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ON THE

GANGLIA AND NERVES OF THE HEART.

BY

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Fellow of the Royal College of Physicians, London.

From the PHILOSOPHICAL TRANSACTIONS.—PART I. FOR 1849.

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III. *On the Ganglia and Nerves of the Heart.* By ROBERT LEE, M.D., F.R.S., Fellow of the Royal College of Physicians, London.

Received May 7,—Read June 7, 1848.

HALLER, WRISBERG, SOEMMERING, and other eminent anatomists prior to SCARPA, have affirmed that no nerves are distributed to the muscular substance of the heart, and that its contractions do not depend upon nervous influence.

B. J. BEHREND, a pupil of SOEMMERING, in 1792 published a memoir, entitled "*Dissertatio qua demonstratur Cor Nervis carere*," in which it is admitted that nerves accompany the coronary arteries, and it is distinctly asserted that the muscular structure is entirely destitute of nerves*.

The elaborate and splendid work of SCARPA, "*Tabulæ Neurologicæ*," fol. 1794, has for its chief object the refutation of these erroneous views; but before referring to the discoveries of that great authority, I may proceed to state that in the magnificent Plates of Mr. SWAN only a few small branches of nerves have been figured, which accompany the trunks of the coronary arteries, and the muscular substance of the heart is represented as almost completely destitute of nerves.

M. CHASSAIGNAC, who translated in 1838 Mr. SWAN'S "*Demonstration of the Nerves of the Human Body*," has repeatedly denied, in the most positive manner, that any nerves except those which accompany the coronary arteries have yet been demonstrated in the heart. "*Anatomie n'a constaté jusqu'à présent, dans le cœur que des nerfs artériels*,"—"l'existence de filets nerveux indépendantes des vaisseaux propres au tissu charnu est encore à démontrer." p. 23.

SCARPA, however, had clearly delineated and described such nerves, viz. running on the heart independently of, and distinct from the coronary arteries. In the work above cited, he has given five views of the nerves of the human heart, in some of which, *e. g.* Tab. IV., upwards of twenty filaments may be counted on the same transverse line near the base of the heart, together with numerous anastomotic angular enlargements, which SCARPA does not specify as ganglions in his text. In the hearts of the larger herbivorous Mammals, however, SCARPA describes and delineates both ganglia and fusiform enlargements of the nerves, which he calls *corpora olivaria*, and these not only upon the nerves at the base of the heart, but upon those that are spread over the superficies of the ventricle: his words are, "*Præcipue autem nervorum cardiacorum trunci ad basim cordis et inter majora vasa arteriosa intumescant*

* *Ac primo quidem nervorum cordis examini scrupulosius intendens, tum observando, tum analogice concludendo didici nullos omnino nervos ne surculum quidem in ipsam cordis carnem dispergi.*

in vera et genuina ganglia ; in Equo autem et Bove etiam in iis ramis cardiacorum qui per cordis superficiem reptant nonnulla corpora olivaria gignunt*." In Tab. VII. fig. 1, he represents, and at p. 42 specifies some of these enlargements ; one, *e. g.* marked 7, as a "gangliformis intumescencia ;" a second, marked 30, as "cardiaci sinistri ganglion insigne." SCARPA also describes and figures several nerves independent of, and not accompanying the blood-vessels of the heart, and avails himself of the fact to refute the conclusions to which BEHREND'S had arrived in the Treatise above quoted.

The following are the facts relative to the nervous supply of the heart which I believe myself to have established by examination of the foetal heart, of the heart of a child at the age of six years, of the heart of an adult in a sound state, of the human heart hypertrophied, and of the heart of the Ox, and which the preparations are preserved to demonstrate.

