

*Citation:*

Winkler, C. & London, D.M. van, About the function of the ventral group of nuclei in the thalamus opticus of man, in:

KNAW, Proceedings, 11, 1908-1909, Amsterdam, 1909, pp. 295-302

There are three rests *A*, namely of  
*xyz*, *x56* and *x78*,  
 there are four rests *B*, i. e. of the type of the Cf. (16<sub>3</sub>, 12<sub>4</sub>) of  
 DE VRIES of the composition

<i>B</i> -	1	2	3	4
5	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
6	<i>b</i>	<i>c</i>	<i>d</i>	<i>a</i>
7	<i>c</i>	<i>d</i>	<i>a</i>	<i>b</i>
8	<i>d</i>	<i>a</i>	<i>b</i>	<i>c</i>

These rests appear for *xab*, *xcd*, *x12*, *x34*.

The other rests are of other types.

III, Complement    *xab*, *xcd*, *x12*; *x34*, *x58*, *x67*,  
*yac*, *ybd*, *y13*, *y24*, *y56*, *y78*,  
*zad*, *zbc*, *z14*, *z23*, *z57*, *z68*,  
*xyz*.

Only *xyz* has rest *A*, there are no rests *B*, all other rests are of other types.

Whether by completing other Cf. (16<sub>3</sub>, 12<sub>4</sub>) other systems than the three above-mentioned will appear, remains undecided; at any rate *B* will lead in at least *one* way to II as it appears among its rests.

**Anatomy.** — “*About the function of the ventral group of nuclei in the thalamus opticus of man.*” By Prof. C. WINKLER and Dr. D. M. VAN LONDEN.

The following remarkable case was offered to our observation in the neurological clinical department of the Binnengasthuis.

An unmarried woman, aged seventy-seven, not having suffered previously of any serious illness, and somewhat dull of hearing during the last years, got one single but severe fit of dizziness three weeks before her admittance.

On Jan. 8<sup>th</sup> 1908 she was found in her room unconscious, and transported thence to the Binnengasthuis, on arrival there she was slightly wandering in her mind. This state continued for three days, afterwards she made no complaints either of pain or of paraesthesia. Incontinence never occurred. There was found sclerosis of the arteries and dilatation of the heart. The urine contained  $\frac{1}{4}$  ‰ of albumen and hyaline-cylindres. After three months death ensued caused by

pneumonia. Clinical examination of the different organs of sense in this woman gave the following results:

*Smell and taste* are normal.

*Sight* has diminished on account of a beginning senile cataract, and has on both sides been reduced to  $\frac{1}{24}$ . The fundus oculi is plainly visible and does not show any alterations. There is no restriction of the visual area worth mentioning.

Hearing is very bad during the first time after her admittance. She is almost completely deaf. The whispering voice is not heard on either sides. After three weeks this disturbance is restored so far, that on the left the whispering voice is distinguished to a distance of 3 M. This degree of dullness of hearing continued till her death.

On both sides the tympanic membrane has suffered slight sclerotic degenerations.

The *sensibility* of the body is in all respects normal to the left, *on the contrary to the right it has considerably decreased*, in the following manner:

*the tactile sensibility* is entirely lost in the right hand and foot, in the lower part of arm and leg it has suffered great disturbance, somewhat less in shoulder and hip, and still less in the right half of the trunk, whilst in the right half of the face hardly any disturbance is to be observed. *The difference between the head and the point of a pin* is badly distinguished on the right side, except in the face. The latter disturbance, like that of the tactile sensibility, has its boundaries towards the left in the mid-dorsal and mid-ventral lines of the trunk and is most marked in hand and foot.

The *pain-sensibility* of the skin has likewise diminished to the right. Piercing of the skin is not at all perceived in the extremities, only feebly in the trunk, but almost normally in the face.

On the contrary *pinching* or *squeezing* of the deeper situated portions produces a much sharper perception of pain to the right than to the left. Vehement repelling movements are occasioned by it.

The perceptions of *intense cold* and *intense heat* have suffered great decrease in the right extremities, to a less degree in the right half of the trunk, whilst the disturbance is feeblest in the face.

