

Nous avons observé encore un phénomène intéressant après l'injection de bulbo-capnine : l'hyperacousie prononcée chez le chat décérébellé complètement. On se demande si le cervelet n'aurait point un effet inhibiteur sur le système auditif étant donné que ce phénomène n'apparaît point chez un chat normal après l'injection de bulbo-capnine.

De l'expérience avec l'extirpation partielle du cervelet, on observe qu'on peut mettre en évidence par la bulbo-capnine des troubles latents de tonus ainsi que l'ont prouvé pour la première fois SPIEGEL et KRISCH pour les lésions de l'écorce cérébrale.

Nous tenons à relever encore un symptôme : L'apparition de la catalepsie suit toujours la disparition des réflexes de redressement.

On peut donc conclure que le cervelet n'est point nécessaire pour la réalisation de la catalepsie et des symptômes organovégétatifs (salivation, etc. ...) obtenue par l'injection de bulbo-capnine et de mescaline, de même que pour la réalisation des hyperkinésies de la mescaline.

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**Neurology.** — *Disturbances of Body Righting Reflexes Following Unilateral Lesions of the Nuclei of Goll and Burdach in Rabbits.* From the Pharmacological Institute of Utrecht (Prof. BYLSMA) and the Neurological Institute of the University of Amsterdam (Prof. B. BROUWER). By Dr. H. HONDELINK (Utrecht) and Dr. J. N. PETERSEN (Travelling Neurological Fellow, McGill University, Montreal, Canada). (Communicated by Dr. A. DE KLEYN.)

(Communicated at the meeting of May 27, 1933).

In a former publication <sup>1)</sup> the results were presented of an investigation in rabbits following unilateral destruction of the nuclei of GOLL and BURDACH by means of needle pricks. While the different vestibular reflexes were all normal the righting reflexes, arising in the body wall and acting on the trunk and limbs, appeared to be weaker or absent on the opposite side. In harmony with this it was found that the application of a solution of cocaine to the surface of the nuclei on one side temporarily abolished these body righting reflexes on the opposite side. Furthermore, if a solution of strychnine was applied to the surface of the nuclei of GOLL and BURDACH, after the method of DUSSE de BARENNE, while the animal was in deep narcosis it was observed that, as narcosis passed off, the righting reflexes arising in the body wall appeared first on the side opposite to the application.

It was concluded from these investigations that the nuclei of GOLL

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<sup>1)</sup> HONDELINK H. and DE KLEYN A. Proc. Koninklijke Akademie van Wetenschappen te Amsterdam 1930, Vol. XXXIII, N<sup>o</sup>. 10, p. 1094.

and BURDACH had some influence over the "body righting reflexes acting on the body" (MAGNUS) of the opposite side, so that on destruction of these nuclei the reflexes disappeared and on stimulation they were increased in intensity.

In order to explain these unexpected results anatomically the nuclei of GOLL and BURDACH were destroyed on one side in two rabbits by one of us (HONDELINK). After verifying the clinical results anatomical studies were carried out by the other. At the same time in a third animal a lesion was made on the left side, caudal to the nuclei of GOLL and BURDACH, and physiological and anatomical investigations were carried out as on the other two. In all three cases serial sections were made and stained alternately by the WEIGERT-PAL and VAN GIESON methods.

Case H 70, B 569. On November 12<sup>th</sup> 1931, under ether narcosis, an opening was made in the membrana atlanto-occipitalis and the left nuclei of GOLL and BURDACH were destroyed by needle pricks. Several examinations in December 1931 and January, February and March 1932 always gave the same results. The last examination was made on March 24<sup>th</sup> 1932. The vestibular reflexes were all normal but during the last month there was a flexion of the head to the left shoulder. Probably it was caused by an otitis media which was found at autopsy. At all times the body righting reflexes acting on the body were absent on the right side and present on the left. That the turning of the head to the shoulder was not responsible for this was clear, in as much as the body righting reflexes were always the same, following the operation, whereas the head turning existed only during the last month. The rabbit was killed on March 24<sup>th</sup> 1932.