The drawing No. 1, entitled "The nerves of the heart of a child nine years of age," nat. size, represents the preparation displaying the nerves distributed over the exterior of the left ventricle which come off from the "plexus coronarius posticus" of SCARPA†, together with a few filaments from the "plexus coronarius anterior," SCARPA. It shows the ganglions which SCARPA has delineated below the letters *a* and *b* in his Tab. IV., and also the slight enlargement at point of confluence of three or more nerves which SCARPA has likewise figured, as *e. g.* between the nerves numbered 58 and 59, and in several other parts of the cardiac nerves displayed in the Tab. IV. above cited. In the place of the long and narrow loop on the nerve which SCARPA figures between the two chief branches of the posterior coronary artery, my preparation shows, as in the drawing herewith sent, a slender fusiform enlargement. The preparation also demonstrates nerves extending beyond the points where they end in SCARPA'S figure, as far as the apex of the heart ; and a slight expansion and flattening is presented by some of these apical filaments of nerves, and nerves not coincident in their course with the arterial branches are also shown in the preparation which have neither been described nor delineated by previous anatomists.

In the dissection of the sound heart of the adult, depicted in the drawing No. 2, entitled "The ganglia and nerves at the apex of the left ventricle of the sound human heart," the additional nerves at the apex of the left ventricle are more clearly shown, in which three slender fusiform enlargements are shown on nerves accompanying the apical branch of the posterior coronary artery : there is also a well-marked angular enlargement at the point of junction of four nerves near a neighbouring branch of the artery.

The preparation which most distinctly establishes the fact of fusiform enlargements of the cardiac nerves, is that represented in the drawing No. 3, entitled "The ganglia and nerves of the left ventricle of a Heifer's heart and cardiac fascia:" in

* *Op. cit.* p. 2.

† *Tabulæ Neurologiæ*, fol. 1794, Tab. IV. Nos. 45, 46, 47, 48, 60 and 61.

which it will be seen that some of these fusiform ganglionic enlargements of the cardiac nerves are nearly in the same position as that of the "ganglion insigne," described and figured by SCARPA in the heart of the Horse, Tab. VII.

The ventricles and auricles of the human heart and those of the larger quadrupeds are covered with two distinct membranes. The first or exterior of these is the serous membrane which lines the pericardium and is reflected over the whole surface of the heart; this membrane is connected rather firmly by cellular tissue with another tunic, which has scarcely if at all been noticed by anatomists. This second membrane has a dense fibrous structure, is semitransparent, and resembles in a striking manner the aponeurotic expansions or fasciæ covering muscles in other parts of the body, and, like them, sends numerous fibres or processes between the muscular fasciculi, blood-vessels, nerves and adipose substance of the heart, which it binds closely together. This aponeurotic expansion investing both ventricles and auricles may be appropriately termed, from its structure and function, the fibrous membrane, or *Cardiac Fascia*.

The drawings, which have been executed by Mr. WEST with the greatest pains and attention to accuracy, will supply the need of special verbal description of the nervous filaments, their anastomotic enlargements and fusiform swellings; and the series of my dissections shows that the nerves of the heart which are distributed over its surface, and throughout its walls to the lining membrane and columnæ carneæ, enlarge with the natural growth of the heart, before birth and during childhood and youth, until the heart has attained its full size in the adult; that the nervous supply of the left ventricle is greater than that of the right; and that when the walls of the auricles and ventricles are affected with hypertrophy, the ganglia and nerves of the heart are enlarged like those of the gravid uterus.

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1 represents the great cardiac ganglionic plexus of nerves, situated between the aorta and pulmonary artery, which receives branches of nerves from the sympathetic, par vagum, and recurrent nerves of both sides: and likewise the ganglia and nerves distributed over the surface of the left ventricle of the heart of a child nine years of age. Natural size.

- a. The arch of the aorta.
- b. The pulmonary artery truncated at its origin.
- c. The anterior surface of the left ventricle of the heart.
- d. The anterior surface of the right ventricle.
- e. The left par vagum and recurrent nerve.
- f. The great cardiac ganglionic plexus of nerves situated between the aorta and pulmonary artery, from which all the principal cardiac nerves are derived.

