Thesis

The Physiology of the Sympathetic System of Man

by

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Much of the Physiology of the Sympathetic System of Nervous Remains yet to be elucidated and to the Student devoting himself to the investigation of this subject a most promising field lies open. Many phenomena in disease a rational explanation of which we are unable to give would berlicable fully explained. From the Physiology of those nerves more particularly comprehended; and to the attainment of their end, investigation, of the nature of these so admirably com-
ducted by those distinguished physicians, Dr. Bernard and Brown Lipard must ultimately lead. In entering upon the subject of this dissertation, it will be well to give a succinct account of what is known with regard to the Anatomy of the Sympathetic
System of nerves: As far as our knowledge of the anatomical laws regulating nervous conduction, such a course must necessarily throw some light on their physiology. Under the term "sym pathetic nervous system" is understood two symmetrical series of ganglia connected by intermediate nervous cords reaching from the upper part of the neck to the lower part of the abdomen, forming in the celiac as in a single ganglion. Connections exist between the ganglia till the spinal nerves, & between the superior cervical ganglion to many of the cranial nerves. The bloodvessels and viscera are supplied by this system of nerves; those supplying the viscera exhibiting a great tendency to formplexuses, whence nerves are given off for the supply of neighboring organs. Here are several points in the minute anatomy of these nerves worthy of attention. The sympathetic nerve branches present a reddish-gray
appearance which has been wrongly accounted for. It has been ascribed by one authority to the presence of Ganglionic Corpuscles. This however is not probable. It is more likely that the appearance is owing to the presence of fibres which have been named "organic nerve fibres." Two kinds of fibres are found in the sympathetic nerves system—the tubular variety resembling those found in the arterial system, as those first described by Remak under the name of "organic nerve fibres," differing from the tubular variety by being softer in Consistence, and more indistinct in outline. The latter appearance being due to the form of nerve-corpuscles. The proportion of the two varieties throughout the sympathetic nerves system is unequal. The organic nerve fibres are found most abundantly in the neighbourhood of ganglia, but hardly at all in the peripheral distribution of the nerve-branches. Remak
Who was the first to describe them expressed the opinion that they are peculiar to the sympathetic system. The tubular variety of nerve-fibres being peculiar to the cerebro-spinal system. He maintained that the organic nerve fibres take their origin from the sympathetic ganglion, being afterwards associated in their course with the cerebro-spinal nerve-fibres. Many objections have been advanced against this view. It has been maintained that those structures present no analogy in appearance to nerve tubes, and that they are merely to be regarded as a modification of white-fibrous tissue serving to protect the true fibres. The principal observations confirmatory of this view are that made by Palentin, that the so-called organic nerve-fibres, instead of taking their origin from the ganglia as asserted by Remak, only arose from the fibrous sheath covering the ganglia; and 2. A very well attested one, that at a
Variable distance from the first intestine of the sympathetic nerve branches especially in the intestine, those peculiar fibers disappear. I think that an empirical consideration of the question, will lead to the adoption of Valentine's hypothesis as being the most probable. This question, however, is by no means determined. And it may be advanced in favor of Remak's opinion, that the fibers of distribution of the olfactory nerve in appearance perfectly resemble the so-called organic nerve fibers. The principal difference stated to be observed between the corpuscles in the ganglia of the sympathetic system, and those in the cerebro-spinal centers, is the existence that fewer processes are given off from the former. It is now settled that these processes are continuous with the nerve-fibers arising from the ganglion, the nature made on their Continuity in the lower animals having established this point. Some of the corpuscles in the sympathetic ganglia
nerve fibres have been demonstrated in the dura mater of the brain. And the plea
bran of the spinal cord, in the peri-
men of the Perivascular sheath and pia mater, thoroughly desribes, the fibres in the
sympathetic as terminating in a looped
arrangement. Generally speaking but
little is known of the ultimate mode of
termination of the sympathetic nerve
filaments.