The lesion was situated on the left side and the greatest destruction was shown at the level of the nuclei of nerves X and XII and of the most distal end of the cerebellum. It extended downwards for a distance of about 1 mm. to the level of the nuclei of nerves XI and XII and upwards for about half that distance, to the most distal part of the dorsal nucleus of nerve VIII; it became gradually smaller in each direction. At the level of maximum destruction (Figure 1) it was wedge shaped with the apex directed inwards. The base of the wedge or triangle extended from the nucleus corporis restiforme to the nucleus of nerve X, the sides reached inwards along the base of the substantia gelatinosa and through the lateral part of the formatio reticularis, the apex being situated at the dorsal extremity of the tractus rubro-spinalis. This area showed complete destruction of the following structures: the fasciculi and nuclei GOLL and BURDACH, the nucleus VON MONAKOW, the fasciculus solitarius, its nucleus and the nucleus parasolitarius, the radix descendens of nerve VIII, the medial two-thirds of the area ovalis corporis restiforme, the fibrae arcuatae internae and the lateral periphery of the fibrae arcuatae intermediae, the fibres of nerve X to the radix spinalis of nerve V and the

dorsomedial tip of the latter and the dorso-lateral part of the formatio reticularis. The nucleus corporis restiforme was largely replaced by glia cells, the magnocellular nucleus of nerve X contained fewer and paler cells on the left side than on the right and there was a direct extension of glial reaction into the dorsal surface of the parvocellular nucleus on the left. There was meningeal and glial reaction around the lesion but no blood in the fourth ventricle.

Proceeding upwards from the maximum extent of the lesion there was a gradual return of myelinization. At its highest level the primary degeneration was confined to the lateral quarter of the triangle bordering on the substantia gelatinosa and extending inwards as far as the dorsal extremity of the tractus rubro-spinalis. The remainder of the triangle, medial to this area of primary degeneration, manifested secondary degeneration. The glial infiltration spread into the caudal portion of the dorsal nucleus of nerve VIII. In addition there was secondary degeneration of some of the crossed fibres of the medial lemniscus on the right side.

Above the highest level of the primary lesion itself, for a short distance, there was slight degeneration between the portio interna and the area ovalis corporis restiforme on the left side and there was glial proliferation in the same region. These disappeared at the oral limit of the nucleus of nerve X. The degeneration in the right medial lemniscus involved only a minority of its fibres and, above the decussation of the corpus trapezoides, was limited to the ventro-lateral quarter of the lemniscus. Opposite the caudal end of the posterior colliculi it began to get markedly less and it disappeared about the oral level of the posterior colliculi. No degeneration was found above this level.

Proceeding downwards from its area of maximum destruction to its lowest level the primary lesion became gradually smaller until finally it involved only the lateral half of the fasciculus BURDACH; the structures surrounding it showed secondary degeneration which gradually became less. Nerve cells were present at this level in the nuclei of GOLL, BURDACH and VON MONAKOW in which also there was a great increase in glia cells. Below the lesion itself there was descending degeneration at the junction of the fasciculus BURDACH and the radix spinalis of nerve V. At higher levels the lateral half of the fasciculus BURDACH was involved in this but, below the last section in which the inferior olives were cut, the degeneration was restricted to the area first mentioned. It tended perhaps to get less, it was always slight in amount but it persisted throughout the sections cut and was present in the last one at the level of the decussation of the pyramids and the origin of cervical nerve I. Below the lesion the cells of the nucleus of nerve XI were a little fewer and paler on the left side. The glial reaction and meningeal thickening gradually became less but could be followed into the last sections cut.

Case H 69, B 570. On November 12<sup>th</sup> 1931, under ether narcosis, an

opening was made in the membrana atlanto-occipitalis and the left nuclei of GOLL and BURDACH were destroyed by needle pricks. Afterwards at several examinations during November and December 1931 and January, February and March 1932 and for the last time on March 24<sup>th</sup> 1932 the vestibular reflexes were all normal and the body righting reflexes acting on the body were normal on the right as well as on the left side. The rabbit was killed on March 24<sup>th</sup> 1932.

