THE

JOURNAL OF MENTAL SCIENCE

[*Published by Authority of the Medico-Psychological Association of Great Britain and Ireland.*]

No. 206 [NEW SERIES No. 170.] JULY, 1903. VOL. XLIX.

Part I.—Original Articles.

The Changes in the Nervous System in a Case of Porencephaly.

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ALTHOUGH much has been written upon porencephaly, yet detailed descriptions of the resulting alterations in the constituent neurons of the cerebro-spinal axis are few in number. As a further contribution in this direction the present case has been studied, and the changes found have been recorded as far as possible graphically. No attempt has been made to collect together the literature, largely clinical, of porencephaly, as it has been felt that this cannot be profitably done until the minute anatomy of the central nervous system has been placed on record in a much larger number of cases than is at present available.(1)

Clinical Account.

Patient is described as being healthy-looking at birth, and delivery is believed not to have been difficult. He remained healthy up to the age of eleven or twelve months, when he had fits, to which his present condition is attributed. Subsequently to the onset of the fits patient's altered physical state mani-

fested itself. No history of any injury at the time of commencement of the fits is obtainable. Patient is not known to have had any illness at this time or subsequently. The fits persisted, and he became an idiot.

When grown up his facial expression was indicative of defective intelligence. He was unable to speak, though he made inarticulate noises, nor could he walk. He was, however, able to waddle about the floor with the aid of the left upper limb. At thirty years of age patient was admitted to the West Riding Asylum. He was then (Fig. 1) of fair height and general development, and moderately well nourished. The head was asymmetrical, the skull being flattened on the right side. The right upper limb was of defective development, the muscles being wasted and the movements of the forearm, hand, and fingers very limited in range; the fingers of this hand could be partly straightened voluntarily. The left upper limb could be moved without difficulty, and appeared unaffected. The lower limbs were both equally wasted, the legs being slightly flexed at the knees, and the feet exhibiting talipes valgus.

Patient had typical epileptic fits. The pupils reacted to light. Internal strabismus was present. The movements of the facial muscles were not defective. Further details respecting the condition of the nervous system are not obtainable. By careful attention patient could be kept clean. The principal visceral lesions were mitral and aortic disease, with left-sided cardiac hypertrophy, and, at the time of death, thirty-two months after admission, left pleuritis.

Patient's father died at seventy-five years of age, and patient's mother at seventy, death in each case being attributed to old age. One brother died at forty-two, cause unknown. A second brother, aged forty-three, is in an asylum suffering from melancholia; he has also mitral disease. Another brother has œdema of the legs, recurring at intervals. Yet another brother has swelling of the joints of the hands. The remaining brother is in good health.

Condition of the Body at the Autopsy.

Body emaciated (Fig. 1). The head was asymmetrical, being flattened on the left side, and was small compared

with the face, which was also asymmetrical in correspondence with the asymmetry of the head. The right eye was turned inwards. On the left side of the neck near the angle of the jaw were several old scars, apparently caused by strumous

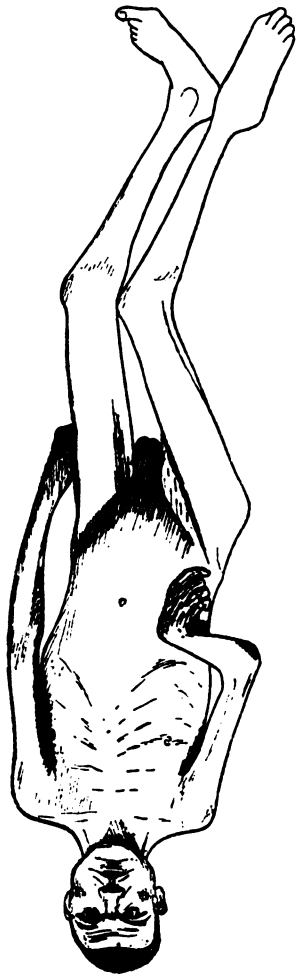

FIG. 1.

The patient (who was unable to stand) is here represented at full length. The flattening of the skull on the left side is noticeable, as is also the internal strabismus. The face is asymmetrical in accordance with the deformity of the skull. The right upper limb is flexed at the elbow, wrist, and finger-joints, the flexion being accompanied by contracture at these joints; a limited range of movement being still left, however. The muscles of this limb are more wasted than those of its fellow, the difference being especially marked in the forearm and hand. The left upper extremity exhibits no contracture, and could be freely moved. The lower limbs are both about equally affected. There is flexion at the hips and knees, and extension at the ankle-joints. There is extreme wasting of the muscles of the legs, less so of the thigh muscles. With the above exceptions the general bodily development is up to the average.

lymphatic glands. There was disproportionate wasting of the muscles of the right upper limb (including the scapular muscles), which was flexed at the elbow, wrist, and finger-joints. The lower limbs were equally wasted, the wasting being especially conspicuous in the legs and feet; the knees

were moderately flexed, and talipes valgus was present, more marked on the right side than the left. The limbs were flaccid at the time of the autopsy, and exhibited only a limited range of movement at the right elbow and wrist, and at the knees and ankles. Rotatory lateral curvature was present, the upper dorsal vertebræ forming a curve convex to the left. Old scars were found over the back of the right elbow. With the exception of the defective formation of the skull, the right upper limb, and both lower limbs, the general bodily development was fairly good.

The skull was asymmetrical, corresponding in its left-sided flattening to the contour of the head. The skull-cap was thick but not dense, and exhibited no local thickening or thinning opposite the area of defect about to be described. Basal fossæ unaltered in appearance. The dura mater, which was not thickened or unduly adherent to the skull-cap, exhibited a very thin blood-stained pellicle on its inner surface over the vertex on the left side. The pia arachnoid was opaque and thickened both at vertex and base, and was somewhat congested. The subarachnoid space contained much clear fluid.