Having now cursorily treated
in the anatomy of the sympathetic
system of nerves, we proceed to what
is known of their physiology. A subject
as yet imperfectly cleared up, its great
importance being sufficiently indicated
by comparatively recent observations.
A difference has been attempted to be
established between the voluntary and
voluntary acts of life, the acts of sense
of sensation, emotion, being comprised
under the first category; those not directly
modified by will or consciousness under
the second. Being that the first division

are described as destitute of these processes, others as possessing one, and
some two; hence the names apolar, monopolar, or bipolar. It has been observed
in monopolar cells, that the nerve fibre, taking origin from its process enveres
traverses its course to the periphery, while in bipolar cells it has been found, that
of the fibres arising from processes at the opposite extremities of the cell, one
takes its course to a nervous centre, the other to the periphery. This of course
is only stated with reference to the lymphatic system. In the connections between
the spinal and sympathetic systems, we find two branches, the one presenting the
white appearance characteristic of the spinal nerves, the other the gray appearance
peculiar to the sympathetic. It is supposed that the white tubular-nerved fibres belong
to the cerebral spinal system whereas they run into the sympathetic ganglia. The gray
fibres correspond in all respects with the peculiar soft fibres of the
Sympathetic, and are supposed to arise
from that system to the spinal nerves.
Güller is of opinion that the communicat-
ing fibres from the sympathetic nervous
nerve connect both with the anterior + posterior roots
of the spinal nerves; but it is still an
unsettled point whether the branches of
Communicating cent from the spinal nerves
are derived from both the anterior + posterior roots. It
is asserted by some that they are derived
solely from the posterior roots. The question
also of the course the Cerebro-Spinal
nerve fibres take after forming the
Sympathetic is undetermined. It is mainta-
ed by one party that the fibres of Communicating
in entering the Ganglionic Cent of the
Sympathetic, take their Course directly
downwards to the pelvis, by another that
the branches descending tend fibres both
upwards & downwards into the Brain
trunks of the Sympathetic. Having now
briefly touched upon some noteworthy
points, there yet remains a department in the
\textit{Innate anatomy of the Sympathetic nerves claiming our best attention, upon which alone amplification might be made far beyond the limits of a brief essay, as the peripheral distribution of this system of nerves. It has been already mentioned that the Sympathetic nerve branches consist of tubular nerve-fibers or the fibers of Remak: and it is known that the nerves are arrived at the ultimate distribution of the branches, we find the broader variety of tubular nerve-fibers disappearing; the fibers being almost entirely of the finer variety, slightly changed in appearance. Ganglia had been detected in the Cardiac intestinal \textit{\& uterine nerve} filaments, as well on the fibers as in the substance of the organs they supply. Miller also describes Ganglia in the Caruncular feeders of the penis. In glands the nerves take a definite course; they are found accompanying the blood-vessels ducts, their course not having been found separate from those Innervation Sympathetic}
is governed by the cerebro-epiglottal system, and the second by the sympa-
tic system. Mr. Bichat has regarded these sys-
tems as independent, each presiding.

to its own functions, and much may be advanced in favor of this view, even up to Comptes-rendus, recent times has been 
pretty generally accepted. Thus the 

heart continues its action when 

sensation, solition are in abeyance. Cere-

in embryos in which the cerebro-spinal 

centres are wanting, nutrition goes on. 