The primary lesion in this case was smaller and more caudal than that in the last. It extended from just below the inferior olives up to the distal end of the cerebellum and showed its greatest destruction at the distal end of the inferior olives. At this level (Figure 2) the lesion formed a triangle the base of which was on the dorsal surface, extending from the lateral border of the fasciculus BURDACH to the medial border of the fasciculus and nucleus GOLL on the left side. The sides extended inwards in the formatio reticularis along the base of the substantia gelatinosa as far as the ventral border of the latter. The medial angle of the base contained some secondarily degenerated fibres of the fasciculus GOLL and the apex contained secondarily degenerated fibres of the formatio reticularis. The primary degeneration of the lesion itself involved the fasciculi and nuclei GOLL and BURDACH, the nucleus VON MONAKOW, the fasciculus solitarius and its nucleus, the dorso-medial tip of the radix spinalis of nerve V and of the substantia gelatinosa, the radix descendens of nerve VIII, the fibres from the nucleus of nerve XI to the radix spinalis of nerve V and the lateral part of the fibrae arcuatae internae. In some places there was degeneration of some of the fine fibres of the nucleus of nerve XI and in a few sections the apex of the triangle manifested primary degeneration. Glial infiltration surrounded the lesion and there was marked meningeal thickening but no blood in the fourth ventricle nor central canal.

At its highest level the primary lesion was confined to the medial part of the fasciculus GOLL and to an area in the formatio reticularis between the fasciculus solitarius and the nucleus of nerve XII. The remainder of the structures in the above described triangle and the corpus restiforme, except its very lateral corner, showed secondary degeneration of different intensities. From here secondary degeneration could be followed upwards in the fibres of the nuclei of GOLL, BURDACH and VON MONAKOW and in the crossed medial lemniscus on the right side. In the last structure it involved a minority of the fibres and could be traced upwards only to the proximal end of the inferior olives. There was secondary degeneration also in the fibres in and about the nucleus corporis restiforme, the cells of which were well developed. This degeneration became gradually less until finally it was confined to a very small area at the dorso-lateral border of the portio interna. It could be traced to within a short distance of the tuberculum acusticum above which no further degeneration could be found.

Descending degeneration could be traced downwards from the lowest

level of the primary lesion in exactly the same area as that described in the preceding case.

Case H 61, B 552. On May 5<sup>th</sup> 1931, under ether narcosis, the membrana atlanto-occipitalis was opened and, caudal to the nuclei of GOLL and BURDACH, the spinal cord was destroyed on the left side by needle pricks. Afterwards the body righting reflexes acting on the body were negative on the left side and positive on the right. Repeated examinations always verified these findings. The last examination was made on February 4<sup>th</sup> 1932 when the vestibular reflexes were normal and symmetrical, the body righting reflexes acting on the body absent on the left side and present on the right. The rabbit was killed on February 2<sup>nd</sup> 1932.

At the level of pyramidal decussation and the distal extremity of the nuclei of GOLL the entire lateral half of the left side of the myelencephalon was destroyed. In WEIGERT-PAL sections practically nothing remained of the involved structures (Figures 3) while the VAN GIESON method showed that they were surrounded by dense scarring and replaced by massive glial proliferation. This primary degeneration involved the radix spinalis of nerve V and its nucleus, the substantia gelatinosa, the lateral third of the fasciculus BURDACH, the tractus rubro-spinalis, the tractus spino-cerebellaris dorsalis and ventralis, the tractus spino-thalamicus, the fibrae pyramidales but not the decussation, the lateral two-thirds of the tractus DEITERS descendens and the lateral part of the formatio reticularis. In addition there was secondary degeneration extending into the center of the fasciculi GOLL and BURDACH and of the formatio reticularis adjoining the primary lesion itself.

Following the cord downwards there was a gradual restitution to normal outline. At the distal end of the pyramidal decussation the form was re-established, though faintly, and all the reformed structures showed marked secondary degeneration. This degeneration involved the lateral half of the fasciculus BURDACH, the radix spinalis of nerve V, the lateral white funiculus and, to a much less extent, the substantia gelatinosa and formatio reticularis. In the lateral white funiculus the degeneration was most intense in a curved vertical band with its concavity inwards, half as wide as the funiculus and occupying its middle part. The degree of myelination gradually improved but least of all in the radix spinalis of nerve V, which continued to show marked degeneration, and in an area of the lateral funiculus bordering on the substantia gelatinosa and involving the middle third of the dorsal surface of the former (Figure 4). Throughout the remainder of the funiculus recovery was rapid and in the last few sections cut, just below the lowest level of pyramidal decussation, degeneration was restricted to the area bordering on the substantia gelatinosa as described. In all these sections the left half of the cord was smaller than the right.