The brain (1100 g.) exhibited a moderate degree of general wasting of the cerebral convolutions, more marked at the vertex than at the base, and attended with corresponding widening of the sulci, not, however, extreme in degree. The right hemisphere was larger than the left (Figs. 2, 3, 4 A, 4 B, 4 C, 4 D). Nevertheless the convolutions generally were of nearly equal size on the two sides, being somewhat smaller on the under surface of the left temporal lobe, but elsewhere exhibiting no very marked general diminution in size on the left side. There was, however, on the left side a defect in the brain mantle (Fig. 2) in the situation of the operculum, the island of Reil, and the superior temporal convolution, which latter was destroyed except at its anterior extremity, while a relic of its white substance still remained visible (Fig. 4 B). This area of defect was occupied by the loose tissue of the pia arachnoid, the meshes of which were filled with fluid, so that no depression was visible on the surface. Its floor was formed, as Figs. 4 A, 4 B, 4 C, and 4 D show, chiefly by the remains of the white matter, though at the edge grey matter is also present. It is evident that the small size of the left hemisphere is partly if not largely due to the rest of the nervous substance

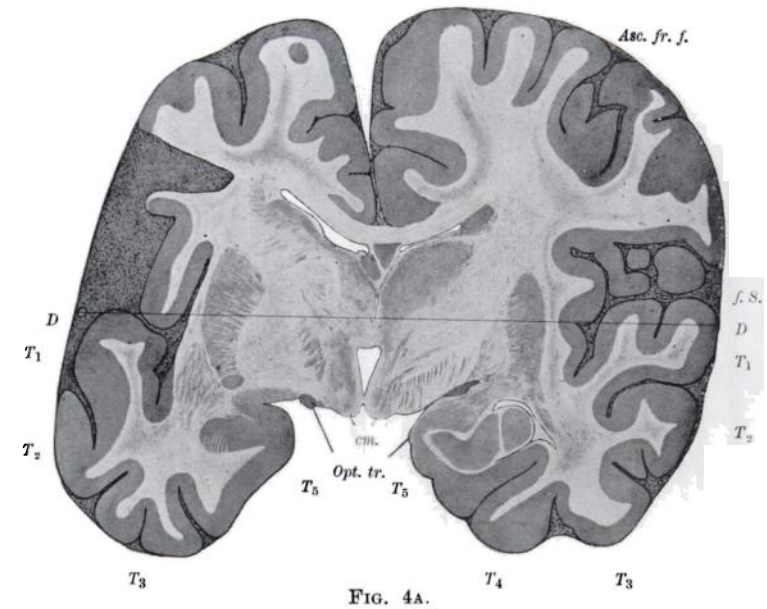

FIG. 4A.

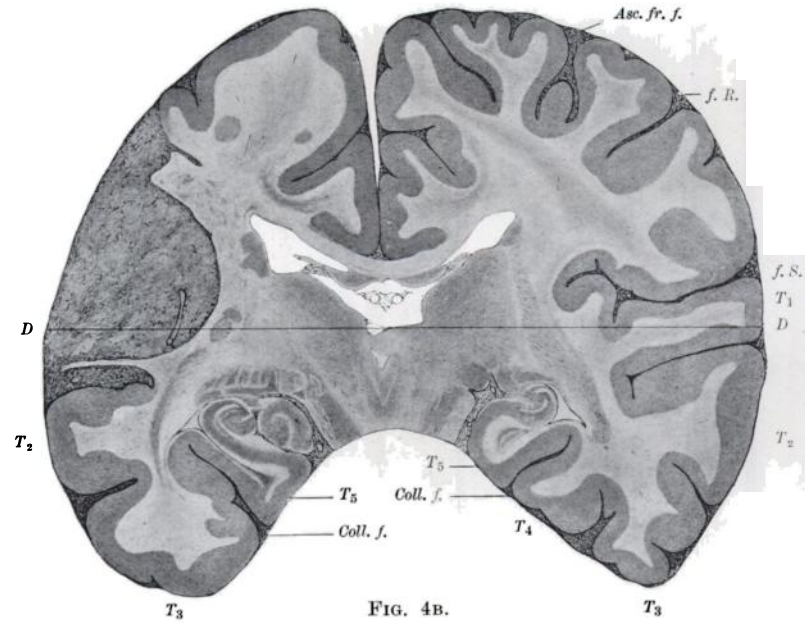

FIG. 4B.

To illustrate Dr. WAKELIN BARRATT'S paper.

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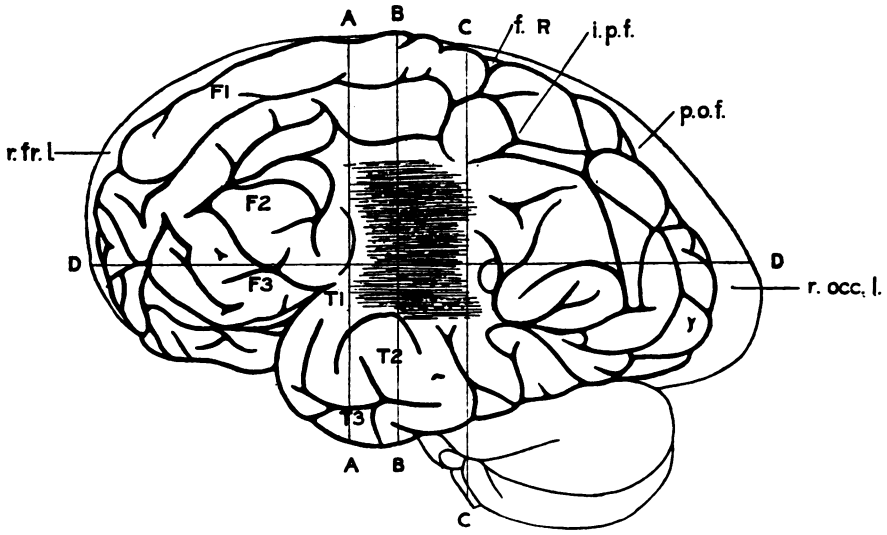
of this hemisphere closing upon the area of cortical destruction (cf. Fig. 4 D, in which the third right frontal gyrus is seen to be extending much farther backwards than is usual in the normal condition), the actual limits of which must have been greater than was at first sight indicated by the brain at the time of the autopsy.

An examination of the brain after hardening showed that

FIG. 2.