*Passive movements* communicated to the fingers, the hand, the toes or the foot of the right side, are not perceived at all, however swift and extensive these movements may be. Movements performed with the articulations of the right elbow or knee are perceived badly, for movements with the articulations of the right hip and shoulder the perception is nearly normal. The patient has lost all notion as to the manner in which her right hand and foot are *placed in space*,

as regards the position of knee and elbow her perception is likewise inaccurate but to a less degree. The position of the upper-arm and leg is ascertained with tolerable accuracy. There is complete *astereognosis* of the right hand. Not a single object put into this hand is recognized. The patient does not know whether she has got something in this hand or not. Oftenest she drops it.

All these disturbances of sensibility to the right remained stationary during the three months the woman was under observation.

On the contrary the motility of the right limbs had suffered only slightly. In the week after the lesion she complained of a certain feebleness of the right extremities.

A paralysis however has never been observed. The complaint was a passing one, and the only fact ascertained was that the right shoulder hung somewhat lower than the left one. Rapid as well as subtile movements could be performed with the right extremities, e. g. to count money, or to bring the finger to the top of the nose, were done nearly as well by the right hand as by the left. *Here is only a slight right-sided cerebral ataxy, and there does not exist any vestige of athetosis, or choreic or other involuntary movements.* The dynamometer in the hand reached 50  $\bar{u}$ . on both sides.

The skin reflex-actions, as the abdominal, cremaster- and plantar-reflex-actions, are normal and on both sides equal. The deep reflex-actions, those of the tendo Achillis and of the knee are not increased, there is no clonus of foot or knee. Neither is there a distinct difference of tonus, nor any atrophy in the muscles of the two halves of the body. There have been no disturbances of speech or articulation. As the patient had never learned reading or writing, possible disturbances in reading or writing were not to be stated. Her condition remained unaltered until her death on the 24<sup>th</sup> of March 1908.

The brains, which were kindly put at our disposition from the laboratory of Prof. KUHN, were indurated in formaline for a few days. Thereupon frontal sections of 1 cm. were made through both hemispheres. The *only* degeneration that may be observed macroscopically is a focal destruction in the medial and caudal portions of the left thalamus opticus.

Consequently for the purpose of microscopical examination there was made a series of frontal sections through the left hemisphere, the most proximal sections of these passing through the caudal ends of the frontal convolutions, the temporal pole and the commissura anterior, whilst the most caudal section passes behind the caudal end of the fissura Sylvii, through the caudal border of the gyrus supra-marginalis, the praecuneus and the splenium corporis callosi.

The nucleus caudatus, the nucleus lenticularis, the capsula interna and the frontal end of the thalamus opticus have not suffered any alteration. Neither has the whole of the nucleus anterior. About halfway the sections through the thalamus, the frontal commencement of the focal softening is found, as a small irregular square in the nucleus lateralis (fig. 1). The hearth consist of leucocytes, lying close to one another, in its wall the capillary vessels are found distended and surcharged with blood-cells.

In the following sections the hearth is rapidly expanding (see fig. II). Irregularly shaped, it is situated within the ventral nuclei<sup>1)</sup>, destroys the largest part of the nucleus ventralis *b*, encompasses like this nucleus the "centre médian" of LÜYS, and enters into the ventral nucleus *a* until near the regio subthalamica. The "Gitterschicht", the lamina medullaris externa and the regio subthalamica are untouched by it; consequently both, the lateral medullary mass of the red nucleus and the strata of the lemmiscus, remain free from damage.

In the same region is found a smaller focus, as yet apparently separate, (but in reality connected with the larger hearth) in the principal portion of the nucleus medialis.

A little more caudalward (see fig. III) the hearth attains its largest extension. It is now situated in the ventral nuclei *a*, *b* and *c*, that are almost completely destroyed, it sends a narrow branch into the nucleus medialis, and proceeds straitened wedge-like towards the regio sub-thalamica, where it approaches very closely the radiations of the lemniscus-fibres and intercepts these.

