On Innervation, Especially, Sensory Innervation of the Pars Pylorica, the Duodenum, the Ductus Choledochus and the Pancreas in Cat.

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Since it has become known that sensory nerve fibres and their terminations of spino-cerebral nature exist in the oesophagus, the stomach, the duodenum and the rectum in man and animals, by the painstaking researches conducted at this laboratory the problem of sensation, in particular of that of splanchnic organs is attracting the attention of clinical practitioners in Japan as a theme of special study. The subject has become a theme of debate especially at the meetings of surgeons.

As a link in the series of the studies concerned with the sensation of splanchnic organs at this laboratory, the author of this paper was also favored with the opportunity of studying the innervation, especially, the sensory innervation of the pars pylorica and the duodenum of cat, mainly from the angle of comparative anatomy. The innervation of the ductus choledochus and the pancreas also came under my investigation. The materials were fixed for long time in 10% neutral formol solution, cut into 40 μ frozen sections and stained with SETO's silver impregnation. The large series of the beautifully stained preparations thus obtained I subjected to detailed microscopic examination and arrived at some interesting observations as reported in the following.

Individual Findings.

I wish to preface the description of my findings on the innervation of the pars pylorica and the duodenum of a cat with a word on their histology. The pars pylorica is about 1 cm in breadth in the main part, loses in size gradually upon approaching the pylorus but enlarges upon passing the pylorus and entering the duodenum to become 0.7—0.8 cm in diameter. In essence, their histological pictures are not different from those of man and other animals, but when examined in details, some parts show rather peculiar structures in cat. Interestingly enough, these organs in cat histologically resemble more the same in hedgehog (EGUCHI) than
The pars pylorica of cat has several well-developed longitudinal mucous folds in it and the pyloric glands are low in the radical part of the folds and more densely arranged than in man and white rat (OHI). The mucous folds decrease in height as the pylorus is approached, and the mucous membrane itself also become thinner.

The lamina muscularis mucosae is composed of two layers of the inner circular and the outer longitudinal and is particularly well developed on the ridges of the mucous folds. The submucosa is a very thin layer consisting of a connective tissue containing a very small quantity of fat tissue. In the radical part of the folds, however, it is somewhat better developed and contains rather large blood vessels. The tunica muscularis is very powerfully developed, consisting of an inner and an outer layers, of which the former runs circularly and is far better developed than the latter, occupying more than the half of the total thickness of the pylorica. The outer layer runs longitudinally and becomes gradually thinner as the pylorus is approached, and it is of great interest that it is much poorer in development in the dorsal side of the pyloric part, almost fading out entirely sometimes. In this part, the inner layer also becomes very thin, nearly only half as thick as that in the ventral and the lateral sides.

In the mucous membrane of the duodenum of cat, it may be mentioned as an interesting fact that nearly no plicae circulares are formed as in man and other animals. The intestinal villi are better developed than those of hedgehog, but are far shorter than those in human duodenum. The intestinal crypts, however, are very elongated and are about two or three folds of the villi in length. No goblet cells were found in the intestinal epithelium of hedgehog, but in that of cat, such cells are found in a considerable number in the villi as well as the crypts. The intestinal cells of cat consist in cylindrical cells with oval nuclei in their basal part in the villi and have cuticular borders unlike those of hedgehog. The intestinal cells of the crypts are lower than the former, are cubic in form and contain round nuclei, but in the basal parts of the crypts we find cylindrical cells in arrangement.

The lamina muscularis mucosae of the duodenum of cat also consists of an inner circular and an outer longitudinal layers as that of the pars pylorica, but in development, it is here much poorer in development. The submucosa, however, is better developed here than in the pyloric part, thicker and containing duodenal glands. These glands are well developed in the proximal part of the duodenum, but gradually lose in development as we go further caudalwards, so that at the level of the opening of the choledochus they are only very rare in existence. In hedgehog, these duodenal glands are surprisingly powerful in development, taking about...
3/5—4/5 of the whole thickness of the duodenal wall, but in cat it is not at all so powerful, occupying only 1/5—1/6 of the duodenal wall in thickness. The tunica muscularis is distinctly divided into the inner circular and the outer longitudinal layers here too, but quite as in the pars pylorica, it is very poor in development in the dorsal side.