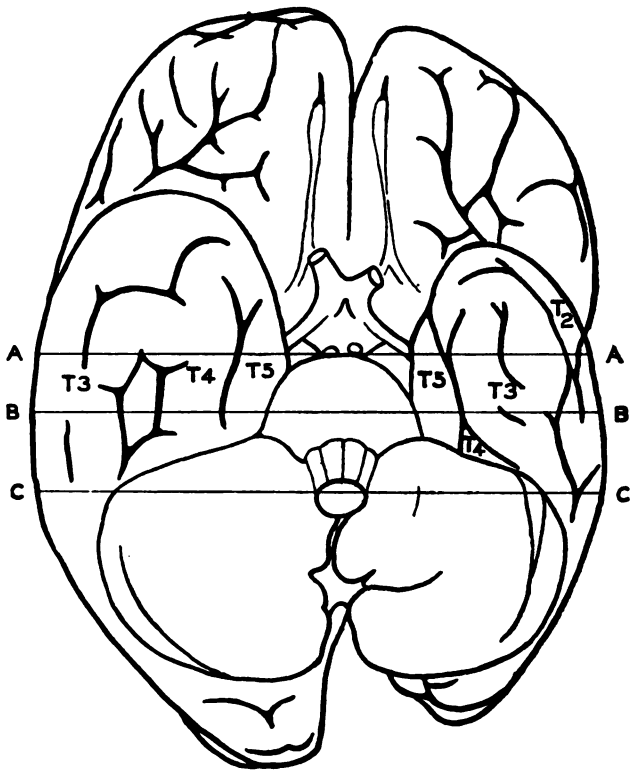


The brain seen from the left side. The left hemisphere is smaller than the right, but its convolutions are in general of good size. In the situation of the operculum and of the greater portion of the first temporal convolution, T1, is an area, indicated by shading, from which the cerebral cortex has disappeared. This area is occupied by the very loose connective tissue of the pia arachnoid, the meshes of which contain fluid. There is no depression on the surface of the brain. The fissure of Rolando and the intra-parietal fissure are represented by *f.* R. and *i. p. f.* respectively. F1, F2, F3; first, second, and third frontal convolutions. T2, T3; second and third temporal convolutions. *R. fr. l.*, right frontal lobe. *R. occ. l.*, right occipital lobe. A A, B B, and C C represent, in this and the succeeding figure, the planes in which the sections shown in Figs. 4 A, 4 B, 4 C respectively lie. D D is the plane in which the section exhibited in 4 D is made. One half the natural size.

the island of Reil had largely if not wholly disappeared on the left side, and that the left claustrum and external capsule were of diminished extent. The left lenticular nucleus was slightly smaller than the right, but the difference was not striking. The caudate nuclei were of equal size. The left optic thalamus

was, however, much smaller than its fellow. This is shown in Figs. 4 B, 4 C; to avoid, however, risk of error arising from possible obliquity of the sections, a horizontal section was made through the middle of the thalami (Fig. 4 D), and the atrophy

FIG. 3.



The brain seen from below. The smaller size of the left cerebral hemisphere, as compared with the right, is much more striking in this than in the preceding figure. The right frontal lobe is slightly bent over to the left. The optic chiasma is also markedly deflected to this side. Notwithstanding the small dimensions of the left hemisphere, its gyri generally are of fair size. The lateral hemispheres of the cerebellum are equal in size. Some asymmetry is, however, visible, the left tonsil projecting to the right (cf. Fig. 5). T 4, T 5, fourth and fifth temporal convolutions. The other letters are as in the preceding figure. Slightly more than one half the natural size.

on the left side conclusively exhibited. The white matter forming the floor of the area of defect on the left side was mottled in aspect. Elsewhere, as the figures show, the white

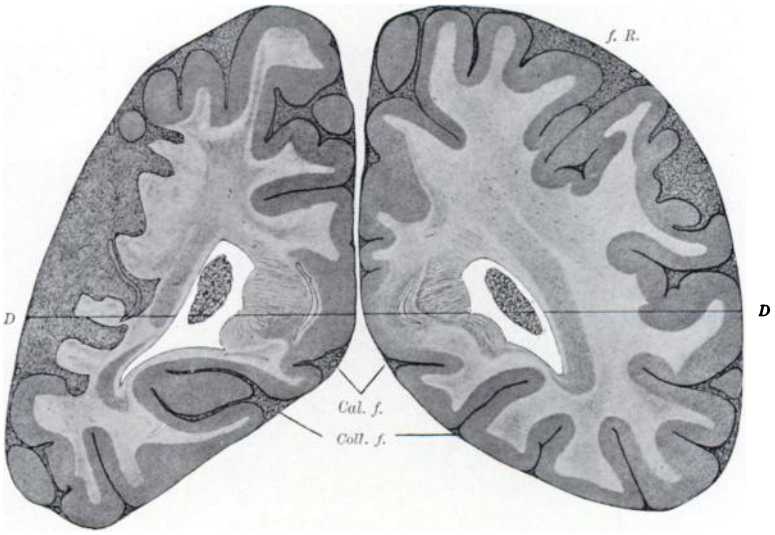


FIG. 4C.

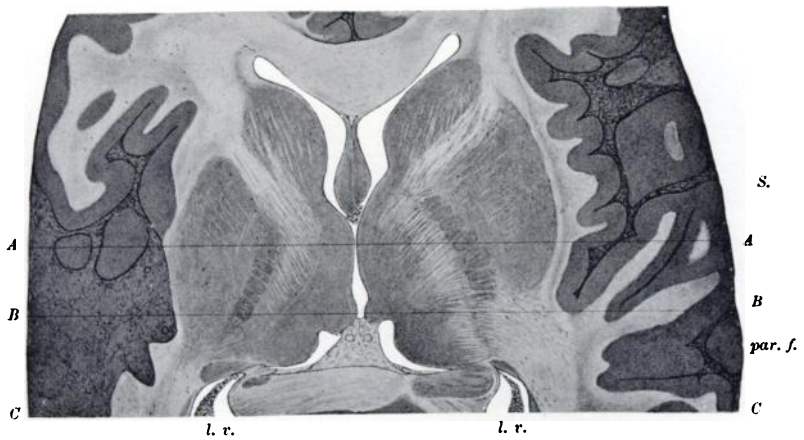


FIG. 4D.

To illustrate Dr. WAKELIN BARRATT's paper.

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was little altered on the two sides. The internal capsule (Fig. 4 D) exhibited in its anterior limb no marked change on the left side. The genu and anterior end of the posterior limb were indistinct on the left side, and the rest of the left posterior limb was much smaller than the corresponding portion of the right internal capsule. The temporo-occipital and thalamo-occipital relations taken together exhibit a diminution in size on the left side (Figs. 4 B, 4 C).

The ventricular cavity of the cerebrum was moderately dilated. Though some asymmetry was present, the lateral ventricles were very nearly of the same size. The choroid plexuses were large. The ependyma was everywhere smooth.