Still more caudalward (see fig. IV) the position of the hearth has become such, that the ventral nucleus *a* is left free, whilst the nuclei *b* and *c* and likewise the posterior nucleus are absorbed by it. The corpus geniculatum mediale forms here likewise part of the hearth (but the radiation from the brachium conjunctivum corporis quadrigemini postici into the nucleus gen. medialis is left uninjured). The hearth continues by a long and narrow branch along the ventral side in the pulvinar thalami optici (see fig. V), ending there.

The corpus geniculatum laterale is no where touched by the hearth. Neither is the so-called "Gitterschicht" of ARNOLD.

From this focus secondary degenerations start into different areas, these degenerations are distinguished partly by the presence of granular cells, partly by the absence of medullated fibres in lighter-coloured areas in preparations after the WEIGERT-PAL method.

In the thalamus, the frontal end of which does not show any degenerative alterations (see fig. I) the posterior part of the medial

<sup>1)</sup> VON MONAKOW's nomenclature of the nuclei Thalami is followed.

principal nucleus has assuredly lost fibres, especially in the portion situated caudal of the hearth. Such is likewise the case with the "Gitterschicht", although it is no where touched directly by the hearth. In the neighbourhood of this latter a great number of the fibres passing the Gitterschicht in their course from the thalamus towards the retro-lenticular portion of the capsula interna, are degenerated. Those degenerated fibres gather into an area, lying close to the "Gitterschicht", an area, which in preparations made after WEIGERT-PAL's method, contrasts with its surroundings by its being light coloured, against the black coloured retro-lenticular portion of capsula. (see fig. IVa)<sup>2</sup>).

Situated at first lateral of the "Gitterschicht" (see fig. IVa), this area may be pursued caudalward (fig. IVa, fig. Va<sub>1</sub>a<sub>2</sub>, fig. VIa<sub>1</sub>a<sub>2</sub>a<sub>3</sub>) and frontalward (fig. IIIa<sub>1</sub>a<sub>2</sub> and fig. IIa<sub>2</sub>). In the caudal sections its ventral boundary is the medullary triangle surrounding the corpus geniculatum externum (*W* in fig. III), expanding thence both in the stratum sagittale externum and in the stratum sagittale internum (see fig. III and fig. IV). In frontal sections this field is situated in the capsula interna, medialward from the caudal ending of the putamen nuclei lenticularis (fig. IIa<sub>2</sub>).

This degenerated area may be followed in three directions:

1<sup>st</sup> in the medullary rays of three temporal convolutions (see fig. I—VIIa<sub>1</sub>) least in the gyrus temporalis I,

2<sup>nd</sup> in the splenium corporis callosi (see fig. VI and VIIa<sub>3</sub>)

3<sup>rd</sup> in the medullary rays of the gyrus supramarginalis and still for a large part in the gyrus centralis posterior (see fig. I—VIIa<sub>2</sub>). When examined in glycerine preparations the medulla of these gyri is thickly interspersed with granular cells.

Summing up the abovetold facts, we find some definite disturbances of perception in an old woman, after a lesion produced by a hearth of degeneration strictly localized within the left thalamus. These disturbances are:

1<sup>st</sup> Temporary deafness on both sides, leaving as its stationary result a certain degree of dullness of hearing on both sides.

2<sup>nd</sup> On the right side a chronic loss of sensibility in all qualities of sense of the skin and the deeper-situated parts, almost complete in the distal ends of the extremities, less marked in the trunk and in the roots of the extremities, unimportant in the face. All this is not accompanied by any choreic movements on that side, whilst there is found only a very slight ataxy to the right.

<sup>2</sup>) In the drawings the areas are represented too light-coloured.

Without any doubt these disturbances are dependent on that hearth.

The loss of hearing is probably connected with the destruction of the corpus geniculatum mediale. This destruction, together with the secondary atrophy towards the temporal radiation (see  $\alpha_1$  in the figures), suffice to explain a certain loss of hearing, according to experiments made by different investigators after very different methods.

It is only to be noted as a remarkable fact that the patient was at first completely deaf on both sides, although the lesion was only at the left side. Remarkable too is the rapid way in which an important amelioration of this deafness set in.

The area of degeneration ( $\alpha_1$  in the figures) does not attain in the first place the medullary cone of the temporal convolution turned towards the fissura Sylvii, but is situated in preference in the two other temporal convolutions. This may be a reason, that she did hear and understood the spoken word.