The vegetative nerves coming into the pars pylorica and the duodenum of cat originate both in the parasympathetic vagal nerves and the sympathetic nerves. These, upon reaching the serosa or the adventitia, spread out plexuswise, then run up to the AUERBACH’s plexus within the muscle layer while making further ramifications and anastomoses, ending in close connection with this plexus. The numerous fine nerve branches emerging from the AUERBACH’s plexus in part diffuse out in the muscularis but in part penetrate further into the submucosa to pass over into MEISSNER’S plexus there. The fine nerve fibres sent out from this plexus run into the propria through the muscularis mucosae. The vegetative fibres distributed in the pars pylorica and the duodenum of cat described above consist in incoming fibres from the sympathetic and the parasympathetic (n. vagus) as well as the long nerve processes (axis cylinders) of the vegetative nerve cells found in the AUERBACH’s and MEISSNER’s plexuses. The histological distinction of these three kinds of vegetative fibres is quite impracticable, especially in the periphery.

The formation of the AUERBACH’s plexus in the pars pylorica and the duodenum of cat is somewhat dissimilar from that in man and other animals. For example, in the feline pars pylorica, such plexus is found not only between the two muscle layers of the tunica muscularis but also in the powerfully developed inner circular layer here and there, containing ganglia of varying sizes. In its duodenum, besides between the two muscle layers, ganglia are found inside the outer longitudinal layer, too. The plexuses are in much better development in the pars pylorica where the muscularis is far better developed than in the duodenum where the latter is in poorer formation.

Ganglion cells are found in the MEISSNER’s plexus too. In pars pylorica, these are chiefly found in the submucosa of the longitudinal mucous folds, in particular, at their basal parts, but since in the duodenum, there is no plica circularis and the submucosa is taken up by duodenal glands, only a small quantity of ganglion cells may be found.

The ganglion cells found in the AUERBACH’s plexus in the pars pylorica and the duodenum of cat, as shown in Fig. 1, are mostly multipolar cells of sympathetic nature and may be in some cases distinguished into the DOGIEL’s Type I and Type II cells by the terminal formation of their short processes. In frequency of emergence, in human digestive canal the largest majority belongs to the Type I, only a minor part being
said to be of Type II (STÖHR, REISER, YOSHITOSHI, SATO, SETO), but in cat, cells of both the types appear in nearly equal frequency, that is to say, in the AUERBACH's plexus in cat, as well as in dog as reported by SUGAMATA in his study on the canine oesophagus and stomach, the cells belonging to DOGIEL's Type I and Type II are contained in a nearly equal number. In these ganglia of cat I found also frequently infantile type cells with their nerve processes very poorly developed and as yet very ill differentiated, and sometimes apolar cells too.

The nerve cells in the MEISSNER's plexus are severely limited in number and the few cells are of the infantile type, with their nerve processes most poorly developed, very rarely to be earmarked as belonging to either of the DOGIEL's Types (Fig. 2). In other animals also this finding seems to apply (OHI, SUGAMATA, TOYOTA, EGUCHI).

As detailed above, the development of the intramural ganglion cells found in the pars pylorica and the duodenum of cat is much poorer than in man, approximately equal with that of similar cells in dog but better than in hedgehog and white rat.

The terminal formation of the vegetative fibres is represented by STÖHR's terminal reticula in the pars pylorica and the duodenum, in agreement with the results of many past studies at this laboratory. The most typical of such reticula are found in the smooth muscle tissue of the muscularis (Fig. 3), but fairly plain samples are also observed in the submucosa and the propria too. These terminal reticula consist in extremely fine neurofibrillar net-cords provided with neuroplasma containing SCHWANN's nuclei, which never end freely but always come into mutual anastomosis. These terminal reticula stand in control by contact over all the supplied cells. Not a few researchers claim that the terminal reticula
send out side-branches to make plasmatic connection with the supplied cells, but in my study, I came upon such an observation in no case, as little
as in the results of the many studies at this laboratory.

