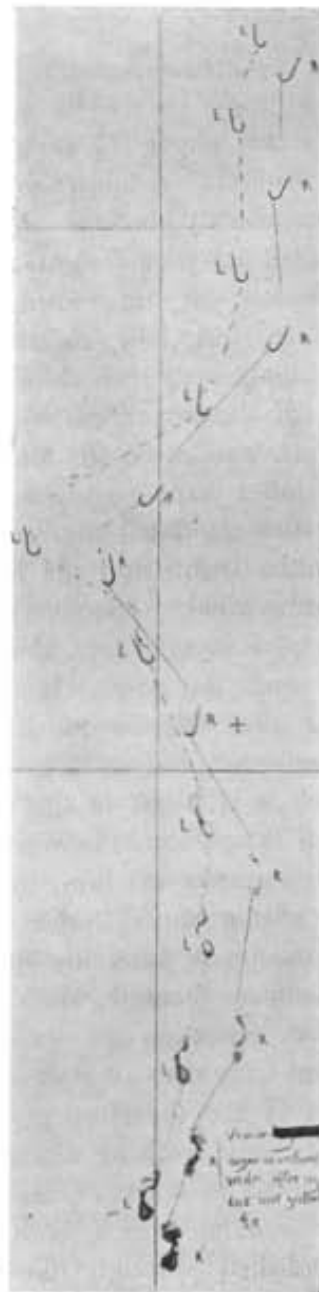


Fig. 2.

It would take me too long in this paper to enter more in particular into this hypothesis; I refer the interested reader to the original communication. The one thing to which I will draw attention, is, that according to this view, considering our equilibrium, there should be made no principal difference between the afferent-proprioceptive stimuli which are conducted from the cerebellar tracts of the lateral column and those from the vestibular apparatus to the cerebellum. All these stimuli are related to the equilibrium-sensation and therefore regulate our gait. These different afferent tracts thus form a whole and they are to be considered as a subdivision of the same equilibrium system.

Now it is important to trace, whether they change, and if so, what alterations these afferent stimuli undergo, when they arrive in the cerebellum.

If, investigating this, one makes patients, suffering from e. g. cerebellar tumors, perform the same walking-tests, as I did with sufferers from tabes or vestibular affliction, then the results prove to be totally the same.

For instance I will report the following case, in which during life the diagnosis was made of a tumor, which was located at the left side, where it pressed as well on the cerebellum as on the nervus octavus. During the operation and also post-mortem the diagnosis could be confirmed.

If one had the patient walk totally unsupported with open eyes, then the part of her gait was obtained as reproduced in fig. 1. The ataxia is distinctly visible. If her eyes were shut, then the path of her gait became as in fig. 2.

When comparing the two the ataxia proves to be considerably augmented. This is comprehensible, because in the latter case the afferent-extero-ceptive stimuli from the eyes are missing. The difference between these two paths of gait results from the influence of the eyes on the performed movements.

It is important to point out once more (see preceding paper) that, when by abnormalities of the static organ a second organ comes to his aid, the latter only can partially replace the deficiencies of the former, if these are of rather severe nature.

This is distinctly visible in fig. 1, because notwithstanding the aid of the eyes, the ataxia however is far from gone.

If we now let such a patient walk quite free with eyes open, but giving her contact sensation through persons next to her, then *although also the neck-equilibrium-impulses are shut out* by means of a bandage, the gait path in fig. 3 is reproduced, in which the

ataxia proves to be totally gone. The equilibrium sensation which is augmented through the contact-sensation of the arms is enabled to compensate all that is missing. What the eyes could not do, the afferent-proprioceptive stimuli of the upper limbs could do. They compensated, thus abolishing the ataxia.



Fig. 3.



Fig. 4.

As one could oppose against this important amelioration that the result had been due for the greater part to the help of the eyes, I repeated the test in precisely the same way, but now with eyes closed. The produced gait path is found in fig. 4. Now too no sign of ataxia is seen. The only deviation is, that the patient walks to the right instead of walking straight on. As this deviation takes place gradually and the gait-path remains straight, the circus gait must be excluded; it seems to me, that in this case one cannot speak of a deviation to the right. It is most probable that the patient did not stand straight in front of the line, but somewhat in oblique direction and therefore walked in that way.

The 4th fig. proves that the contact sensation through the arms is yet able to abolish the ataxia, even if the patient misses the afferent-extero-ceptive impulses from the eyes.

One thus sees here exactly the same phenomenon as with the ataxia in tabes and in vestibular affliction.

Therefore it lies at hand to assume that cerebellar sensory ataxia arises when in the cerebellum the equilibrium paths are being interrupted which from the spinal cord and the nervus octavus pass into it.

This would confirm JELGERSMA's¹⁾ view (pg. 217): "The supposition that the cerebellum is a central place of innervation for both these organs²⁾, is therefore probable."

