Peripheral Nerve-Endings in the Cat

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Peripheral nerve endings in the Cat.

Laura Hay 1895.
Peripheral nerve endings in the cut

Preparation of Materials

In the preparation of material for the study of nerve endings, I have followed Edge, "De Pasteur Annual Lectures" (1880), Ranvier's "Method of Microscopical Anatomy and Embryology," (1877) and Bristol, "American Naturalist" (Sept. 1893). Edge's method was discarded after the first trial, because the tissue was decomposed before they were sufficiently stained. A modification of Ranvier's method was employed, in which nitric acid took the place of lemon juice. The stain was only partially satisfactory, because the tissues were stained to a dark color on the outside and had little or no stain on the inside. The gold chloride method of Bristol produced a very good stain, and gave the best material for study.

Several preparations were made before satisfactory results were obtained. It had been claimed that certain compounds may be recognized for the proper results, but that the tissues were allowed to remain an hour, some minutes before placing them in acid water, and that.
that they were prepared in the afternoon and remained over night before being exposed to the sunlight.

Silver nitrate, brass-camphine, and Delafield's haematoxylin were also used for Paraffin Bodies.

The tissues were prepared for sectioning by being hardened in alcohol and embedded in Paraffin.

The parts taken were skin from the toe, nose, and lip, muscle membrane from the lip, portions of the tongue containing fungiform and circumvallate papillae, cones, tendon, retina, pancreas, stomach, intestine, muscle, and mucosa containing corpuscles of Vater. The nerve endings in the cones, tendon, stomach and corpuscle of Vater were studied, and a full description of them will be given.

Nerve endings in general.

From one point of view the nervous system may be said to have a center and a periphery. The center is made up of the brain and spinal cord, from which the nerve fibers radiate. The ultimate ends of
The nerve fibers may be called the periphery of the nervous system or the peripheral nerve endings.

The nerve trunks, when they leave the nerve center, are composed of medullated and non-medullated fibers. As the nerves space toward the exterior they subdivide many times. There are two kinds of division, one in which there is merely a separation of the fibers, and the other in which the fibers themselves are divided. In the medullated nerve, when the fibers separate, the points of separation correspond in position to the nodes of Ranvier, and at some one of these insertions the medullary substance or white matter of Schwann ends.

The nerves, now alike in structure, pass on to their destination, being covered with the neurilemma and nerve corpuscles. These corpuscles become gradually thinner until the neurilemma is entirely lost, as the nerve proceeds, the corpuscles occur less frequently and finally altogether disappear. One account of as many divisions the nerve at this point in its course is so small, it may be as single axis cylinders or as small bundle of nerve.
fibular, which is later divided into a number of
single fillets.

Classification.

The motor endings of the sense may be divided into the general classes of sensory
and motor nerve endings. The sensory nerves have two kinds of endings, those within cells,
and free ends.

Among the organs of special senses, the hair has the best known endings within cells. The
hair cells of the skin, the nasal epithelium, the
endings of the ear, and the retina, and the gustatory
cells of the taste buds, may be mentioned as
examples.

The free ends may be simple and
modified or special. The axis cylinder fibers of the
cosmoc nerve, from which the simple ends are drawn
as they near their destination, first form a demi-
sphere, then are nucleated, triangular,
chapel, nodule, points, points, etc, at the junctions
of the axis cylinders. From this sphere small bundles
of fibrillae are given off, which unite to form the
intermediate or terminal fibrillae. This fibrillae is
situated in the connective tissue of the organ,
to be supplied, and from it arise the fibrillae,
which penetrate the epithelium. They are spherical terminations between the cells for pointed or club-shaped knobs, which seem to be caused by expansion of the ends of the radula.

