# XXXIII. *Eſſay on the Uſe of the Ganglions of the Nerves: By* James Johnſtone, *M. D. Communicated by the Right Rev.* Charles *Lord Biſhop of* Carliſle, *and F. R. S.*

Read May 31, 1764.

THE Ganglions of the incercoſtal nerves, firſt diſcovered by Fallopius, are oblong and very hard bodies; the uſes of which have not been ſatisfactorily aſcertained by any one. Few anatomiſts have indeed entered deep into the ſubject, except the learned J. M. Lanciſi, who imagined them muſcles ſui generis, and, like other muſcles, capable of contractions; by which he thought the nervous ſpirits were acclerated and impelled with ſuch additional forces, as are by him ſuppoſed neceſſary to the production of motions in muſcles ſubject to the will: And in order to give an idea of the ſtructure of all other Ganglions, he particularly deſcribes and delineates that of the firſt cervical Ganglion (*a*).

This theory has the misfortune to be erroneous in its foundation. For Haller and other ſucceeding anatomiſts have not been able to diſcover this muſcular apparatus in the firſt cervical Ganglion (*b*). The coats of Ganglions I have found with the appearance and firmneſs of ligaments; but incapable of ſuch extenſion or retraction, as elaſtic muſcular fibres always allow of.

(*a*) See Lanciſi's Diſſertation in Morgagni adverſar.
(*b*) Halle, Element. Phyſiolog. Human. T. iv. p. 203.

Ganglions beſides, inſtead of being inſtruments ſubſervient to the will, are almoſt peculiar to nerves, diſtributed to parts, the motions of which are totally involuntary. And our author muſt indeed have been greatly miſled by his hypotheſis not to obſerve this ſtriking circumſtance.

The theory, which prevailed in his time and country, of the action of the dura mater upon the brain, now exploded, might lead this great man more entirely to believe an analogous muſcular power in Ganglions. But the brain needs no muſcular force to impreſs motion upon the animal ſpirits; and granting Ganglions to be, as is ingeniouſly conjectured by Lanciſi and Winſlow, ſubſidiary brains, or analogous to the brain in their office, neither will they need any ſuch muſcular apparatus and force. A power, in fine, abſurd no leſs than chimerical, as it ſuppoſes the force of muſcles of the greateſt exertion and effect, to be derived from thoſe of leaſt bulk and ſtrength (which muſt be in ſome proportion to the quantity of muſcular fibres); and would be a ſingle inſtance of a mechanical force producing another infinitely greater than itſelf.

1. Ganglions are obſerved to be formed generally upon nervous cords formed by the union of ſeveral different nerves. 2. They appear to abound with blood veſſels. 3. The bulk of a Ganglion exceeds, for the moſt part, that of all the nerves and veſſels, which it receives, and of which it may ſeem compoſed (*c*). Hence we may not unreaſonably conclude,

(*c*) Gangliorum moles major eſt quam ſit aggregatum omnium vaſorum ingredientium atque egredientium; quo ſit, ut ad eorum productionem, neceſſe ſit concurrere, præter communia vaſa, peculiare aliud corpus, non tam ex cohærentia et

that

that in Ganglions the different nervous filaments are very intimately mixed, a new nervous organization, or modification of the medullary ſubſtance, may take place, ſo as to ſecern new animal ſpirits, or alter the direction of thoſe already brought thither; a conjecture, which has the ſanction of the lateſt as well as the earlier thoughts of the great Morgagni (*d*).

In order to determine the particular uſe of Ganglions (the intimate ſtructure of which, equally with that of the brain and medullary ſubſtance of the nerves, we are hitherto ignorant of) in the animal ſyſtem; let us try, if ſomething tending this way may not be ſuggeſted, by reflecting on the functions and motions of the parts applied principally by nervous cords from below the Ganglions.

The intercoſtal or great ſympathetic nerves abound moſt of all others with Ganglions (*e*); and by examining what is peculiar in the motions of parts, to which theſe nerves are diſtributed, we ſhall probably be led to the uſes of Ganglions.