This view has not withstanded the 

Ante-Comptes. Valentin maintained 

that the two systems are not separate, 

that the sympathetic nerves are 

endowed with their functions by the 

cerebro-epiglottal system, and are to be 

considered as proceeding from its 

center. Even though it is undeniable 

that we are unconscious of ordinary 
impressions on the sympathized nerve 

branches, yet when their irritability 
becomes increased, as in disease, a
Denervation in pincerless. Consequences of an emaciation only taking place in the Celiac ganglion. Certain structures which secrete their secretions from the cranial accessory, the lacrimal and salivary glands, are as far as regards sensibility, situated similarly to glands supplied from the sympathetic system. The fact mentioned that in anencephalon, embryonic development proceeds in admitted, but it is denied that we have any proof that the processes of development in the embryo are regulated by nervous influence at all. In considering these two methods of viewing the relations between the two systems, I think it must be admitted that both are extreme. I think we may go the length of saying that the sympathetic ganglia act as nervous centres, generating nervous force and modifying impressions by diffusing and weakening them; but at the same time we should hesitate to say that impressions are not transmitted from one system to the other. For ever
This is not the case, how could we explain the contraction of the abdominal muscles in police, the blushing, or the fact sufficiently observed, that mental excitement is not without its effect on the secretions? It has been supposed that the gelatinous nerve fibers given the processes of nutrition, that excitation and emotion sensation and the function of the tubular variety of nerve fibers derived from the Spinal Cord. Also that the peculiar sympathetic nerve fibers from in the Spinal nerves, are derived from the Sympathetic System and regulate nutrition in the course of these nerves. This however is but a theory. The results of experiments on the frog are very indirect. It is found that the brain or Spinal Cord having been destroyed, the heart may continue to beat for weeks, the circulation as observed in the web of the foot, as well as the excretion of urine continuing. The destruction of the Spinal Cord is not however without its effects.
become topographical and loses form on the
animals, whence we may infer that
in the fry at least both systems are
engaged in nutrition. Also from other
phenomena observed, that independently
of the branches of communication
lead from the Cerbello-Galenal. System,
the Sympathetic ganglia are centers
originating both sensory and motor
filaments. That they are so in the
higher animals is undoubtedly proved
by the Confinement of the rhythmal
movements of the heart after its
removal from the body; and it will
be well here to enlarge a little on
this phenomenon. It has been doubted
whether the elements of the blood of
the micro filaments described by
Remak on the inner surface of the heart
is the Cause of the rhythmal movements
of this organ! And in vindication of
this doubt it has been advanced that
the movements of the heart take place
after its removal from the body, when
all stimuli such as air &c are excluded. Now this fact is believed to be associated with the theory alluded to—viz. that the blood to afford the stimuli to the heart to action. But this contradiction may be only seeming. We know that a certain low degree of vitality persists in the spinal and sympathetic gang for some time after the life of the brain is destroyed. As is sufficiently shown by the application of galvanic or other stimuli, and such being the case, what we must seek for is the stimuli which causes the rhythmic action to persist after death. Seeing that life has departed, that element which continually maintains the high & complex chemical composition of the organic structures of the body, resisting their tendency to a decomposition into simpler compounds, the first process that will follow on the abolition of the conduction, will be a commencing alteration in chemical composition of
the organic structures. This will probably give rise to a slight current of electricity which in the heart, being transmitted through the sensory filaments to the ganglia of the heart may give rise to the alternate contractions or dilatations of the organ.

Varying statements have been made as to the sensory properties of the sympathetic system in its branches. It is stated that the superior cervical ganglion has been removed from the neck of the horse without the animal appearing to suffer. There is no doubt however that irritation of the sympathetic system in the case of the heart ganglia or any of the larger plexuses is attended with pain; the pain diminishing in the ratio of our approach to the peripheral distribution of the branch. This is explained by the anatomical constitution of the system, it being necessary that an irritation applied to a filament near its termination must be weakened by its diffusion through so many centers before it can be transmitted to the main cord through
the Spinal Cord to the brain. Such an irritation unless very powerful, would be lost in its diffusion. It diffusion through so many centres. As to the motor properties of the sympathetic, sufficient evidence of their existence is afforded by the fact that an irritation applied to the sensory branches, gives rise to intense emotions in the past supplied by this eysytem. Thus when in an animal the abdominal worms are removed, irritants applied to the aplanchnic nerves in the thorax give rise to movements of the intestines. The application of the galvanic stimuli to the filaments of the sympathetic supplying the heart quickens the action of this organ, but it would appear that a current of sufficient strength instead of quickening arrests the movements of the heart. E.H. Weber is of opinion that the organs filaments exercise a restraining power over the muscles of the heart, the effect of irritation of these filaments being undoubtedly to either arrest altogether the Cardiac movements, such a function cannot however in my
Opinion be with any propriety ascribed to these filaments! The different effects accompanying irritation of the sympathetic and vagus filaments, being solely attributable to the fact that in the former case, the stimulus being very much diffused, is only sufficient to quicken the action of the heart; whereas in the latter case it stimulates of equal force, not being weakened but remaining concentrated paralyses the action of the organ. A similar effect has been observed to follow section of the sympathetic in the neck, viz., contraction of the pupil and alteration of temperature in the injured side of the head. These effects are imperceptible persistent with the exception that dilatation instead of contraction of the pupil ensues, when instead of mere section of the Cords excitation of the Superior Cervical ganglia is practiced. We may suppose that fibers ascend from the Superior Cervical ganglia to the Cerebellum and thence to the brain; but at the same time it must be mentioned that a similar effect—viz., dilatation of the
pupil, follows irritation of the Spinal Cord at any point between the tenth dorsal and fifth cervical vertebrae. Different views are entertained of the channel the sympathetic system takes in irritation. Some authorities go to the length of affirming that the processes of irritation are conducted independently of any nervous influence whatever, adducing as a proof nutrition in the plants and the fact that nutrition commences in the embryo before the appearance of nervous tissue. This view however is directly opposed to conclusions derived from observations and experiments; and excluding it from consideration I may view the question of irises as an attempt to determine what respective share the Cerebro Spinal and Sympathetic System take in irritation. We may here refer to a class of functions denominated secretory, motor, and secretory, to the effects of mental disturbance on the processes of secretion and digestion, and to the transmission of impressions through the Cerebro Spinal
Centers to the sympathetic system inducing changes in the state of the circulation & capillaries, we may refer to these here as evidence of the close relation by the sympathetic system in nutrition. It is however probable that it is not the sympathetic system exclusively which is engaged in nutrition. As proof of this action of the thoracic nerves before it receives sympathetic filaments has been observed to be followed by inflammation of the eyeball often terminating in complete destruction. Cases in which injury to the spinal cord are followed by mortification of the extremities are common. Many other facts showing that both systems preserve our nutrition might be adduced. But what relative share the two systems take is not yet determined. That the sympathetic system exercises a peculiar influence on nutrition by its action on the bloodvessels is known. Action of the cord in the neck causes inflammation of the conjunctiva as observed by Dr. Beunard.
in the rabbit distinct to the distension of the vessels of the ear and an increase of temperature on the injured side of the head. An increase of the lacrimal secretion is also a consequence. The increase of temperature as already
mentioned is much more persistent when excitation of the ganglion is practiced. There can I think be little