Many sensory nerves have specialized free endings. The simplest of these are found in the tactile cells. The latter are found in the deeper layers of the epithelium. They are oval or fusiform in shape and unbranched, resembling ganglion cells in composition. Applied to the ventrally directed uniserial of the cells is a meniscus or tactile disk with which the nerve fiber is connected. The special free endings are modifications of the tactile cell. They occur when two or more tactile cells come together to receive the nerve fiber. The meniscus and Toldi's sheath of the nerve unite with the connective tissue covering of the cells. There is a tactile disk between the cells, in which the axon extends. The nerve passes into medullary sheath while the axis cylinder enters the tactile disk.

The next higher modification is found in the tactile corpuscles. This is an ovoid sheaf
The sensory nerves are of two kinds:

1. The motor nerves are the nerves of muscle. The fibers supplying voluntary muscle are for the most part non-mixed, with a few white fibers intermixed. In such
muscle, as the fibres near their termination, they form complicated plexuses. The usual internal plexus has been observed and was
meshed with ganglion cells surrounding the medullary plexus. As the nerves come closer to their termination, the plexuses
are cut and meshed and sparse smaller fibres from the external plexus and filaments are given off, the termination of which is not definitely
known.

In voluntary muscle there are both sensory and motor nerves. The medullated nerve fibre of the motor nerves of the muscle
form a plexus between the fascicles of the muscle. Fibres are given off in such a way that each muscle fibre is supplied with one
medullated axis-cylinder. When the nerve fibre ends, the muscle fibre the medullated substance ends, and the neurilemma
with the sarcolemma to form the teloderm.
The axis cylinder continues for some distance between the muscle sheath and the sarcolemma substance. Before it breaks up into its ultimate
filaments. These filaments have a botryose
decess and end in rounded or thickened
Plate I.

A. Strand plexus from the substantia propria of the cornea.

B. Subtacular and subepithelial plexuses of the cornea.
   a. Subtacular plexus.
   b. Subepithelial plexus.

C. Nerve endings of the epithelium of the cornea. Oblique section.
   c. Basement membrane.
fibrous membranes. A flattened, uncalcified mass, composed of granular [part]phange is formed on the surface of the mucous substance, in which the terminations of the nerve are embedded. This is called the ade plate, and it, together with the nerve-endings, make up the motor disk or end plate.

Description of Contra.-

The cornea is well supplied with nerves, especially in the anterior layers. About sixty radially disposed twigs, each composed of from three to twelve fibres, enter the cornea at the limbus. Within a distance of 0.5 mm. from the limbus they become non-medullated. The nerve fibres form a coarse granular plexus, within the substantia propria, near the middle third of the cornea. [See Plate I, A.) Some fibres are given off from this plexus to supply the most external layers of the cornea, the other fibres pass inward to form the corneal plexus, which lies just beneath the anterior elastic membrane [Plate I, B.) Some fibres are given off from the plexus, which pass outward to the under...
Anders of the epithelium, where they come the subepithelial lamellae (Plate I, B). Cells of the lamellae enter the epithelium and end between the cells at the subepithelial lamellae. The Pacinian body or corpuscle of Yater is the most highly specialized of the sensory nerve-endings (Plate I, D). They are widely distributed throughout the body of the cat, but the one described here takes origin from the meninges. On the outside they are covered by a layer of endothelial plate, a continuation of the skin covering the meninges. In Yater they are regularly oval. Their near of the sides long and of the mid-side. Each body is attached to the main nerve trunk by a slender stalk made up of connective tissue, a blood vessel and one medullated fiber enclosed by its perineurium.

The three parts of the corpuscles are the capsule, the inner fiber and the nerve fiber. The capsule is made up of twenty-five to thirty concentrically placed lamellae. Each lamella has two layers of fibers, an outer transparent, and an inner longitudinal layer. The lining of the lamellae is a single layer.
A. Perinuclear body, or corpuscle of Vater. 
from the mesentery.

a. Lamellae of the capsule.
b. Nuclei of endothelial cells.
c. Core.
d. Nerve fibre.
e. Terminal branches of the aortic plexus.