Recently, SATO and OHTSU have demonstrated the existence of cerebrospinal sensory nerve fibres and their terminations in the human stomach and OHI, OHTSU, TOYOTA, EGUCHI, SUGAMATA and MAKINO the same in animal stomachs, thereby exploding the idea supported by many a past neurologist that the sensation in the stomach depended on autonomic nerve fibres partaking an afferrent nature. Such an existence of sensory fibres was also demonstrated by SETO, UTSUSHI and OHTSU in the human and by OHI, EGUCHI and MAKINO in animal duodena. In the wake of the above studies, I have succeeded in clearly demonstrating the existence of thick medullated sensory fibres and their terminations in the stomach, in particular, in its pyloric part, and the duodenum of cat. Consequently, I too am of the opinion that the sensation in these parts does not depend on autonomic nerves, but originates in cerebrospinal sensory fibres.

In the pars pylorica of cat, the sensory nerves probably originate in a part in the vagal nerve and partly in the nn. splanchnici (OHSAKI). These thick medullated sensory fibres first run through the outer layer of the tunica muscularis in company with very thin vegetative fibres into the AUERBACH's plexus, and thence through the inner layer of the muscularis into the submucosa, while some of them run further through the muscularis mucosae into the propria. These sensory fibres and their terminations are more numerous than in man (SATO), resembling the pars pylorica of hedgehog (EGUCHI) in this respect.

The sensory terminations are nearly never found in the tunica muscularis as in man and white rats but only in the propria as in dog (OHTSU) and hedgehog (EGUCHI). Only rarely, they are found in the submucosa and the muscularis mucosae too. Very frequently, the sensory fibres coming into the propria run beyond the bases of the pyloric glands and up through the thin connective tissue septa between the tubular glands, occasionally to end just beneath the epithelium of the foveolae gastricae.

The sensory terminations in the pars pylorica of cat, however, are simpler in construction than those of man and dog, consisting only in unbranched and simple branched terminations, on such complex glomerular terminations as found in the human pylorus being ever observed in cat. The unbranched terminations represent the simplest type of sensory terminations, consisting of single medullated fibres which, upon losing their myelin sheaths, run comparatively straight or sometimes spiral or wavy winding courses, to end in sharp points. Figs. 4 and 5 show unbranched terminations, formed in the submucosa and the propria respectively. The terminal fibre in Fig. 4 is found to show a rather markedly winding course.
In a branched termination, a medullated fibre, having lost its myelin sheath, divides out into a few branches which run straight or winding courses and end in sharp points, quite as the fibres in unbranched terminations. In Figs. 6, 7 and 8 are shown simple branched terminations found in the propria of pars pylorica. In Fig. 6, the branches all end sharply in the interglandular connective tissue septa, but never penetrating into the epithelial cells. As seen in Figs. 7 and 8, the sensory terminations
rather often accompany vegetative fibres or their terminal reticula. In the stomach of man and many other animals, snake-like terminations may be found beside these, but no such termination was found in the feline stomach in the typical form.

The sensory fibres running into the duodenum are more numerous than those in the pars pylorica in cat. They originate in the nn. splan-
chnici which come through the plexus solaris, as in man and other animals. These fibres first run through the adventitia of the dorsal wall of the duodenum to the AUERBACH's plexus, then through the muscularis into the submucosa, sometimes forming their terminations therein, but in most cases run further through the muscularis mucosae into the propria, to end in it in free endings spreading out widely.

It is of deep interest that while the development of the sensory fibres and their terminations is very good in the proximal part of the duodenum where duodenal glands are found, only very few sensory fibres are found running into the part lower than the opening of the ductus choledochus, where the duodenal glands are only ill developed, if developed at all. This seems to suggest their close relation to the digestive function. That is, the existence of sensory fibres is deemed necessary in the stomach and the upper part of the duodenum where reflex secretion from the specific glands is required upon food intake.