- g.* The ganglionic plexus of nerves accompanying and surrounding the trunk and branches of the left coronary artery, and the ganglia and nerves distributed over the muscular substance of the left ventricle to the apex; the serous membrane and cardiac fascia having been removed.

Fig. 2 represents the ganglia and nerves at the apex of the anterior surface of the adult human heart in the natural state, with a portion of the cardiac fascia dissected off from the blood-vessels, nerves and muscular substance to which it firmly adhered.

- a.* The branches of the coronary artery at the apex of the heart surrounded by ganglia and nerves.
b. Ganglia and nerves on the muscular substance of the heart at the apex not accompanying blood-vessels.
c. The cardiac fascia.

PLATE II.

Represents a portion of the cardiac fascia, and the ganglia and nerves on the surface of the left ventricle of the Heifer's heart.

- a.* A portion of the serous membrane dissected off from the cardiac fascia.
b. The cardiac fascia with the numerous ganglia and nerves seen through it, undisturbed by dissection.
c. Branches of the left coronary artery, with ganglia on the nerves where they cross the blood-vessels.

IV. *Postscript to a Paper "On the Ganglia and Nerves of the Heart."**By* ROBERT LEE, M.D., F.R.S.

Received December 21, 1848,—Read January 11, 1849.

SINCE the communication above referred to was presented to the Royal Society, I have made a very minute dissection in alcohol of the whole nervous system of the young heifer's heart. The distribution of the ganglia and nerves over the entire surface of the heart, and the relations of these structures to the blood-vessels and muscular substance, are far more fully displayed in these preparations than in any of my former dissections. On the anterior surface, there are distinctly visible to the naked eye ninety ganglia or ganglionic enlargements on the nerves, which pass obliquely across the arteries and the muscular fibres of the ventricles from their base to the apex. These ganglionic enlargements are observed on the nerves, not only where they are crossing the arteries, but where they are ramifying on the muscular substance without the blood-vessels.

On the posterior surface, the principal branches of the coronary arteries plunge into the muscular substance of the heart near the base, and many nerves with ganglia accompany them throughout the walls to the lining membrane and columnæ carneæ. From the sudden disappearance of the chief branches of the coronary arteries on the posterior surface, the nervous structure distributed over a considerable portion of the left ventricle is completely isolated from the blood-vessels, and on these, numerous ganglionic enlargements are likewise observed, but smaller in size than the chains of ganglia formed over the blood-vessels on the anterior surface of the heart. In the accompanying beautiful drawings, Mr. WEST has depicted with the greatest accuracy and minuteness the whole nervous structures demonstrable in these preparations on the surface of the heart. But the ganglia and nerves represented in these drawings constitute only a small portion of the nervous system of the heart, numerous ganglia being formed in the walls of the heart which no artist can represent. It can be clearly demonstrated that every artery distributed throughout the walls of the Uterus and Heart, and every muscular fasciculus of these organs, is supplied with nerves upon which ganglia are formed.

EXPLANATION OF THE PLATES.

PLATE III.

Exhibits the trunk and branches of the coronary arteries, and the ganglia and nerves distributed over the anterior surface of the ventricles of the young Heifer's heart; the serous membrane and cardiac fascia having been wholly removed.

PLATE IV.

Represents the posterior surface of the same heart covered with ganglia and nerves, from the base to the apex.

PLATE V.

Represents the aorta and the anterior surface of a human heart which was hypertrophied, and weighed four pounds. The trunk and some of the branches of the left coronary artery were ossified. The pulmonary artery has been cut away close to the right ventricle. A portion of the wall of the right ventricle has been removed to expose the cavity and the septum between the ventricles. The serous membrane has been reflected off from the cardiac fascia, a small portion only of which has been left covering the ventricle.

