PARALYSIS OF THE MOVEMENT OF CONVERGENCE OF THE EYES.

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(Translated from the French MS. by Henry Juler, F.R.C.S.)

The paralyses of the muscles of the eye, as of those of other parts of the body, arise either from central or peripheral causes. Until the last few years this fact appears to have been ignored, for the descriptions are devoted almost exclusively to the paralyses of the third pair of nerves, and the symptomatology is exactly deduced from the distribution of these nerves and from the action of each muscle. Several works, however, have been published on this question, notably those on conjugate paralysis, paralysis of the sixth pair, and Hutchinson's ophthalmoplegia.

I may here be permitted to remark that in several publications, of which the first appeared in 1877, I have endeavoured to establish the distinction between peripheral and central paralyses. Hitherto these subjects have not seriously occupied the attention of oculists, but at the present time, thanks to the efforts of Prof. Mauthner, this gap in the literature of ophthalmology is becoming filled up.

In my paper on "Paralysis of Associated Movements," I have insisted upon the necessity of searching for clinical types which shall enable us to understand the significance of those partial and complex forms which are most common amongst central paralysis.

Associated paralyses, i.e. those referring to similar binocular movements, are central paralyses par excellence. One of these is well known as conjugate paralysis of the sixth pair, thanks

1 The cases on which this paper was written were observed, either in Dr. Parinaud's ophthalmic clinique or in the Salpêtrière, where the author fills the post of Ophthalmologist to the Neurological Department of Prof. Charcot.—Ed.
2 'Archives de Neurologie,' March, 1883.
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to the clinical observations of Prevost, Foville and Priestley Smith; to a previous case with autopsy by Féréol; to the experimental researches of Duval, Laborde and Graux; and to a memoir by Landouzy, who enlarges the subject by examining the relations existing between the hemispheres and the bulbo-pontal nuclei.

Conjugate paralysis from lesion of the nucleus of the sixth pair of nerves is not the only associated paralysis that has been observed. This is easily conceived, inasmuch as the other binocular movements in virtue of their peculiar anatomical disposition are equally associated.

Amongst other forms of associated paralysis that I have studied, I have signalised the Paralysis of Convergence, of which I desire to delineate the characteristic features.

It is hardly necessary to remark that this central paralysis of convergence is distinct from the insufficiency of the internal recti muscles, with which we are familiar in connection with myopia, with peculiar arrangement of the cranial bones, and from a congenital muscular insufficiency.

The deficient converging power observed in exophthalmic goitre by Möbius has always seemed to me to be in relation with the ocular protrusion. In certain cases it is true this symptom may appear before the latter is very manifest. But, though the disease be primarily of nervous origin, the loss of convergence in Basedow's disease must be referred to a mechanical cause, as Möbius suggests, and must not be taken for a paralysis strictly so called.

I may call attention here to one form of insufficiency of the internal recti which is in some sense intermediate between insufficiency from ocular and that from cerebral causes. It may be called Insufficiency from over-fatigue, from excessive cerebral, as well as muscular, exhaustion.

In July last year three young girls were brought to me from the Ecole Normale Supérieure. They all presented symptoms of muscular asthenopia, and all the characters of pronounced insufficiency of the internal recti muscles. None of the patients were myopic. The visual trouble at first developed towards the end of the scholastic year, and after

1 Centralblatt für Nervenheilkunde,' 1886.
the most assiduous labour. The use of prisms afforded some relief and enabled them to continue their studies. After the rest of the vacation, these symptoms all disappeared, and the use of the spectacles was discontinued.

There are two forms of paralysis of convergence arising from central causes. The one may be called essential and the other combined; combined, because it coincides with paralysis of elevation and depression.

A.—Essential Paralysis of Convergence.

The vision of a near object is accompanied by three distinct muscular acts; The convergence of the eyes towards the object looked at, the effort of accommodation, and the contraction of the pupil. These three acts are concerned in the typical forms of essential paralysis of convergence.

(a.) Paralysis of the movement of convergence is indicated by two principal symptoms: the objectively appreciable defect of convergence and a peculiar diplopia.