Viewed from below, the difference in size of the two hemispheres was striking. The optic chiasma was bent over to the left. The cranial nerves were all of natural aspect, and equal in size on the two sides. The strabismus from which the patient suffered was not attributable to a lesion involving the third, fourth, or sixth cranial nerves. The mesencephalon shows an atrophy of the left crus. Otherwise the mid-brain is unaffected in its naked-eye aspect.

The cerebellum was well developed. The middle lobe was natural in aspect, and the hemispheres were symmetrical except in respect of the tonsils, of which the left reaches farther posteriorly than the right (Fig. 5). On exposing the tonsils more fully it was readily seen that this asymmetry did not indicate any defect in bulk of the right tonsil. Nor was any one-sided atrophy recognisable in any of the lobes of the cerebellum. The vermis was well developed. The peduncles on the left side appeared of the same size as on the right side.

The pons exhibited some want of fulness on the left side as compared with the right, but was otherwise unaltered in its external characters.

Seen from before, the medulla oblongata exhibited a striking atrophy of the left anterior pyramid, which is less than half as broad as the right (Fig. 6). The olivary eminences are, however, equally developed, as are also the posterior columns and the restiform bodies. The anterior median fissure is displaced to the left of the middle line, and the left olive approaches nearer the median antero-posterior plane than the right.

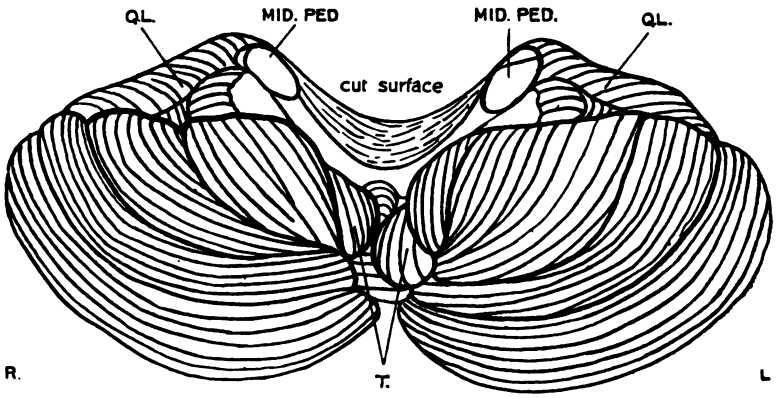
The pia arachnoid covering the spinal cord was somewhat opaque in aspect, and clear yellowish fluid was present in the

subarachnoid space. Beyond this there were no other macroscopic changes to be noted in the spinal cord and its membranes, nerve-roots, and posterior root-ganglia.

The longitudinal, lateral, straight, and cavernous sinuses were patent, the left lateral sinus being larger than the right. The cerebral surface veins exhibited no defect, being equally developed over the two hemispheres. On the left side the anastomotic vein of Trolard was present, and of similar aspect to its fellow.

The left middle cerebral artery was smaller than the right. It presented, however, no occlusion or narrowing, and its four main branches were present and patent.

FIG. 5.



The cerebellum seen from below. The lateral hemispheres are everywhere symmetrical except in the situation of the tonsils, T, the left descending lower than the right. Nevertheless on exposing these structures completely it was readily recognised that the right was quite as large as the left. No other asymmetry is visible, and the lobes of the vermis are natural in size and aspect. Q. L., quadrate lobe. Natural size.

The basal arteries of the brain were free from atheroma.

The right pleura was healthy; the left was covered with lymph 1 to 3 mm. thick, and contained 750 c.c. of blood-stained sero-pus. The right lung (555 grs.) was congested and œdematous, behind and below; the left lung was collapsed and carnified.

The pericardium was thickened; there was about 55 c.c. of clear fluid in the pericardial sac. The heart (365 grs.) exhibited left-sided hypertrophy. The heart muscle was firm and of good colour. The mitral valve was thickened considerably; the aortic valve was also greatly thickened, and was incompetent.

Commencing atheroma was present in the root of the aorta. The coronary arteries were healthy.

The liver was healthy.

The kidneys (right 75 grs., left 110 grs.) were small, and exhibited evidence of chronic interstitial nephritis, the cortex being slightly wasted, and the capsule stripping with erosion of the subjacent tissue.

No morbid changes calling for special note were found in the remaining viscera.

Minute Anatomy of the Nervous System.

Spinal cord.—All the segments of the spinal cord, hardened in a nearly saturated solution of potassium bichromate, were sectioned as far as the fifth sacral segment. The sections were stained by Pal's, Marchi's, and von Gieson's methods.

The right side of the cord was smaller than the left (Fig. 7), the change affecting both white and grey matter in the cervical region, but scarcely at all in the dorsal region below the second segment. On the left side the mesial portion of the antero-lateral column was atrophied. The grey matter was diminished, and the number of its cells diminished on the right side, chiefly in the cervical region. Asymmetry affecting both white and grey matter was present. These changes will now be described in detail.

Commencing with the white matter, reference may first be made to the posterior columns. These, as Fig. 7 shows, exhibited nowhere any change or defect on either side.

On the right side the antero-lateral column was defective, not in its anterior portion, which was well developed, but in the lateral part of its extent. In particular, as a reference to the figure will show, there is on this side, as compared with the left, a narrowing of the portion of white matter lying between the base of the posterior horn and the lateral surface of the spinal cord. This difference is noticeable in the whole length of the cervical region. It is present in a slighter degree in the dorsal and lumbar regions, but is not recognisable in the sacral segments.

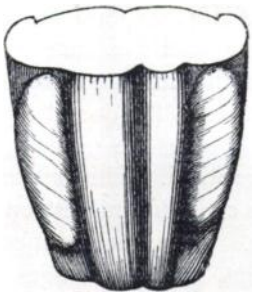
On the left side that portion of the white matter lying between the anterior horn and the anterior median fissure was defective. As Fig. 7 shows, this defect, which was striking in

the cervical region, was continued in the dorsal and lumbar segments, gradually lessening in degree until it became absent in the sacral segments.

There was no sclerosis of the white matter of the spinal cord in any of the white columns.