Should my view be right, then cerebellar sensory ataxia will occur, when the process of the disease arises in those parts of the cerebellum, in which the equilibrium-paths pass.

In connection with the above a few questions arise.

The first is whether the cerebellum exclusively dominates the equilibrium.

This question is answered in negative sense by many investigators, because e.g. experiments on animals have taught that experimentally obtained cerebellar ataxia can totally pass away after a certain time, which proves that the afferent equilibrium impulses can arrive at the cerebrum also along other paths.

The second question is whether the cerebellar ataxia always shows the same image.

Should I, as regards the experiments on animals, confine myself to the well-known investigations of LUCIANI³⁾, then he too made a

¹⁾ JELGERSMA, G. The function of the cerebellum. Psych. Neur. bl. 1915.

²⁾ Meant are: tonus- and equilibrium organ and the deep sensation.

³⁾ LUCIANI, L. Das Kleinhirn. Georg. Thieme. Leipzig 1893.

difference between the ordinary atactive movements and those which were indicated by him as "dysmetria".

When one wishes to see these differences reproduced distinctly I refer to my photographs in my communication on "cerebellar ataxia". Plate VIII, X to XIV ¹⁾.

In man, where the phenomenon cannot be localized as sure as in animal-experiment, a conclusion is drawn with more difficulty. Yet I will quote some writers, who showed that the deviations in gait do not always give the same aspect.

JELGERSMA (l. c. p. 227) e. g. writes that the occurrence of the cerebellar ataxia is due to the fact that the trunk sways over the legs: "a gait, which greatly resembles the walking of drunken men."

He only describes one type of deviation of the gait. OPPENHEIM, however, differentiates in his hand-book two forms of cerebellar ataxia, 1. "auf (Schwindel und) Gleichgewichtsstörung beruhende, "die grosse Aehnlichkeit mit der Gangweise des Betrunkenen "zeigt," and 2. "eine auf Bewegungsataxie beruhende. Patient "geht breitbeinig und stampfend, aber ohne dass ein ubermässiges "Schleudern eintritt. . . . Eine scharfe Unterscheidung dieser Gehstörung "von der spinalataktischen ist wohl nur möglich, wenn sich die unter "1^e beschriebene Abart mit ihr verbindet."

OPPENHEIM therefore thinks the cerebella ataxia e. g. also dependent on the spinal cord.

DÉGÉRINE on the other hand writes in his work "Traité de Pathologie générale" 1901, on page 643 "b. Ataxie labyrinthique. Les affections "de l'oreille interne produisent quelquefois des troubles de la marche "et de l'équilibre, qui ressemblent jusqu'a un certain point aux "désordres de l'ataxie cerebelleuse." DÉGÉRINE points out in this case the connection of the cerebellar ataxia with the phenomena which are found in vestibular disturbances.

Now the question arises to interpret the difference in the atactic aspect.

In my former communication I explained that even although the equilibrium-impulses, originating from the vestibular organ may be considered as to belong to the same which come from the spinal cord, yet there exists a great difference in their results, owing to the higher development of that organ.

The consequence of this is, that according to the afferent equilibrium path suffering more in the one case than in the other, the complex of atactic symptoms will also appear differently.

If the spinal tracts have suffered most, then the type as described

¹⁾ Psych. Neur. Bl. 1909 N^o. 4.

by OPPENHEIM will be found in general, viz. his second form of cerebellar ataxia.

Should the vestibular tract be hurt, then the description of DÉGÉRINE comes right. If there is an interruption of both the paths or if the disturbance of the paths from the right and from the left side commences more or less simultaneously, then perhaps the gait of the drunken man will become more prominent.

If the results of the animal experiment are compared with those found in man, then we may say that the cerebellar ataxia does not always show the same aspect and that this can be explained by the fact, that the cerebellum possesses more than one afferent tract, whose interruption causes disturbance in its course and that according to the suffering of the one or the other or more paths, the aspect will change.

The *third* question is to explain in cerebellar disturbance the fact how the equilibrium sensation of the upper limbs can totally compensate the ataxia, because one may accept that its equilibrium paths, just as those of the lower limbs, pass into the cerebellum and therefore will also be broken off by the process of the illness.

I must acknowledge that I cannot very well give an explanation of this fact, if not the possibility should be accepted of a better connection of the equilibrium sensation of the arms (apart from the cerebellum) with the cerebrum, than is the case with the legs. Later experiments will have to give a decision on this point.

CONCLUSION.

1. By interruption in the cerebellum of afferent cerebellar tracts, originating from the vestibular organ and the tractus spino-cerebellares, ataxia appears.

2. According as these tracts suffer more or less, whether alone, or together, the aspect of the cerebellar ataxia will present a different type.