doubt that the distension of the vessels observed in this experiment is due to
their paralysis. It is stated by Dr. Remond

that when the Cephalic extremity of the
Cub Port is Galvanised, the distension of
the vessels disappears, the temperature is
also sinking even lower than in health.
I do not know that any attempt has
been made to explain this very singular
fact. It is possible that the function
of the nerve being in abeyance owing to
the injury sustained, are again called
into activity by the stimuli of
Galvanism. We may suppose the
increase of temperature on the injured
side of the head to be analogous to the increase in inflammation, there being a disturbance in the nutrition of the part partly owing to the state of the blood vessels. This matter however is much complicated by the circumstance that similar effects follow when division of each half of the spinal cord in the neck. An interesting experiment is mentioned by Valentin. When the nerves supplying the posterior extremities of the frog are divided at their roots, no disturbance in nutrition followed; wounds being slow to heal by the ordinary processes. Then however when the branches of the lumbar nerves were divided below their ganglia great disturbance of nutrition ensued. Nervous secretion stopped, the blood-colpospules disappeared, and the cord and its membranes became much congested. On removal of the lower part of the sympathetic cord, extensive mercury followed. The blood vessels of the lower extremities became distended, urine
was not described. Blood was extravasated into the bladder & despicably effusion took place. In connection with this experiment a still alluded fact may be mentioned—viz. that destruction of the renal glomeri causes an imperfect evacuation of urine, there being blood plasma & albumen found in the effusion.

With reference to the series of effects produced by section of the sympathetic spinal cord in the neck, it would be of importance to ascertain what the origin of the cervical sympathetic is. Dr. Augustinus Haller has, from repeated experiments come to the conclusion that the fibres of the sympathetic join to the iris originate from the cord between the 8th cervical & 1st dorsal vertebrae. Dr. Brown Seager however is of opinion that their origin is more extensive, having found that a section of the lateral half of the spinal cord even as low as the 10th dorsal vertebra affects the iris similarly to section
of the Sympathetic. Mr. Brown Elyot's opinion further that numerous supplying bloodvessels are derived as well from the Spinal Cord as from the Cervical Sympathetic: and found this belief on the observation that section of the lateral half of the Spinal Cord in the lower region, is followed by the local effects in section of the cervical Sympathetic, these being: 1. dilatation of blood-vessels, 2. greater afflux of blood, 3. elevation of temperature; 4. hyperesthesia of increased point of touch on sensory motor nerves. There can be no doubt that contraction of bloodvessels may take place by a reflex action through the Spinal Cord. The observation of Mr. Brown Elyot is that when one hand is dipped into cold water, the bloodvessels of the other hand contract from this. It is also recorded by several physiologists that when the cutaneous branches of some spinal nerves are cutated, the bloodvessels of the ear contract; and Mr. Brown
Edward Concedes that one of the
principal features of an effective
fit, depends upon a reflex contract-
through the sympathetic of the
ripples of the brain - for the
existence of these phenomena, the
gene
As put by the distinguished physiologist
as often mentioned, naturally presents
itself - Can we explain all the
phenomena normal & pathologic
showing the direct or the reflex influence
of the nervous system on sensation &
action by the above notions concerning
the effects of paralysis or excitation
of the sympathetic nerves on bloodflow?
I think we Cannot - I think we must
admit that a nervous influence is
dependent of the mere effect of parole,
in the size of the blood vessels, besides
over the principles of nutrition.