The muſcular ſubſtance of the heart has its principal, or rather all its nerves, from the intercoſtals;

complicatione præfatorum nervorum, ac ſanguiferorum, quam ex novis organicis partibus, quas provida ſolersque natura, ſubſiſtentibus probeq excoctis liquidis, ſimul etiam elongatis, varieque diſpoſitis, ſolidorum fibris, fingat et creat. Lanciſi, de Gangliis, loc. cit.

(*d*) See Morgagni, adverſar. Anatom. ii. p. 71. And De Sedibus et Cauſis morborum, Epiſt. xii. art. 14. p. 95, vol. I.

(*e*) Super omnes nervos, intercoſtali, Ganglia ſunt frequentiſſima, in cervice quidem tria; in thorace, lumbis, et pelvi tot, quot nervorum ex ſpinali medulla propagines intercoſtalis accipit: tum in cordis vicinia, ſub diaphragmate, circa arteriæ cœliacæ et meſentericæ originem: et circa renem paſſim in plexuoſis retibus. Haller, Elem. Phyſ. T. iv. p. 202.

which

which are always detached from the principal cords below the Ganglions, and chiefly from the inferior cervical Ganglion. The few nervous cords from the par vagum or 8 pair, which in the human ſubject are ſent towards the heart, are almoſt totally ſpread upon the pericardium and great veſſels (*f*).

In the abdomen this nerve unites with the par vagum of the right ſide (*g*), and together form the great ſemi-lunar Ganglion; from which, and from other Ganglions formed in inferior parts of the abdomen, filaments are diſtributed to the inteſtines, the liver, the ſpleen, the kidneys; and ſome of them deſcend to the Fallopian tubes, uterus, and other parts in the pelvis; ſome of which are alſo in part furniſhed with filaments from the lumbar nerves.

The heart and inteſtines being wholely ſupplied by nervous filaments detached below ſome remarkable Ganglion, we muſt inquire what is particular in the motions of theſe parts, or in their ſtructure: But the motions of the heart and inteſtines are remarkable, and exactly analogous in being involuntary, or not liable to be either ſtopped, renewed, or in any way controuled by the will.

Tho' it be very certain that theſe motions are excited in the heart by the gentle ſtimulus of the blood upon the infernal ſurface of that organ; and in the inteſtines by that of the ſecreted liquors, and of the food taken in; of which ſtimuli theſe parts have the quickeſt and moſt exquiſite perception: yet this being ordinarily not ſo ſtrong as to make us conſcious of its action, much leſs painfully ſo, can hardly be

(*f*) Haller, Elem. Phyſ. T. i. p. 366.
(*g*) Winſlow, Traité des Nerfs, N°. 141.

ſuppoſed

ſuppoſed to render theſe motions quite uncontroulable by the will, without ſome other efficient cauſe (*b*).

Anatomy diſcovers no peculiarity in the muſcular ſtructure of theſe parts likely to account for this; and, excepting in their nerves having Ganglions, which ſeem indeed almoſt appropriated to them, no anatomical difference has been obſerved, no mechaniſm, which theſe parts have more than thoſe muſcles, which are ſubject to the direction of the will.

May we not then reaſonably conclude, that Ganglions are the inſtruments, by which the motions of the heart and inteſtines are, from the earlieſt to the laſt periods of animal life, rendered uniformly involuntary; and that to anſwer this purpoſe is their uſe, which they ſubſerve by a ſtructure unknown to us, no leſs than that of the brain, though it ſeems not improbable the firſt may be analogous to the laſt?