It is formed by degenerated fibres, arriving thither both from the stratum sagittale externum and from the stratum sagittale internum, as becomes evident especially in the more frontal sections. In the sections made more caudalward, a degenerated fascicle going towards the splenium corporis callosi may also be pursued.

Perhaps these facts may add something to an eventual explanation of the incomplete deafness on both sides after focal disturbances on one side of the brain. But leaving this aside as less important, we desire only to call attention to the chief point of this interesting case.

The *ventral groups of nuclei* in the thalamus opticus, more especially their caudal portions — and these nuclei only, with the exclusion of all others — are found softened in the cerebrum of a person, who during life had lost all sensibility in the distal ends of the crossed extremities without choreic movements, without intensive cortical ataxy on that side, whilst the sensibility remained nearly intact in the face, and had suffered some decrease at the proximal ends of extremities.

Similar strictly defined hearths of degeneration are very rarely found in hemi-anaesthesia, but they contribute important data to the study of the intra-cerebral course of the tracts for the general sensibility.

These tracts are less known by far than the intracerebral course of the tracts for sight and hearing.

Since TÜRK in 1850 by his experimental researches gave the first impulse to the study of the intra-cerebral sensibility tracts, there has appeared an enormous amount of literature on this subject, which has been recapitulated with sufficient accuracy in the dissertation of LONG<sup>1)</sup> (under guidance of DÉJÉRINE). The chief result of this mass

<sup>1)</sup> EDUARD LONG. Les voies centrales de la sensibilité générale. (Étude Anatomoclinique). Thèse de Paris. 1899.

of labour was, that at present it has become nearly generally assumed that the thalamus opticus, amongst other functions, also contributes to provide for the sensibility of the crossed half of the body.

From the side of the school of DÉJÉRINE this opinion has been put forth with marked emphasis in the excellent book of ROUSSY<sup>1)</sup>, who includes the disturbance of sensibility in the crossed half of the body in his "syndrome thalamique."

But not even in this work is treated a hearth localized so exclusively on the thalamus opticus<sup>2)</sup>. The strict localization noted in our case justifies the thesis:

*The caudal portions of the ventral groups of nuclei in the thalamus opticus take a similar part in the central projection of the sensibility of the skin and of the deeper portions in the distal ends of the crossed extremities (less completely of the trunk and of the roots of the extremities, hardly at all of the face) as that taken by the corpus geniculatum mediale in the central projection of the impressions from the cochlea and by the corpus geniculatum laterale in the projection of the impressions from the retina.*

A case, closely resembling the one given here, has been described by VON MONAKOW<sup>3)</sup>. Unfortunately he could not dispose of sufficient clinical data, especially as regards the question whether there had been hemianaesthesia during life. On the other hand he has described with the most careful accuracy the secondary atrophic degenerations, consequent to the loss of the posterior ventral nuclei, these degenerations being nearly the same as in the case related in the foregoing. It appears to us that in this latter case the gyrus centralis posterior receives a greater number of fibres from the atrophic area than in this well-known case of VON MONAKOW, offering nevertheless many striking points of resemblance with it.

It is moreover an important fact that the face remained almost wholly exempt from the loss of sensibility. Perhaps this is somehow connected with the fact that the median principal nucleus and the centre médian remained likewise almost wholly free from the degenerative hearth. For in animals the secondary tracts of the trigeminus have been traced principally to the centre médian (WALLENBERG<sup>4)</sup>)

<sup>1)</sup> GUSTAVE ROUSSY. La couche optique et le syndrome thalamique. Paris, Steinhil. 1907.

<sup>2)</sup> ROUSSY l. c. Compare cas JOSSAUME p. 229.

<sup>3)</sup> C. VON MONAKOW. Zur Anatomie und Physiologie des unteren Scheitelläppchens. Arch. f. Psych. 1899. XXXI S. 1—74. Fall D'auj. Also conf. L. EDINGER, Erkrankung des Thalamus opticus. Bd. XXI. Arch. f. Ps. 1899. S. 657.