The right grey crescent was shortened from before backwards in the second and third cervical segments, but there is widening from side to side, and no defect was apparent. Below this level there was, in addition to a shortening of the crescent from before backwards, a defect of grey matter affecting chiefly the anterior horn on the right side, very slight in the fourth and fifth cervical segments, better seen in the sixth, seventh, and eighth cervical and the first, second, and third dorsal segments,

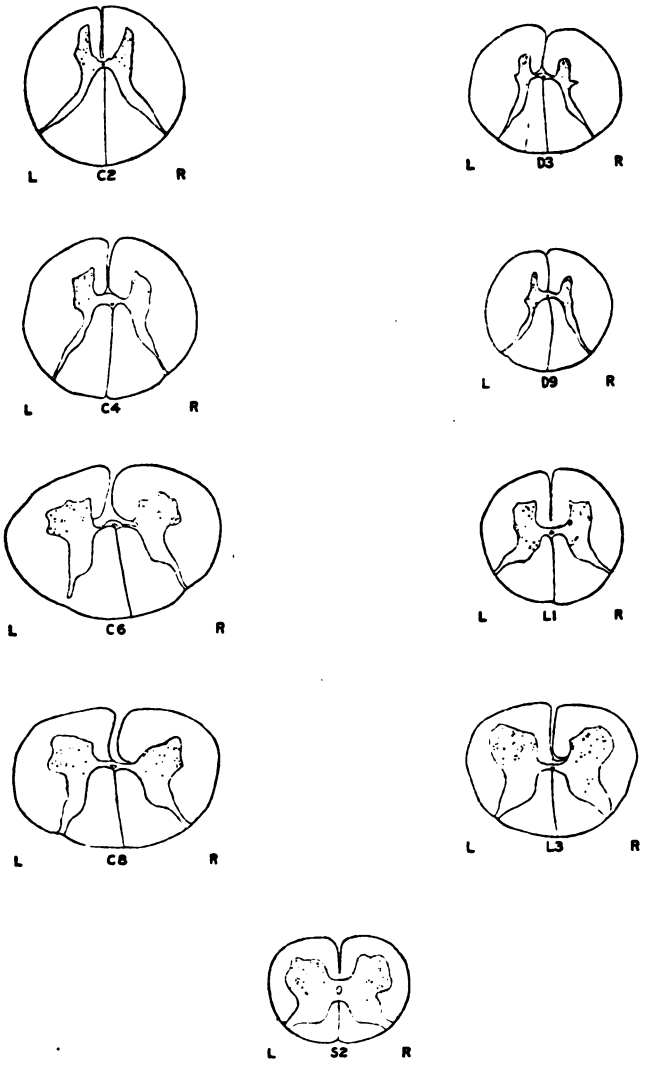
FIG. 6.



The medulla oblongata seen from before. The left anterior pyramid is conspicuously smaller than its fellow, and the anterior median fissure is displaced a little to the left of the middle line. The olives are of fairly equal size, and the medulla is otherwise free from asymmetry. Figs. 8 and 9 represent respectively the lower and upper surfaces of the medulla as here shown. × 1½.

becoming slight again in the fourth and fifth dorsal segments, and disappearing or becoming too slight to recognise with certainty in the rest of the cord. This diminution in size of the grey matter was attended with a defect in the number of large cells in the anterior cornua. The latter was not so extensive as the diminution in size of the grey matter, being noticeable only in the sixth, seventh, and eighth cervical and first dorsal segments. The defect was noticed in the lateral cell groups. In the adjoining, and also in the lumbar and sacral segments, the examination of a large number of sections failed to reveal any constant preponderance of cells on one side. The meshes of the grey matter lying outside the base of the

FIG. 7.



Transverse sections of the second, fourth, sixth, and eighth cervical, the third and ninth dorsal, the first and third lumbar, and the second sacral segments of the spinal cord, all drawn to the same scale. Attention should be directed to the diminished size of the left antero-internal column in all the segments as far as the sacral, but chiefly in the cervical and dorsal regions; and to the relatively smaller size of the right half of the cord, the defect involving grey and white matter, the latter being greatest in the situation of the crossed pyramidal tract. The defect of grey matter is attended with diminution in the number of nerve-cells in the lower cervical region. No sclerosis of the white matter is present. Further details are given in the text. R, right; L, left. Stained by van Gieson's method. × 2.

posterior horn were finer in the second and third cervical segments on the right side than on the left. Clarke's column was well seen in the sections, and was of equal size on the two sides.

The asymmetry of the spinal cord in transverse section was caused by the above-described defect in white and grey matter. In the dorsal region below the second segment the atrophy on the one side compensated for that on the other, and there was no inequality in area, though the defects in grey and white matter were readily observed.

Staining by Marchi's method revealed no evidence of recent tract-degeneration. There was much pigmentation of the anterior horn-cells at all levels of the cord.

The pial sheath of the spinal cord remained fairly thin, although opaque in naked-eye aspect, and the septa were not markedly thickened. The anterior septum was distorted, being convex to the left. The blood-vessels of the cord were numerous, but did not show any marked change. At the bottom of the anterior fissure a large vessel on each side, running longitudinally, was frequently seen.

The nerve-roots of the spinal cord presented no marked diminution in size in the cervical region or elsewhere.

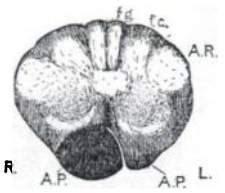
The medulla oblongata.—The study of microscopic sections of the medulla (Figs. 8 and 9) exhibited more in detail what has already been described as the result of naked-eye examination, furnishing at the same time further information as to the condition of those parts of the medulla which were not represented externally. The sections were asymmetrical, this being due apparently entirely to the difference in size of the anterior pyramids, the right being about twice the diameter, and therefore about four times the sectional area, of the left. The consequence of this was that the anterior median fissure was displaced to the left, particularly at the lower part of the medulla just above the decussation of the pyramids (Fig. 8). If, however, the pyramids were neglected it was seen that the medulla was otherwise almost perfectly symmetrical, the most marked difference being that the olive approached nearer to the median septum on the left side (Fig. 9), while at the lower part of the medulla there was also apparently some narrowing of the commencing formatio reticularis on this side.

The olives appeared of fairly equal size on the two sides,

such differences as existed in individual sections (cf. Fig. 9, in which more of the left olive was cut across than the right) not being constant at all levels, and therefore attributable to obliquity in the section. The formatio reticularis, the ascending root of the fifth nerve, the posterior longitudinal bundles, and the arciform fibres all appeared developed to the normal extent, nor was any definite alteration to be noted in the size or structure of the various collections of grey matter situated in the medulla.