In order to recognise the defect of convergence, we proceed in the same manner as for insufficiency of the internal recti. If the patient be told to fix the finger as it rapidly approaches his face, the eyes remain immovable; if the movement be performed, it is incomplete, the patient cannot continue to look at the object with both eyes, but one of the eyes turns outwards and he squints. Lastly, in making him fix a near object alternately with either eye, the eye which has been momentarily excluded from vision executes a movement of readjustment, in order to fix the object. These are the objective symptoms of insufficiency of the internal recti.

On the other hand, in the lateral movements the internal recti contract normally. In a word, the innervation of the internal recti is only concerned in the movement of convergence; it remains normal for adduction in displacements where the visual axes are parallel. The diplopia appears in the median plane at a variable distance from the subject; it is crossed, and there is moderate separation of the images which persist without notable modification in all directions of looking. The separation is not sensibly increased when the candle is moved laterally, sometimes it diminishes, a character which
distinguishes this diplopia from that of all ordinary paralyses of the internal recti. The images not unfrequently become fused at four or five metres from the patient, a distance at which but little convergence is exercised, but cases do occur in which the diplopia persists at all ranges; this may be explained either by the degree of paralysis, or by the individual differences in the static condition of the eyes. There are subjects in whom, during absolute repose, the globes have such a tendency to diverge, that the maintenance of parallelism necessitates the intervention of converging force.

If the patient does not complain of diplopia when a coloured glass is employed, a prism, placed base upwards, before one of the eyes will generally cause the double vision to appear, and so allow its characters to be studied.

(b.) Accommodation is involved in this form of paralysis in various ways. In certain cases there is absolute paralysis in both eyes; in others there is more or less notable reduction of its amplitude; whilst in a third class the accommodation is normal.

Accommodation remains defective in monocular as well as in binocular vision. It cannot be admitted that it is indirectly associated in virtue of the functional association of accommodation and convergence. This explanation, more or less applicable in certain cases where the paralysis is recent, does not account for those in which the paralysis of accommodation is absolute and may persist indefinitely.

The double paralysis of accommodation is not accompanied by mydriasis from paralysis of the sphincter, which distinguishes it from certain facts of double paralysis belonging to ophthalmoplegia interna and derived from another process.

We may further distinguish paralysis of accommodation connected with paralysis of convergence from paralysis arising from reflex causes, or from those occurring after diphtheria in which there is no paralysis of the iris. In one case of double paralysis of accommodation, after diphtheria, which I recently studied from this standpoint, convergence and pupillary reflex were normal.

(c.) If in this form of paralysis there be no paralytic mydriasis, the pupillary reflexes are nevertheless modified, and
mostly in a very characteristic manner. *The reflex is abolished for convergence and retained for light,* thus constituting a modification exactly inverse to that pointed out by Argyll Robertson as occurring in tabes. The reflex is equally defective when the patient is made to fix a near object with one eye only. In certain cases the pupil, though not dilated, will not react to any excitation.

**Paralysis of Divergence.**

The association of ocular movements for fixation at different distances can be modified in another manner. Eyes may converge for short distances, but yet be unable either to bring their visual axes back to the parallel directions, or even to fix an object at the distance of one or two metres. This I have called *paralysis of divergence.*

Paralysis of divergence can hardly be recognised except by the character of the diplopia. This, in the median plane, only appears at a certain distance, *it is homonymous, with slight separation of the images, and persists without notable modification in all directions of looking.*

The paralysis of divergence is not incompatible with defective convergence. In some cases the visual axes are found to cross at a certain distance, whilst the amplitude of convergence is nil. Beyond this point the diplopia is homonymous; within it the diplopia is crossed.

Amongst other symptoms accompanying paralysis of convergence must be mentioned the difficulty of estimating distances and vertigo. The first of these is sufficiently accounted for by the paralysis of convergence and accommodation. This symptom is most marked when the visual trouble is rapidly developed. The vertigo is partly explained by the false notion as to the position of the object, and by the diplopia, but this is not its sole cause. *The majority of patients in whom this paralysis exists suffer from vertigo independently of their ocular troubles.* In some there is vertigo with a sense of translation in space, similar to that observed in Ménière’s disease. It is, moreover, remarkable that aural troubles are sometimes found to be co-existent.
The essential paralysis of convergence consists, then, in the lesion of that function in virtue of which the point of convergence of the visual axes is displaced in fixation at different distances, a function which may be disturbed in two ways, by lesion of the forces of convergence, and of the forces of divergence.