H. HONDELINK and J. N. PETERSEN: DISTURBANCES OF BODY RIGHTING REFLEXES FOLLOWING UNILATERAL LESIONS OF THE NUCLEI OF GOLL AND BURDACH IN RABBITS.

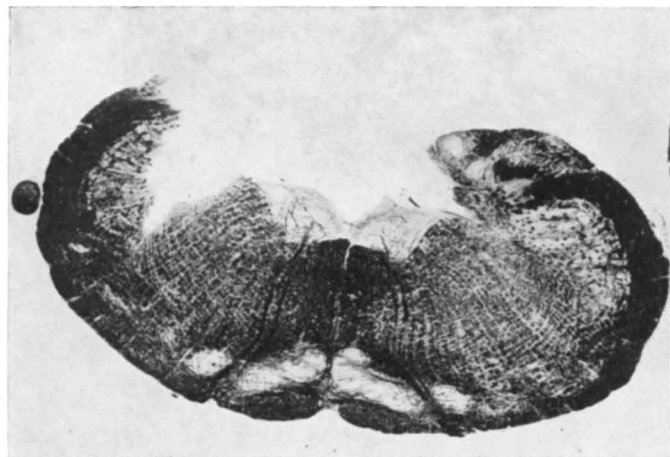


Fig. 1. The lesion in the first case (WEIGERT-PAL).

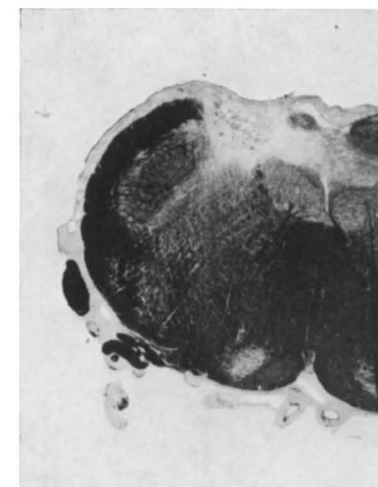


Fig. 2. The lesion in the second case (WEIGERT-PAL).

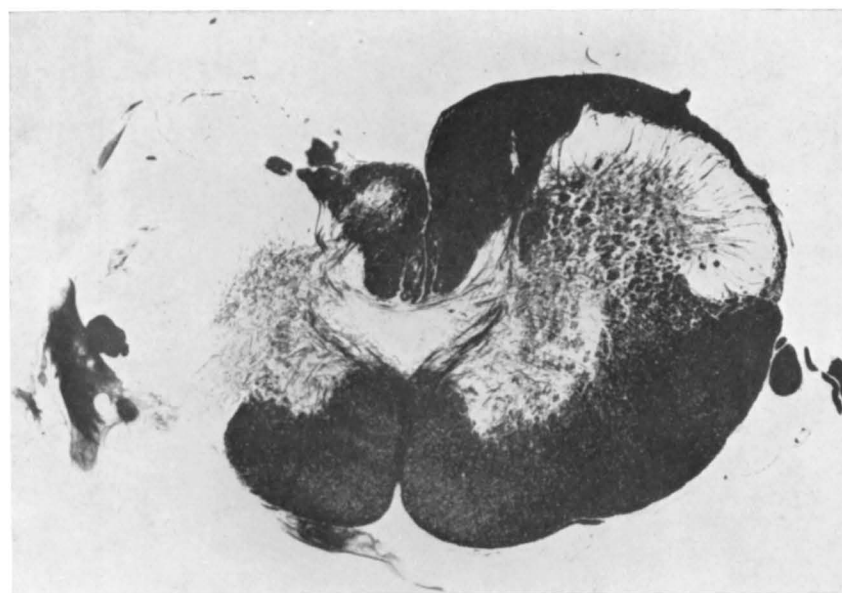


Fig. 3. The lesion in the third case (WEIGERT-PAL).