The anterior pyramids stained by Pal's method exhibited a darker staining on the right side than on the left (Figs. 8 and 9). The nerve-fibres on the latter side were not conspicu-

FIG. 8.



Transverse section of the medulla oblongata, three millimetres below the olivary bodies, and just above the decussation of the pyramids. The medulla is somewhat flattened in front on the left side. The same marked disproportion between the anterior pyramids, A. P., is to be noted as in Figs. 6 and 9, but no marked asymmetry is seen in the arrangement of the rest of the nervous tissue. In the middle line, lying behind the anterior pyramids, is the superior pyramidal decussation, and on each side of this the formatio reticularis, between which and the pyramids lies on each side the lower end of the corresponding accessory olivary nucleus. In front of the superior pyramidal decussation is the grey matter surrounding the central canal. Posteriorly are to be noted, proceeding from within outwards, the gracile and cuneate nuclei and the tubercle of Rolando. R., right; L., left. Stained by Pal's method. × 2.

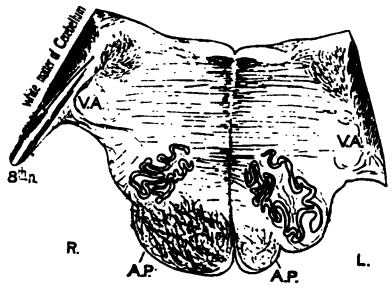
ously smaller than on the former, but were separated by a certain amount of unstainable material. There was, therefore, in the medulla, unlike the spinal cord, some degree of sclerosis of the left pyramidal tract. No such difference in the colour of analogous portions of the medulla, white or grey, was noted elsewhere.

The cerebellum.—There is little further to be said of the cerebellum. Microscopic sections in various parts, particularly the uvula, pyramid, tonsils, and the cuneate and central lobes, were in every respect natural. Sections of the ganglia of the

medullary centre also failed to exhibit any marked change. The restiform bodies and superior peduncles, as mentioned elsewhere, showed no structural change.

The pons Varolii.—Microscopical sections of the pons Varolii exhibited an asymmetry similar to that noted in the medulla oblongata, and, like it, affecting only the anterior part of the section, though to a lesser degree. Beyond the diminished size of the left pyramidal tract there was little further to note. The fillet, the tegmentum, the posterior longitudinal bundles, the descending roots of the fifth nerves, and

FIG. 9.



Transverse section of the upper end of the medulla oblongata at its junction with the pons. The section is asymmetrical, the left side being smaller than the right owing to the extremely small size of the anterior pyramid, A. P., on this side. In this, as in the preceding figure, the right anterior pyramid is more deeply stained than the left. Behind the pyramids, on each side of the middle line, are seen the olivary bodies, the left coming nearer to the median *raphe* than the right; and still more posteriorly the formatio reticularis, lying upon which beneath the floor of the fourth ventricle on each side of the middle line the hypoglossal nuclei are situated, separated from the reticular formation by the posterior longitudinal bundles. External to the hypoglossal nuclei lie the auditory nuclei, not well outlined in the figure. Behind and external to the olivary bodies the ascending root of the fifth nerve, V. A., is imperfectly seen, and dorsal to this the restiform body, in relation to which the fibres of the eighth nerve appear on the right side. The portion of the section lying behind the anterior pyramids is asymmetrical, but presents nowhere any clear evidence of defect. R., right; L., left. Stained by Pal's method. × 2.

the various masses of grey matter, all alike appeared equal on the two sides and of normal aspect. The various tracts of nerve-fibres exhibited no difference in staining reaction by Pal's method on the two sides; in particular it was not possible to recognise any sclerosis of the left pyramidal tract. So far as could be judged, also, the condition of the larger nerve-cells in

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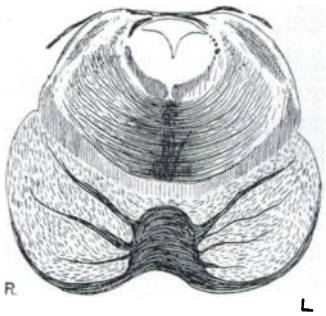
respect of their number, size, and pigmentation was equal on the two sides.

The mesencephalon, thalamencephalon, and prosencephalon.—As these structures were examined together by means of frontal vertical sections, it will be convenient to consider them together.

As regards the mesencephalon, no marked change was noted in the corpora quadrigemina, which were equal on the two sides. The superior brachia were not so well seen as is usual, but were equal on the two sides. The left inferior brachium was present, but was much smaller than the right. The tegmentum, the

FIG. 10.



Transverse section at junction of the mesencephalon and pons. Asymmetry is present, affecting only the anterior part of the section, being confined to the left crus. The remaining structures in the section are well developed, being quite free from atrophy. In the middle line, and penetrating a short distance between the bundles of the crura, are some of the fibres of the upper end of the middle commissure of the cerebellum darkly stained. More posteriorly is seen the fillet, which is prolonged backwards on each side, and is equally developed in the two halves of the section. The lower end of the locus niger, intervening between the fillet and crus on each side, is not shown in the figure. Dorsal to the fillet in the middle line is the tegmentum, between which and the grey matter bounding the aqueduct of Sylvius lie the posterior longitudinal bundles, also of equal size. Still more posteriorly are seen the fourth nerves, decussating in the valve of Vieussens. R., right; L., left. Stained by Pal's method. × 1½.

posterior longitudinal bundles, and the upward continuation of the lemniscus were also unaltered, while the grey matter around the central canal, in the tegmentum, and in the locus niger was similar in the two halves of the section. The diminished size of the left crus as compared with its fellow has already been mentioned; no clear indication of sclerosis by Pal's method could, however, be here recognised.

https://doi.org/10.1192/bjp.49.206.389 Published online by Cambridge University Press

The thalamencephalon, as has been stated above, was wasted on the left side. Frontal sections stained by Pal's method showed that this wasting did not affect the anterior nucleus of the left optic thalamus, which by contrast formed a striking object in the section, from the lower end of which the bundle of Vicq d'Azyr, which was free from atrophy, descended. The mesial and lateral nuclei, and still more the ventral nucleus, of the left optic thalamus were considerably atrophied. Both the grey and the white matter were affected, especially the former. The subthalamic tegmental region also shared in the atrophy, but it was difficult to decide upon the degree to which its individual constituents were involved, as the structures below the left optic thalamus in this region could not readily be subdivided. The middle commissure was present. The mammillary bodies and their tracts were of equal size and similar structure on the two sides. The right optic nerve was of good size and equal development; on the left side von Gudden's commissure was atrophied, but the lateral root was of good development. The external geniculate bodies were of nearly equal size, but the left internal geniculate body was very atrophied and its cells degenerated, while the right appeared much larger than natural.

