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Editorial

A critique of posturology: towards an alternative neuroanatomy?

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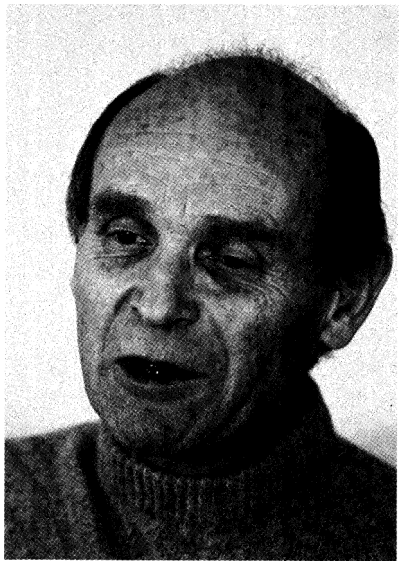

Posturology replies to the question of Charles Bell

'How does a man main sustain an upright or inclined posture against the wind blowing against him? It is evident that he possesses a sense through which he is aware of the inclination of his body and that he possesses the capacity of adjusting it and of correcting any departure from the vertical. But what then is this sense?'.

The desire to respond to this question, so marvelously formulated by Charles Bell, consituted the attractive force that gave birth to posturology: a slow birth since it involved the abandonment of inappropriate questioning, a slow birth since it was a long wait for the necessary technological advances. But since the 19th century men have sought passionately for the sense that stabilises us in our environment and have found it a plurality. There is vision, since Romberg's patients fell only when they closed their eyes; there is sensation in the lower limbs, again Romberg; there is the vestibular sensation of Flourens but also 'muscular sensation': in 1850, Longet, a pupil of Claude Bernard, showed that section of the nuchal muscles destabilised his animaIs as much as the labyrinthectomies of Flourens' pupils. Finally, there is oculomotor information, for weIl before the end of the last century Cyon demonstrated the destabilising effects of his spectacles with prismatie lenses placed before the eyes of pigeons!

The quest for a postural sense was fruitful in the 19th century, perhaps too fruitful. The researchers sought one sense and found several, and this seems to have disconcerted them since there was no sign of an attempt at synthesis.

One man, however, in the middle of the 19th century, opened a way to the answer by changing the problem: instead of seeking too hasty an explanation of the mechanism that keeps a man upright, he simply began by seeking to observe and describe this upright position itself. Unfortunately, Vierordt, in the Berlin of the 1840s, had available only a pen attached to the spikes of his soldiers' helmets, which scratched a sheet of smoked paper. The signal recorded, a mere scrawl, was very difficult to interpret and, what was worse, this technique modified the phenomenon observed by adding cephalic interference. AlI Vierordt's rivaIs, and they were many : Mitchell SW 1886, Hinsdale R 1887, Bullard WN 1903, Hancock JA 1894, Bolton JW 1903, Miles WR 1922, Fearing FS 1924,

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Latmanizova LV 1931, Hellebrandt FA 1938, Edwards AS 1924, Goldberg L 1943, to mention only the more important, encountered the same difficulties however ingenious their apparatus, until the day when progress in electronic and computer technique made it possible to record the phenomenon without modifying it and to analyse the signal. We now know how to investigate the control of orthostatic posture and its variations under the influence of various factors. Today, posturology is able to answer Charles Bell's question by supplying a simple and coherent model validated by a satisfactory series of experiments : the model of the fine postural system.

The fine-tuned postural system

It is impossible for a man in the standing position to control small variations in position in relation to the environment without the aid of sensory organs related to that environment: the retinae, the utricular and saccular maculae, and the baroreceptors of the soles of the feet are the 'exoceptors' of the fine postural system. At the moment we do not know of any others.

But the eye moves in the orbit whereas the vestibule is enclosed in the petrous block, and the information supplied by these two organs can only he used conjointly by the system if it has available complementary information as to the reciprocal position of these exoceptors. The position of the retina in relation to the macula of the utricle can be supplied only by the oculomotor system. There thus appears the concept of a particular captor of the fine-tuned postural system, the 'endocaptor', without direct relationship with the environment and yet essential to monitoring of the orthostatie posture. The same reasoning applies to the plantar exoceptors in relation to the cephalic exoceptors. The feet enjoy a great many degrees of freedom in relation to the head, and the position of the various parts of the skeleton from the occiput to the bones of the tarsus and metatarsus must he relayed to the system by the other, proprioceptive, endoceptors to provide awareness of the reciprocal position of the cephalic and plantar exoceptors.