As to the seat of the lesion which concerns this function, we are not able actually to arrive at a precise determination. There are some reasons for believing it to be situated in the cerebellum.

I would mention in the first place the condition of vertigo which I have found to exist in several patients, and which is independent of visual troubles. It is not necessary to recapitulate the rôle which the cerebellum is supposed to play in cases of this kind, and in the vertigo with sensation of translation of the Ménière type. Recent works render almost certain the existence of a special nerve, called nerve of space ("nerf de l'espace"), connected with the auditory nerve, the lesion of which produces the vertigo of Ménière. But it is not only peripheral lesions of the nerve that give rise to this; those of the cerebellum, to which it leads, can produce exactly similar vertiginous symptoms to those of the aural disease.

We form our notions of space not only by the sense of hearing, but also by that of sight. It is, however, especially by the movements of convergence of the eyes that we obtain our notion of the third dimension to which that of space is essentially allied. It is probable that this notion of space has a functional centre, whether perceived by the eye or the ear. If, in reference to hearing, there are reasons for placing this in the cerebellum, these facts are in favour of a centre in the same situation for the co-ordination of the movements of convergence.

Lastly, I will mention that the experiments of Duval and Laborde have clearly established the influence of the cerebellum upon the co-ordination of the movements of the eyes; and, a fact of importance from our present standpoint, this influence appears to bear exclusively upon the relations of the ocular axes to one another. Whilst lesions of the bulb and of the pons constantly produce conjugate deviations of
the eyes, those of the cerebellum, and particularly of the vermis inferior, produces what these experimenters call dissociated deviations, in which the axes of the two eyes, instead of being displaced parallel to each other, are modified in their relations, so as to produce strabismus.

At the moment of sending this memoir to the press, I observed with M. Charcot a new case of paralysis of convergence, which has more strongly fixed our attention upon the relation of this paralysis to the vertigo of Ménière's disease (Obs. IV.).

The patient, in whom the visual trouble declared itself eight months ago, in what he terms an attack of congestion, had suffered from vertigo with diminished acuteness of hearing for fifteen years. The attacks, according to MM. Charcot and Gellé, who examined the state of hearing, presented the true characters of aural vertigo, and possibly the supposed congestion which marked the outset of the diplopia was nothing more than violent vertigo.

In the presence of such a case, the question arises whether a lesion of the ear could not give rise to visual troubles by reflex influence. We must always remember that this paralysis may exist for months, years, or even indefinitely, which is hardly the case with reflex paralyses; and besides that, it may exist without these violent attacks of vertigo, and without lesion of the ear. I am more disposed to believe that the troubles of hearing and of vision arise from the same central lesion.

I am hardly competent to solve this difficult question. I will only mention that Jackson has indicated the existence of abnormal movements of the eyes during aural vertigo, and that he attributes to them a certain rôle in the mode or origin of the access.

M. Charcot, on the other hand, has observed in patients the existence of diplopia during the access. Lastly, in some cases we may see ordinary paralysis persisting in certain muscles. One patient at the Salpêtrière presented at the same time as the paralysis of convergence, an absolute paralysis of the left external rectus muscle.

I must add that many patients suffering from typical aural vertigo present no symptom of loss of convergence.
Observation I.—Paralysis of Convergence and of Accommodation
Abolition of Pupillary Reflex and of Convergence.

M. Vern—, 30, mechanic.
Power of convergence, nil.
On attempting to converge, the left eye deviates freely outwards.
Adduction normal during lateral movements of the eyes.
Crossed diplopia in the median plane for all distances. Beyond
3 mètres, separation of images diminishes; it does not increase
lateral directions of regard.
M = −1 D in each eye. Double paralysis of accommodation.
With + 2.5 D. reads No. 1 at 30 centimetres.
Pupils equal, of normal dimensions. No reflex for convergence.
Active to light. Nor does the pupil react when he fixes with a
single eye.
No lesion of fundus.
Appreciates distances badly, a circumstance which he much
laments, as he was formerly an excellent shot.
Visual trouble commenced with diplopia three weeks ago.
Headache five years. Vertigo three months. Erythropsia.