The lenticular nuclei, as far as could be judged, were equal on the two sides. It was not so easy to compare them as it was to compare the optic thalami, because in the sections the former were found to be much more asymmetrically placed than the latter. Thus in Fig. 4 A, for example, the left lenticular nucleus was larger than the right, while in Fig. 4 D the reverse was the case. Owing to a certain degree of displacement of the lenticular nuclei relatively to each other, it was not possible to cut the two nuclei at the same time in the same position, but so far as an opinion could be formed the lenticular nuclei had escaped, the left not showing any change as the result of the cortical lesion. The various divisions of the lenticular nucleus were well defined on the two sides, and preserved their relative proportion, while no clear alteration of either white or grey matter was discernible.

The left caudate nucleus was also unaffected. The large cells of this nucleus were similar in size and number to those on the opposite side.

Sections of the left internal capsule stained by Pal's method

showed no alteration in the anterior limb, but the posterior limb was narrowed (cf. Fig. 4 D), the diminution in size as seen in sagittal section being greatest in the interval between the optic thalamus and the upper part of the globus pallidus. In this situation, however, there was not, so far as could be judged, any diminution in size of the nerve-fibres, nor was there any recognisable increase of neuroglia.

The condition of the left optic radiation of Gratiolet and inferior longitudinal bundle was, like that of the internal capsule, more readily observed in sections stained by Pal's method than in macroscopic sections of the chrome-hardened brain. Fig. 4 B shows this joint bundle to be defective at the junction of middle and lower third; microscopic sections showed that the defect involved both constituents, the portion of the inferior longitudinal bundle which was totally absent being greater than that of the optic radiation, while elsewhere the narrowing of the former was similarly greater than that of the latter. This narrowing is not accompanied by any very obvious alteration of the size of the individual nerve-fibres, though, owing to the small size of the latter, observation of calibre is difficult. On the right side the inferior longitudinal bundle was stained darkly, while the optic radiation was relatively lightly stained, this being the relation usually observed when these structures are healthy. On the left side this separation of the two tracts was not everywhere distinct, and when present this relation was reversed, the inner tract being slightly darker than the outer.

The long association bundles of the cerebrum were well developed on the left side only at some distance from the area of defect, and the degree to which they persist may be judged by studying Figs. 4 A, 4 B, 4 C. In the neighbourhood of the cortical defect, as these figures show, a mottled appearance was seen in the white matter. Stained by Pal's method, the white matter was here found to consist in many places of neuroglia quite free from nerve-fibres, or containing such only in very small numbers.

The cortex of the cerebrum exhibited on the left side the same appearance as on the right, except at the edge of the area of defect, where the different layers of nerve-cells became represented by a single layer of cells showing little cell-protoplasm and no distinct cell-processes.

Review.

Further reference must now be made to the nature of the lesion causing porencephaly, and the resulting changes in the central nervous system must be very briefly summarised and criticised.

As regards the nature of the lesion, this was obviously vascular in origin, since it corresponds very closely to the area of distribution of the left middle cerebral artery. This vessel must have been blocked just beyond the point at which the lenticulo-striate branches were given off. Concerning the cause of the blocking, it is not improbable that this was the result of an embolus detached from a cardiac valve exhibiting vegetations, for at the autopsy valvular heart disease of old standing was found ; and there is a family history pointing to rheumatic fever in patient's brother. As, however, the artery was patent at the time of death, though smaller than its fellow, it would appear that the plug did not permanently obstruct the vessel, but that the lumen was subsequently restored, though only after destruction of the corresponding area of the brain mantle had occurred.

Turning now to alternative theories, we may consider first thrombosis of the artery in question, dependent upon localised arterial disease. This appears improbable, since it implies disease at a single spot in a single arterial wall, all the other vessels apparently escaping. Similarly hæmorrhage appears to be excluded by the entire absence of any localised thickening of the membranes of the brain, and again by the affected area coinciding so closely with an arterial area. The latter circumstance is also opposed to intra-venous thrombosis having led to the cortical defect.

The age at which the lesion occurred was probably eleven or twelve months, when the first fits were observed. The few particulars collected respecting the birth of the patient are perhaps not very reliable, since they were obtained at second hand from the patient's brother thirty years later. If, however, the belief expressed that delivery was not difficult be correct, then the possibility of the cortical defect being due to birth-palsy—that is to say, to injury during or resulting from delivery—is negatived, a conclusion which seems supported by the limitation of the cortical area referred to above.

To sum up, all the evidence available points to the cause of the porencephaly being embolism of the left middle cerebral artery occurring towards the close of the first year of life.

Turning now to the resulting changes in the central nervous system, these may be summarised as follows:

1. There was a defect in the brain mantle on the left side involving the operculum, the island of Reil, and the superior temporal convolution. The floor of this area was formed by the remains of the subjacent white matter, which was very defective in medullated fibres. The left hemisphere was small, and had contracted upon the area of defect; the left temporal lobe, seen from below, was also defective in size. The inferior longitudinal bundle on the left side was defective. As the destructive lesion of the temporal lobe was confined to the superior temporal convolution, it follows that the defective nerve-fibres arose in this gyrus.

2. The caudate and lenticular nuclei were unaffected.

3. The left optic thalamus was atrophied, the atrophy involving the lateral median and ventral nuclei (especially the last), while the anterior nucleus was unaffected. The corpora mammillaria remained intact. The left internal geniculate body was very small; the right was unusually large. The left optic radiation was atrophied. The atrophy of the optic thalamus was entirely dependent on the cortical lesion, being outside the vascular area involved in the latter.

4. The cortico-spinal and thalamo-spinal tracts coming from the left hemisphere were markedly wasted in the mesencephalon, pons, and medulla in comparison with the corresponding tracts of the other side.

5. The cerebellum was normally developed.

6. The spinal cord exhibited a defect of the left antero-internal column, while the right antero-lateral column was of defective width opposite the base of the anterior horn. There was also diminution in size of the right anterior horn.