- a. The arch of the aorta.
- b. The origin of the pulmonary artery, which has been completely removed.
- c. The anterior surface of the left ventricle.
- d. The anterior surface of the right ventricle.
- e. The great ganglionic plexus of nerves into which branches from the par vagum, recurrent and sympathetic nerves of both sides enter, and from which the principal cardiac nerves take their origin.
- f. The par vagum of the left side.
- g. The trunk of the left coronary artery ossified and completely surrounded with ganglia and nerves, which are distributed over the whole surface of the ventricle to the apex.
- h. The serous membrane reflected off from the cardiac fascia, a small portion only of which is left covering the ganglia and nerves near the apex.
- i. The cardiac fascia.

Fig. 1.

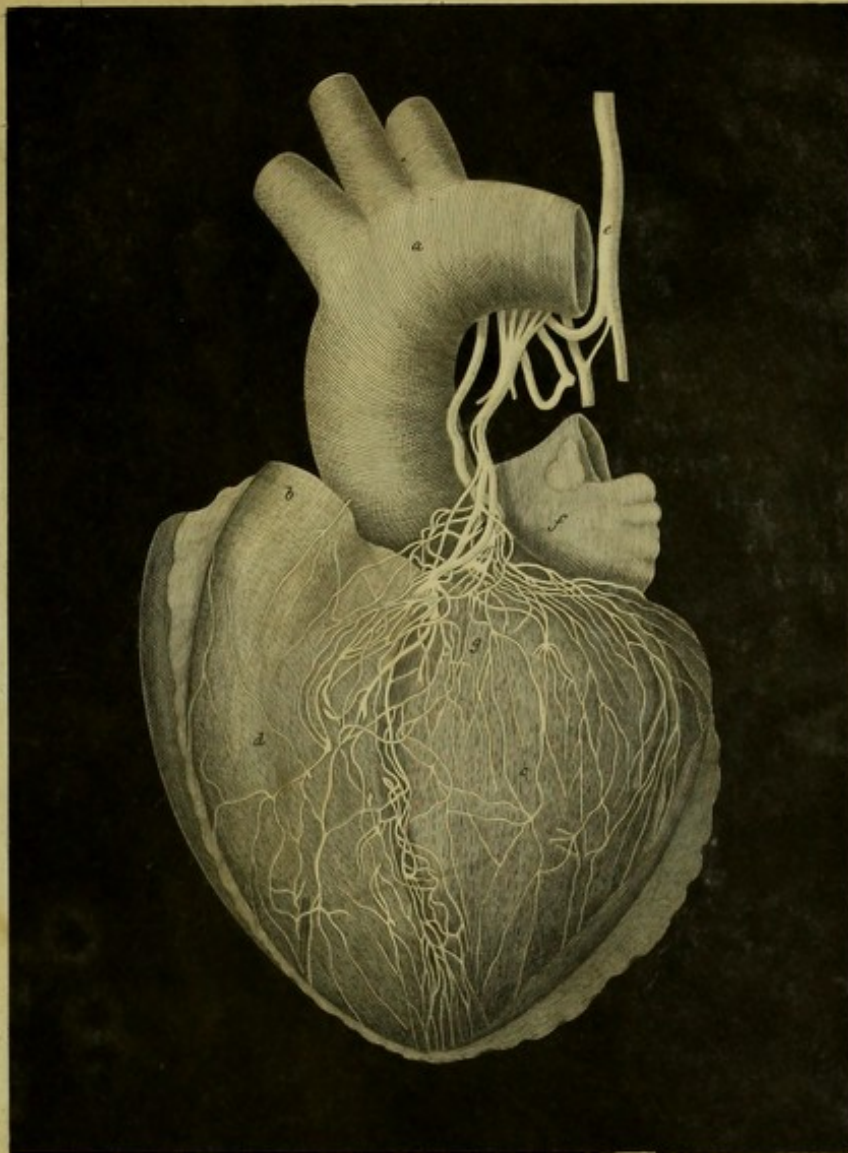


Fig. 2.