B. Endothelial plates from the mesentery covering the corpuscle.

C. Endothelial plates lining the lamellae.
Of endothelial plates, whose nuclei are seen in the sections of the corioplate. (Plate II c).
The outer lamellae are thicker and are placed farther apart than the inner ones. The spaces between them are filled with a clear, serous fluid, serous in lymphatic, and partaking containing lymphoid structures.

Just inside the capsule is the inner wall. It is made up of a tissue more or less homogeneous, closely resembling proto-plasm. This mass of tissue is cylindrical in shape, a little granular or stippled in appearance. Sometimes nuclei or fibres are contained in the proto-plasm.

The nerve which enters the Pecamin body is carried by several layers of connective tissue which unite with the inner layers of the capsule and help to form the intra-capsular ligament. Some of the inner lamellae unite with the inner border of the outer layers, and thus have a part in the formation of the ligament.

The more internal lamellae have rounded ends which lie along the margin of the nerve canal.

The nerve loses its medullary substance.
at the point where it enters the cor.

Beyond this joint its appearance is changed. If its flat side is seen it seems like a flatly situated and indistinct band or strip, but when the edge is seen it appears darker and a little defined narrower line. The end of the fibre is at first an expansion of the axis-cylinder situated at the upper extremity of the core. Sometimes processes are given off from the fibre but their termination is not understood. The axis-cylinder sometimes divides after it enters the core; the point of division is not fixed as the latter may occur even after the nerve enters the core or just begin to reach its termination.

Blood is carried to the Pacinian body by means of an artery which enters along with the nerve. This artery divides into capillaries which pass between the times. Arteries are joined to carry the blood into a vein which takes it away from the corpuscle. One capillary follows the axis-cylinder as far as the core.

The use of the corpuscle of Osler is not known, but it may be inferred that
It is a nerve ending in which pressure on the lamellae and the fluid between them affects the axe cylinders in such a way as to produce results similar to those produced on the other nerve endings.

The organ of Tiber in the tendon consists of so-called tendon spindles, which is provided with a nervous network. These spindles are found in the tendon near the place where it joins the muscle. They are greatly elongated, elliptical masses made up of several tendinous bundles more or less fused into one. One end of the organ is connected with the tendon, and the other, usually with some muscle fibers. The spindle is enclosed in a connective-tissue sheath which is united with the sheath of the tendon bundles. Endothelial plates cover the surface of the spindle within the sheath. A few medullated nerve fibers enter the tendon spindle either at the center or at one end. They divide several times, and the pale non-medullated fibers spread out on the surface of the organ, the axiofibers passing between the tendon bundles and their union.
Plate III.

A. Nervous network on the surface of a tendon spindle from Tendo Achillie.

A x 195.

B. Plexus of Meissner from the stomach.

B x 195.

C. Plexus of Auerbach from the stomach.

C x 180.
From an irregularly meshed network, which, to some extent resembles the end plates of the muscles, (Plate III A). The termination of the axis-cylinder are fine wound knots, the expanded ends of nerve fibres.

The nerves supplying the stomach and intestine are derived from the sympathetic system. They contain many more unmyelinated than white fibres. The unmyelinated fibres are unmyelinated and are covered by the perineurium. They pass through the same coat of the stomach and from the pleura of Duerfack between the circular and longitudinal muscular layers. (Plate III C)

This is a rich, coarse pleura with ganglion cells at the nodal joints from this pleura fibres are given off to supply the nerve end, the outer longitudinal layer of muscle and the outer part of the circular muscular layer. Other fibres pass through the circular muscular layer and from the pleura of Mesnier in the submucosa (Plate II B).

This is also a ganglionic pleura, but is finer meshed and made up of more delicate fibres from it numerous fibres are sent
of which enter the mucosa and are distributed beneath the epithelium and to the gastric glands. This fact, termination of the phialae, has not been discovered.