The mass of information supplied by these exo- and endoceptors is considerable and yet aIl this information must he integrated and, what is more, in real time or else the man will become unsteady. The quality of postural control depends not only on good functioning of the different receptors and of their centripetal routes, but also - even especially - on sensory integration. The most evident quality of the control of orthostatic posture is the fineness of its precision, which is demonstrated by posturographic recordings. Every normal standing motionless man maintains his line of gravit y within a cylinder of barely a square cm in section. Such fineness of precision postulates discrimination of a particularly high acuity, the attribute of low-amplitude movements, as has been known for the neuromuscular spindles since the studies of PBC Matthews and, for the oculomotor muscles, since the work of *IB* Baron. Movements of high amplitude are not controlled with the same fineness. Only the organisation that presides over the control of orthostatic posture and of minimal postural oscillations deserves to be characterised as a fine-tuned postural system. Beyond a certain limit of destabilisation, return to the position of equilibrium is governed by another system: the semicircular canals then come into play, the bonds of muscular thixotropy are broken according to EG Walsh, and the neuromuscular spindles respond more feebly.

The posturographic study of unstable subjects confirms this distinction by isolating two populations of patients: one that functions by its fine-tuned postural system, however deranged it may be, the other not.

There should be no confusion in this matter. The behavior controlling orthostatic posture is a particular hehavior specified by identified neurophysiologie responses, and deserves a name: it is the behavior of the fine-tuned postural system.

Naive posturology

The fine-tuned postural system is a model on the route pursued by posturology, one constructed over the years to express its research, quite simple and sincerely, without taking account of when it hecame a' threat to other medical disciplines such as anatomy and clinieal neuroanatomy. For when posturology speaks of a 'system', it is really utilising the concept of the theory of compulsion, ie of the 'black box' which contains no-one knows what, which can be as complicated as it is possible to imagine, of which one knows only what goes in and what comes out, and whose transference functions can be studied. That the central nervous system should be regarded as a black box is to make a mockery of the remarkable studies of generations of anatomists! **It** means a break with the most fundamental bases of clinieal neuroanatomy, in opposition to a long, respectable and effective tradition.

It may still he accepted that, in this sense, posturology is 'non-neurological' - everyone is entitIed to pursue his fantasies - but it is clear enough that the epistemologic bases of posturology are serious and

undeniable, that what it has to say also falls within a long cultural tradition, and it even seems to display a clinical and therapeutie effectiveness. Posturology is working well! It is a naive posturology that allows itself to appear so critical.

Possibilities for a critique

On this basis there would be no possibility of reestablishing a dialogue between clinical neuroanatomy and posturology unless each contained its faults.

It is unacceptable to renounce altogether any understanding of the 'black box'. Hence, posturology necessarily appears to be marked out as of historical nature, to be only a stage. Even if this stage is presently essential, we should not bluff and disguise our ignorance of the anatomy of the central nervous system. Sooner or later posturology will rejoin the royal road of anatomo-clinical neurology, provided only that the latter also corrects its inexactitudes, For neurology takes as the foundation of its principles the concept of the 'lesion', yet in the era of the electron mieroscope and stereochemistry it may weil be asked what a lesion is. How are we entitled to refuse the term 'lesion' to a disorder that decimates only one part of the population of the neurones of the brainstem nuclei: the nuclei of III, the red nuclei as regularly seen in animals subjected to craniocervical injury , or the vestibular nuclei as has been described in man in post-concuscional syndromes? And suppose only the mitochondria have disappeared? Or if it is a neuromediator that has been deprived of a radical? Where are the bounds of the concept of the lesion? The dichotomy we still perceive between functional and lesional disorders is based on habits of thought rather th an on critical thought. We must agree to a change of scale in our view of the central nervous system: what was an enormous advance in the 19th century should not block our present progress. We need another dimension for the anatomy of the central nervous system.

Towards an alternative neuroanatomy

Current studies in posturology underline the importance of sensory integration, and particularly of its derangements in postural disorders. This means that attention is no longer focussed on the nervous pathways and centers but on the neurones and their dendrites, the sites of nervous integration. And we no longer need the histology of Ramon y Cajal but a new study of the neurone, fertilised by the essential concepts of anatomy: cranial and caudal, ventral and dorsal, right and left, and the Euclidean dimensions, the patient geometrie application to measure the neurone in its relational space. For the temporal series of events which take place at dendritie level are surely dependent on these geometrie conditions. The waves of depolarisation progress here and there on the dendrites and encounter each other or not at their branchings for strictly spatio-temporal reasons. An awareness of the geometric anatomy of the neurones is necessary even if, as we may suspect, the evolution of the temporal series hold surprises for us in their caprices. No doubt, this anatomy will usher us into the fractal domain

Conclusions

Is posturology, then critical? This was never its intention, it is solely its success which challenges and questions. All that has been said is so obvious that the only wonder is why it has not been said sooner. But since there appears to be a problem, why not survey it? And one is finally confronted with a project that is incapable of further division, the requirement to understand sensory integration in the certainty that anatomic thought must play a leading role therein.