The sensory terminations in the duodenum formed always in the propria are more wide in their scope of diffusion than those in the pars pylorica, branched terminations sometimes being found spreading out over extremely large areas. Of course, some unbranched terminations are also in existence beside such branched terminations. The terminal branches often run winding courses while showing change in size characteristic of sensory fibres and often run up to just beneath the duodenal glands or

Fig. 8. A simple branched sensory termination accompanied by the vegetative terminal reticulum (t) formed in the propria of pars pylorica of a cat. m muscularis mucosae. Same staining. ×320.
the intestinal epithelium before ending sharply, but never into the epithelium to form intraepithelial fibres.

Two unbranched terminations formed around the ducts of the duodenal glands found deep in the propria of the duodenum of cat are shown in Fig. 9. In these, quite as in similar terminations in the pars pylorica, the stem fibre, upon losing its myelin sheath, runs a relatively straight course to end around a gland duct in a sharp point. In Figs. 10 and 11 are shown simple branched terminations similarly formed in the propria. The termination in Fig. 10 is a simple bifurcated one, both the branches of which run peculiar wavy courses while changing their size and end sharply, one in the vicinity of the base of an intestinal crypt and the other in a small lymph nodule. In Fig. 11, the stem fibre is found losing its myelin sheath upon coming into the propria and soon ramifying into terminal branches. The 3 branches directed downwards are all cut short and their subsequent courses cannot be verified, but in all probability, these spread out widely in the propria after running rather long courses, as SETO has found in human embryos in similar cases. The branch running toward the left side is seen after running a lengthy conspicuous specific winding course showing change in size ending in a sharp point. Above this termination, another termination, unbranched, is visible, ending sharply near the bases of intestinal crypts.
Before giving my description on the innervation of the distal part of ductus choledochus of cat, I will speak on its histology. The mucous membrane, provided with many small longitudinal folds very rich in undulation. The mucous glands with their bases deep in the propria open out at the bottom of these folds. The epithelium of the mucous membrane consists of very tall single-rowed cylindrical cells and that of the mucous glands of single-rowed cubic cells low in height. The propria contains a very small amount of smooth muscle fibres and consists of a connective tissue rich in cells. The ductus choledochus is wrapped up in a connective tissue rich in fat tissue on all sides, and in the part nearer the duodenal wall, a muscularis consisting in a smooth muscle tissue come into strong development. That is, upon approaching the duodenum, the ductus choledochus comes to be surrounded by the tunica muscularis extending from the duodenum. Interestingly enough, the outer longitudinal muscle layer of the duodenum becomes the outer circular layer covering the ductus and the inner circular layer of the former turns into the inner longitudinal layer of the latter. Besides, in this part of the choledochus, a lamina muscularis mucosae equally coming from the inner circular layer of the

![Fig. 10. A bifurcated sensory termination found in the propria of duodenum of a cat. m conspicuous myelin of a thick sensory stem fibre, t terminal reticulum, l small lymph nodulus, m' muscularis mucosae. Details in the text. Same staining. ×320, reduced to 4/5.](image)
duodenum begins to form. When the choledochus reaches into the duodenal wall, its own tunica muscularis goes out, but its muscularis mucosae remains in existence until the ductus opens out on the surface of the mucous membrane of the duodenum.