This concluſion concerning the uſe of Ganglions is ſupported by every truly parallel inſtance. Thus the motions of the uvea, or muſcular circle of the eye, ever contracted or dilated as the eye is more or leſs irradiated with light, are as much involuntary as thoſe of the heart; and it is known to anatomiſts, that the muſcular fibres of the uvea are ſupplied by nerves from the lenticular Ganglion, which ſeems

(*b*) In the beſt explanation of the vital and involuntary motions, which the public has been favoured with, it is remarked by the moſt ingenious author, "I imagine, that the mind's want "of power over the motion of the head is not only owing to "its being continually acted upon by a ſtimulus, but in part to "an original conſtitution; and that, tho' we ſhould ſuppoſe this "organ for a little while free from every degree of irritation, yet "the mind, by an effort of the will, could not move it." Dr. Whytt's Eſſay on the vital and involuntary motions of Animals, p. 316.

formed ſolely for the uſe of that muſcle, and for that purpoſe.

That the determinations of the will are, as it were, intercepted, and prevented from reaching certain parts of the body, by the means of Ganglions, may be farther inferred by conſidering, that all nerves, which have a ready communication with the ſoul, either by affecting it with perceptions, or conveying its commands, have no Ganglions: Theſe are never found upon the olfactory, optic, or auditory nerves, any more than upon the nerves and inſtruments in voluntary motion. For we may well imagine the ſame mechaniſm, which prevents the will from extending its controul to ſome muſcles, placed upon a ſenſory nerve, would have equally hindered the conveyance of any ſenſible impreſſion to the mind.

The left nerve of the eighth pair, diſtributed to the ſtomach, and probably the cauſe of the diſtinct and exquiſite ſenſation of that organ, and perhaps alſo principally concerned in tranſmitting the ſenſe of hunger to the mind, may therefore be reckoned a ſenſory nerve. It is certain alſo, that Haller (*i*) and moſt modern anatomiſts do not allow any Ganglion to this nerve, though Winſlow does, and Vieuſſens delineates one not far from the great Ganglion of the intercoſtal nerve as proper to the eight pair.

If muſcles ſubject to the will might have been totally ſupplied with nerves, which have Ganglions; the diaphragm had probably been entirely furniſhed from the intercoſtals, as moſt of the parts in the thorax above it and in the abdomen below it are. But as the motions of this muſcular membrane were to be

(*i*) A. Haller, Primæ Lin. Phyſiolog. N°. 377.

controulable

controulable by the will, we find peculiar nerves, namely the phrenic, which have no Ganglions ſent to it from a great diſtance.

In propoſing this as the probable uſe of Ganglions, I am far from thinking it entirely exempt from difficulties; but they are chiefly ſuch, as ariſe from our imperfect knowledge of the nerves in general; a terra incognita, which remains to immortalize the name of ſome future diſcoverer in anatomy. It is well known, for inſtance, that all the nerves ſent from the ſpinal marrow have Ganglions, where they ſend off the branch, which communicates with the intercoſtals (*k*). Though this be true, it is moſt probable, that theſe Ganglions reſpect the intercoſtals, and only affect its nerves, leaving the other fibres fit and free for the conveyance of the commands of the will, as in fact many of them are diſtributed to muſcles under its power and direction.

So likewiſe we are not to imagine, wherever the nerves unite, that their medullary ſubſtance either decuſſates, or is ſo intimately mixed, as is reaſonably ſuppoſed to be the caſe in Ganglions by moſt anatomiſts from Lanciſi down to Haller. We know at leaſt, that this is far from being the caſe in the optic nerves; for though they unite, and were ſuppoſed to croſs each other, the contrary appears by obſervations made in the bodies of perſons, who were blind of one eye, from a fault in the optic nerve, the nerve of the affected ſide only being waſted, while the other was large and plump (*l*). And we may juſtly infer the

(*k*) See the table of Vieuſſens.

(*l*) See Monro's Anatomy, p. 356; alſo N° 23, of the nerves in general.

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plexiform unions of the nerves diſtributed to the ſuperior extremities not more intimate, nor to ſerve any ſuch purpoſe as Ganglions, ſince theſe nerves are equally motory and ſenſory, no other nerves being diſtributed to the ſkin, the organ of touch, but from the ſubdiviſion of theſe plexuſes.

Kidderminſter,
Nov. 24, 1763.

James Johnſtone, *M. D.*

XXXIV. *An*