Observation II.—Paralysis of Convergence and of Accommodation.
Absence of Pupillary Reflex.

Madame Bodd—, 52.
Power of convergence, nil.
Contraction of internal recti normal in the lateral directions of
regard.
Crossed diplopia upon the median line for all distances. When
the candle is displaced laterally, the separation of images instead
of being increased is diminished. Diplopia persists in all directions
of regard.
H. = + 1.5 D. Double paralysis of accommodation. With
+ 5.5 D. reads No. 1 at 30 centimetres.
Pupils equal, freely dilated.
Both reflexes abolished.
Fundi normal.
Vertigo frequently since the age of 2. Patient always feels
as if she were intoxicated.
Persistent pains in the occipital and left temporal regions.
Knee-jerk normal. No ataxy, no syphilis.

Observation III.—Paralysis of Convergence and of Accommodation.
Abolition of the Reflex of Convergence.

Madame Mita—, 54.
Fixation of a near object gives rise to no change in the pupils.
Patient does not complain of diplopia. This can be produced by the simultaneous use of a red glass and a prism base upwards. At 4 metres the images are upon the same vertical line. Nearer to the patient there is crossed diplopia; the separation is not increased by lateral displacements of the candle. Double paralysis of accommodation $H = + 2 \, \text{D}$. With $+ 6 \, \text{D.}$ pp. at 30 cm. reads No. 1.

Pupils equal, normal in size.
Reflex retained for light, abolished for convergence.
Onset undetermined, vertigo for a long time. When the patient goes out in the bright sunlight she is seized with vertigo and vomiting. Sense of numbness on the left side.


Mr. Ball—, set. 42.
Movement of convergence, nil. The lateral movements have their normal amplitude, but are accompanied by slight nystagmus. Crossed diplopia for all distances and in all directions of regard. No notable modifications of separation in the right and left directions of regard.
Pupil-reflex reserved for light, defective when convergence is attempted or when a near object is fixed with a single eye.
Paralysis of accommodation in each eye. $M = -1.25 \, \text{D}$. $V = \frac{a}{10}$. With 3 D. pp. at 30 cm. reads No. 1 Snellen.
No lesion of fundus.
Onset of visual trouble in October 1885.
After an attack, without complete loss of consciousness, the patient suffered for fifteen days from visual trouble which prevented him counting his fingers; since he has improved, he has remarked that he sees double.
For fifteen years the patient has had vertigo with slight deafness, in which MM. Charcot and Gellé have recognised the characters of aural vertigo.

Observation V.—Paralysis of Divergence.

Madame Lep—, set. 31.
Neither strabismus nor trouble in ocular movements are objectively appreciable. Homonymous diplopia becomes evident at 40 cm. from the patient and increased beyond that distance. The separation of the images remains moderate; instead of becoming increased when the candle is moved to the right or left, it tends to diminish. The diplopia persists in all directions of regard, in the
upper as well as the lower half of the visual field. No inclination of images.
The pupils react to light and to convergence, but feebly.
Sensibility of retina normal. No ophthalmoscopic lesions.
Sudden onset of visual trouble on Jan. 1, 1884, without loss of consciousness, without other accident. No vertigo. Habitually suffers from frontal headache. No ataxy nor syphilis.

Observation VI.—Paralysis of Convergence and Divergence.

Madame Dup—, aged 62.
All other movements normal.
Crossed diplopia on the median plane, for a short distance.
At 1.50 metre the images become fused. At 3 metres diplopia becomes homonymous.
Diplopia persists in all directions, without any notable modification for the same distance.
Pupils normal in size, and reaction.
Sudden onset of visual trouble by diplopia without any other symptom. No vertigo.

B. Combined Paralysis of Convergence.

In this form of paralysis, the defect of convergence is accompanied by paralysis of elevation, and of depression in both eyes, with retention of lateral movements.
This paralysis appears to be very rare in its typical and complete form. I have seen one case where the visual trouble, which had come on suddenly in a polyuric patient, was clearly characterised. The following is a résumé of the observation, reported more fully in my memoir on Associated Paralyses.