<sup>4)</sup> ADOLF WALLENBERG. Secundäre Bahnen aus dem frontalen sensiblen Trigemuskern des Kaninchens. Anat. Anz. XXVI. 1905 S. 145—155.



together with the ventral nucleus, others also believe the medial nucleus to be connected with the N. trigeminus (ARRIENS KAPPERS<sup>1)</sup>); besides animals with a powerfully developed trigeminus (e. g. the mole) possess a large medial nucleus. Consequently in regard to this case the possibility is not to be denied that the medial nucleus may stand in some closer relation to the sensibility of the face than the ventral does.

The above described case represents an almost unique experiment taken by Nature, and it demonstrates, *that isolated destruction of the ventral thalamus-nuclei may be accompanied by loss of all sensible perception in the distal ends of the crossed extremities.*

#### EXPLANATION OF THE FIGURES.

Fig. I—VII, frontal sections through the left hemisphere. Fig. I is a section frontal from the red nucleus, which hits the corp. subthalamicum; the frontal beginning of the hearth. Fig. II through the red nucleus, the retrolenticular portion of the capsula interna here begins. Fig. III through the largest expansion of the hearth, the c. quadr. anterior is sectioned. Fig. IV through the corpora geniculata and pulvinar thalami. Fig. V the caudal end of the hearth in the pulvinar thalami.

In all sections *a.* indicates the area of degeneration in the retro-lenticular portion of the capsula interna, situated lateral from the Gitterschicht,  $a_1 a_1$  the portion of the degenerative field towards the temporal radiation,  $a_2 a_2$  the radiation towards the gyrus supramarginalis and towards the gyrus centralis posterior,  $a_3 a_3$  the radiation towards the corpus callosum.

Fig. VI, the section through the splenium corp. callosi. The degenerative areas.

Fig. VII, through the splenium corp. callosi and the tapetum.

In all figures the signification of the letters employed is as follows:

cap. n. c. = caput nuclei caudati, caud. n. c. = cauda nuclei caudati, c. c. = corpus callosum, c. f. = columna fornicis, f. f. = fimbria fornicis, f. c. = fissura centralis, f. i. p. = fissura interparietalis, f. p. c. = fissura postcentralis; f. S. = fissura Sylvii, r. a. f. S. = ramus ascendens fissurae Sylvii, G. C. a. = gyrus centralis anterior, G. C. p. = Gyrus centralis posterior, G. s. M. = Gyrus supramarginalis, G. L. = gyrus lingualis, G. F. = gyrus fornicatus, G. H. = gyrus hippocampi, G. P.<sub>1</sub> = gyrus parietalis superior, G. Para C. = gyrus paracentralis, G. Pr = gyrus praecuneus, G. O. T. = gyrus occipito-temporalis, GT<sub>1</sub>, GT<sub>2</sub>, GT<sub>3</sub> = gyri temporales, l. m. c. = lamina medullaris externa thalami, l. m. i. = lamina medullaris interna, p. p. = pes pedunculi, pulv. = pulvinar thalami, n. ant. = nucleus anterior thalami, n. med. = nucleus medialis thalami, n. lat. = nucleus lateralis thalami, n. ventr. (a. b. c.) = nucleus ventralis thalami (a. b. c.), Gitt. = Gitterschicht, n. c. = nucleus caudatus, n. l. = nucleus lenticularis, N. R. = nucleus ruber, m. d. N. R. = medulla dorsalis nuclei rubri, s. n. = substantia nigra, c. L. = corpus subthalamicum, c. m. L. = centre median Luys, spl. c. c. = splenium corporis callosi, s. s. ext. = stratum sagittale externum, s. s. int. = stratum sagittale internum (radiation of GRATIOLET), str. t. = stria terminalis, tap. = tapetum, W. = stratum medullare corporis geniculati lateralis (WERNICKE's triangular area), c. g. l. = corpus geniculatum laterale, c. g. i. = corpus geniculatum mediale.

<sup>1)</sup> C. A. ARRIENS KAPPERS. Weitere Mitteilungen über die Phylognese des Corp. striatum und des Thalamus. Anat. Anz. 1908. Bd. XXXIII. No. 13 und 14, S. 321.