Two further points may be referred to in conclusion. The first is that the pia arachnoid was opaque and thickened over both hemispheres, and that the right hemisphere also showed some general wasting. This would appear to be independent of the local cortical lesion, and to be of the same nature as the brain atrophy, attended with thickening and opacity of the pia arachnoid, seen in asylums in epileptic patients not exhibit-

ing porencephaly. The second point is the non-development of neuroglia in the spinal cord in the situation in which the right crossed pyramidal fibres should be found, so that no sclerosis is here recognisable, though a certain amount of sclerosis is to be seen in the medulla oblongata in the left anterior pyramid. This is apparently to be explained by the circumstance that degeneration of the fibres descending from the cerebral cortex and optic thalamus occurred before myelination was complete, and thus was attended with less sclerosis than would occur had the myelinated fibres been fully developed.

(1) Reference may be made to the cases recorded by Mott and Tredgold, "Hemiatrophy of the Brain and its Results," *Brain*, vol. xxxiii, 1900, pp. 239—264; and by David A. Shirres, "On a Case of Congenital Porencephalus," *Studies from the Royal Victoria Hospital, Montreal*, vol. i, No. 2, 1902. Further references are given in these papers.

FIG. 4 A.—Frontal section of the brain in the plane A A, Figs. 2 and 3. The depth of the area of destruction of the brain tissue of the left hemisphere is shown. Its floor is formed partly by grey and partly by white matter. The chief branches of the middle cerebral artery are readily recognised on both sides. The left hemisphere is smaller in section than the right in this and the two succeeding sections. Owing to the asymmetry of the brain, the section is oblique as regards the basal ganglia and the optic tracts, *opt. tr.* In consequence of this the lenticular nucleus and the tail of the caudate nucleus appear larger on the left side than on the right. The right optic thalamus is much larger than the left; this is in part because the latter is cut more anteriorly than its fellow (cf. Fig. 4 D). Below the corpus callosum lie on each side the lateral ventricles, and in the middle line the fornix. Beneath the fornix lies the third ventricle divided into two parts by the middle commissure. Still lower are seen on each side the corpora mammillaria, *c. m.* On the right side the descending horn of the lateral ventricle is seen. The anterior portion of the left superior temporal convolution, T 1, is seen in the section (compare with Fig. 2). *asc. fr. f.*, ascending frontal fissure. *f. S.*, posterior limb of the fissure of Sylvius. T 2, T 3, T 4, T 5, second, third, fourth, and fifth temporal convolutions respectively. This and the succeeding three sections represent the brain hardened in potassium bichromate. × ⅔.

FIG. 4 B.—Frontal section of the brain in the plane B B, Figs. 2 and 3. The floor of the area of destruction of brain tissue is now formed by the remains of the white matter, which exhibits, as in Figs. 4 A and 4 C, a mottled appearance. The first left temporal convolution has nearly disappeared, only a portion of its white substance remaining. The section is somewhat oblique in respect of the basal ganglia. The left optic thalamus is smaller in section than its fellow, and the left claustrum is irregular in aspect. Below the corpus callosum are seen the lateral bands of the fornix, external to which lie the lateral ventricles. Lower down in the middle line the supra-pineal recess and veins of Galen are seen, and also the pineal recess, which lies a little to the left of the middle line. Next comes the posterior commissure, beneath which is seen the upper end of the aqueduct of Sylvius. On each side is seen the inferior horn of the lateral ventricle, lying external to the corresponding hippocampal gyrus. *f. R.*, fissure of Rolando. *coll. f.*, collateral fissure. The other letters as in the preceding figure. × ⅔.

FIG. 4 C.—Frontal section of the brain in the plane C C, Figs. 2 and 3, towards the posterior limit of the area of defect, and immediately behind the posterior extremity of the corpus callosum. The floor of this area is formed by the remains of the white matter. The optic radiation and inferior longitudinal bundle taken together are thinner on the left side below, where a defect is visible at the junction

of middle and lower thirds, than on the opposite side. The lateral ventricles are dilated; within them the choroid plexuses, also enlarged, are seen. *cal. f.*, calcarine fissure. Other letters as in the preceding figure. × ¾.

FIG. 4 D.—Horizontal section of the brain, made in the plane D D, Figs. 2, 3, 4 A, 4 B, 4 C. The section passes through the area of defect. The anterior portion of the left island of Reil still persists, covered by the posterior extremity of the third left frontal gyrus, which passes much farther backwards than on the right side. Posteriorly the splenium of the corpus callosum is seen, with a portion of the lateral ventricle, *l. v.*, containing the choroid plexus, bounding it on each side. In front of the splenium is a portion of the velum interpositum, in which the two veins of Galen lie; and anterior to this, in the middle line, the cavity of the third ventricle is seen. Externally, on each side, lie the optic thalami, the left being smaller than the right. Outside the thalami are the lenticular nuclei; the left is slightly smaller than the right. The caudate nuclei, which lie more anteriorly, are of equal size. The anterior limbs of the internal capsule are well developed on both sides; the left posterior limb is smaller than its fellow, and its anterior end is indistinct. The basal ganglia are somewhat distorted on the left side. Between the caudate nuclei lie the anterior horns of the lateral ventricles, separated by the anterior pillars of the fornix and the septum lucidum, in front of which is the genu of the corpus callosum. × ¾.

Concerning the Significance of Central Chromatolysis with Displacement of Nucleus in the Cells of the Central Nervous System of Man.

By JOHN TURNER, M.B., Senior Assistant Medical Officer, Essex Asylum.

A LARGE amount of both experimental and clinical work has now accumulated around this subject. I need only briefly mention the main results of the former, as they have been so often referred to by others that they are now probably familiar to all workers in this field.

Nissl, in 1894 or thereabouts, showed that shortly after section or injury of the axons of the hypoglossal cells, these cells showed alterations in their appearance. These were—swelling, then dissolution of the central chromatoplasm, and displacement of the nucleus towards the periphery of the cell. After reunion of the axis-cylinders restitution occurred; if reunion was prevented the cells, or many of them, degenerated beyond repair. Further experiments showed that section of *any* motor axons resulted in a similar change in their cells of origin. Marinesco and others have amply confirmed these results. As regards sensory cells, an important difference was noted. Lugaro (1) claims to have been the first to demonstrate that section of the peripheral branch of the posterior