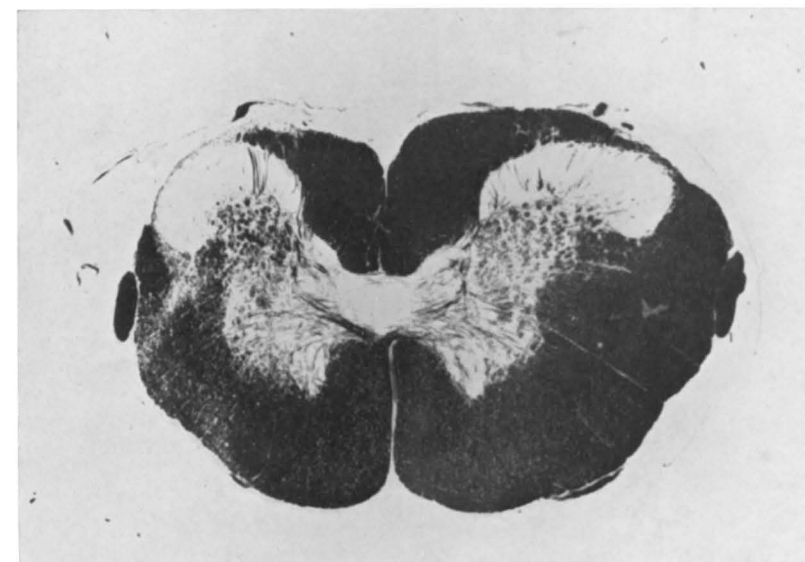


Fig. 4. The descending degeneration in the third case (WEIGERT-PAL).

Proceeding upwards from the maximum extent of the lesion retrograde degeneration could be followed for a short distance in the radix spinalis of nerve V, the substantia gelatinosa, the tractus rubro-spinalis and the tractus DEITERS descendens but all these structures were normal at the caudal level of the inferior olives. Primary degeneration of the lesion itself could be followed upwards as a shallow, but fairly wide, line of cleavage between the fasciculus BURDACH and the radix spinalis of nerve V. There was also secondary degeneration of the lateral and ventral two-thirds of the fasciculus BURDACH but not of the nuclei GOLL and BURDACH, the fibrae arcuatae internae nor the medial lemniscus. Secondary degeneration could be followed likewise in the medial part of the area ovalis corporis restiforme and in the fibres terminating in the nucleus corporis restiforme, the cells of which were normal. The degeneration in the tractus spinocerebellaris ventralis was followed upwards to a level between the nucleus of nerve VII and the superior olives.

The physiological observations and conclusions reported here are those of the senior author while the anatomical studies and conclusions are those of the junior author. These new experiments seem to have verified the conclusions of the previous publication referred to and to have adduced further physiological evidence to the effect that, in rabbits, the nuclei of GOLL and BURDACH on one side exert an influence over the "body righting reflex acting on the body" of the opposite side. The anatomical examination showed that in the first two cases described, among other structures, the nuclei of GOLL and BURDACH were destroyed on the left side and ascending degeneration could be followed in the right medial lemniscus. Consequently the anatomical study has not explained the physiological differences noted between these, beyond the fact that the lesion in the second case was smaller and more caudal than that in the first. In the third case the disappearance of the reflex on the homolateral side cannot be ascribed to a centripetal effect alone, as many pathways in the lateral column of the spinal cord, both centripetal and centrifugal, were destroyed.

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**Physics.** — *On the influence of electric fields on the absorption spectrum of potassium* <sup>1)</sup>. By C. J. BAKKER. (Communicated by Prof. P. ZEEMAN).

(Communicated at the meeting of May 27, 1933).

1. *Introduction.* The method of the investigation of the absorption has been applied by various authors, with great accuracy, to the investigation of the inverse quadratic STARK-effect, especially of the alkalis.

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<sup>1)</sup> Cf. the paper by SEGRÉ and WICK in this same number of the Proceedings. It ought to have been inserted after the present communication.