Observation VII.—Paralysis of Convergence with Paralysis of Elevation and Depression in both Eyes. Retention of Lateral Movements.

M. Sey—, âé. 67.
Movements of elevation and depression almost nil in both eyes.
Complete paralysis of convergence.
The internal recti contract normally for adduction in lateral movements.
The diplopia is crossed or homonymous, according to the distance of the candle. The image of the right eye always remains rather the lower.
The elevators of the lids are intact.
No paralysis of iris; there is, on the contrary, slight myosis with abolition of reflexes.

The amplitude of accommodation is almost nil, but, knowing the patient's age, one cannot ascertain whether this be paralysed.

The paralysis appeared suddenly on the night of Feb. 8, 1881. Since that date there has been a tendency to fall to the left. Polyuria recurring in crisis, with heaviness of the head, from which the patient suffered before the development of the ocular trouble. Pulse 52.

In an observation by Wernicke, quoted by Nothnagel, we find the same type of paralysis. The two eyes are unable to move either upwards or downwards, whilst lateral mobility to the right or left remains perfectly normal. But the condition of the convergence is not pointed out.

This form of paralysis may be incomplete. With paralysis of convergence we may have only paralysis of elevation (Observation V. in my memoir), or paralysis of depression (Observation by Priestley Smith).

These symptoms correspond exactly to those of paralysis by lesion of the nuclei of the 3rd pair, as we take it to be along with integrity of the nuclei of the 6th pair, which are well known to innervate the external rectus of the same side and the internal rectus of the opposite side, but only for the lateral movements.

The extension of the paralysis to both eyes may be explained by the alteration of the two nuclei which are sufficiently near to each other to be simultaneously attacked by the same lesion. Moreover it is not impossible that the lesion of a single nucleus may produce bilateral results. This hypothesis has already been advanced to explain certain cases of labio-glosso-pharyngeal paralysis (oral communication by M. Charcot).

Finally, it is not impossible that the lesion, instead of directly attacking the bulbo-pontal nuclei, is situated in a

1 'Ophth. Hosp. Reports,' 1876.
2 I do not know of any very conclusive observations on paralysis of the 3rd pair relating to one eye only in which the movements of adduction of the internal rectus are conserved in the lateral directions of looking. Therefore in considering typical nuclear paralysis we must suppose each nucleus to innervate one eye only. The following remarks bear upon a case in which this form of paralysis was well characterised, but the affection appeared to be congenital:
neighbouring centre, which acts immediately upon them, and it appears that this centre may be the tubercula quadrigemina. This appears to be the result of Wernicke's observation (paralysis of elevation in each eye, with conservation of lateral movements), where the autopsy proved a lesion of the right corpora quadrigemina, and of another by Hénoch¹ in which the paralysis of elevation in each eye was connected with a well-defined tubercular lesion of the left posterior quadrigeminal body.

It has been long known that connections exist between the oculo-motor centres and the quadrigeminal bodies. In this direction, we shall bear in mind the recent experiences of Darkchewitch,² who confirms and delineates the existence of these connections.

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Observation VIII.—Paralysis of the 3rd pair, with Conservation of the Movement of Adduction, probably Congenital.

Marie Bauv—, at 12.⁴

Left Eye.—Movements normal in monocular and binocular vision.

Right Eye.—In monocular exploring, the movements of elevation and depression almost nil. Adduction and abduction normal. Action of inferior oblique appears to be completely defective. Action of superior oblique, deprived of its antagonist by the movements of torsion, is, on the contrary, exaggerated. If the patient attempt to look downwards and outwards the eye describes a downward movement, and further undergoes a very marked degree of torsion, similar to the hands of a watch.

In exploring binocular vision the same results are found, and further that the movement of convergence, which is normal in the left is absent in the right eye; it is true this eye is highly amblyopic, only counts fingers.

No lesion of the fundus.

The pupil is slightly dilated, but there is no paralysis of the sphincter. The reflex is absent for convergence, it is feeble for light. The elevator of the upper lid is not affected. The affection appears to be congenital; the child has always squinted freely; she had convulsions at the age of 26 months.

² 'Neurolog. Centralblatt,' 1885.