![Fig. 11. A simple branched sensory termination found in the propria of duodenum of a cat. m myelin of a thick stem fibre, t terminal reticulum, m' muscularis mucosae. Details in the text. Same staining. ×320, reduced to 1/2.](image)

In the choledochus still far from the duodenum and not provided with a tunica muscularis, the nerve plexus formed in the outer connective tissue layer surrounding the mucous membrane is rather poorer in development than in human embryo (UTSUSHI) and few ganglia are formed in the plexus, but as the duodenum is approached, and the tunica muscularis of the ductus comes into existence, the development of the nerve plexus becomes much more perceptible. Plexus corresponding to the AUERBACH's in the alimentary canal begins to be formed between the two muscle layers and ganglia are formed here and there. In the mucous membrane there, many fine nerve bundles are also found running. The cells in the ganglia here are not at all dissimilar in form and nature from those found in the duodenum. When the choledochus runs through the duodenum, a submucosa comes into formation by the appearance of lamina muscularis mucosae, but this submucosa is very thin, so that the development of MEISSNER's plexus in it is very poor and the ganglion cells are only very rarely found. The vegetative fibres always end in STÖHR's terminal
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reticula in the choledochus too.

As in the duodenum, thick medullated sensory fibers are found running into the plexus from the surroundings of the ductus choledochus, accompanying fine vegetative nerve fibers. In number, the sensory fibers are not inferior either and the density of the distribution of the sensory terminations in the mucous membrane of the choledochus is nearly as large as in the duodenum.

The sensory fibers in the ductus choledochus, quite as in the duodenum, form the terminations chiefly in the mucous membrane. Their terminal mode consists in unbranched and simple branched terminations as in the choledochus of human embryos (UTSUSI) and in the duodenum of cat above. The sensory fiber, upon losing its myelin sheath, without branching or ramifying into 2—3 terminal branches, ends in many places in the propria. The terminal fiber or fibers often show characteristic winding courses and usually end in sharp points. Here also the terminal branches run closely up to the mucous glands or the epithelium, but never penetrate into the cell bodies.

In Fig. 12 is illustrated an unbranched sensory termination found beneath the epithelium of the choledochus near the duodenum and showing marked change in size and winding course. Fig. 13 shows a bifurcated sensory termination formed closely beneath the epithelium of the choledochus where it runs through the duodenal wall. In this figure, the transi-

![Fig. 12. An unbranched sensory termination showing conspicuous change in size and running a wavy course formed in the propria of ductus choledochus near the duodenum of a cat. Terminal reticulum. Same staining. ×320, reduced to 4/5.](image-url)
A bifurcated sensory termination of straight type formed beneath the epithelium of ductus choledochus passing through the duodenal wall of a cat. *m* myelin of a thick stem fibre, *g* mucous glands, *t* terminal reticulum. Same staining. ×500, reduced to 2/3.

Many thick sensory fibres and an unbranched and 2 simple branched sensory terminations found in the propria of the most distal part of ductus choledochus passing through the duodenal wall of a cat. *t* terminal reticulum. Details in the text. Same staining. ×320, reduced to 3/5.
In Fig. 14 we see a rather large number of sensory fibres and two conspicuous simple branched terminations found in the distalmost part of the choledochus. These two terminations have terminal branches which all show change in size in their wavy courses and end very close to the epithelium in sharp points, but never penetrate into the epithelium. As seen in this figure, so many fibres are often found in groups in the choledochus. In Fig. 15, another simple branched sensory termination of 4 branches found near a mucous gland in the deep part of the propria of the choledochus running through the duodenal wall is shown. As that in Fig. 13, the branches here run relatively straight courses without showing much change in size and end sharply. Quite as in the case with the duodenum, the terminal fibres of these sensory terminations often accompany fine vegetative fibres along them (Figs. 14 and 15).

That PACINian bodies are found in the pancreas of cat has long since demonstrated by KRAUSE, PETRINE and KÖLLIKER and the bodies in the human pancreas have been described by CEELEN and SSOBOLEW. As these researchers, however, had only now obsolete staining methods under command, their descriptions lacked much in definition. Now, SETO and UTSUSHI (1953) have used the best silver impregnation now available in carrying out their thorough study on the innervation of the pancreas of human embryos and clearly demonstrated that a relatively large quantity...
of sensory fibres originating in the nn. splanchnici run into the pancreas, especially into its caput and form beside PACINian bodies also specific terminal bodies as well as unbranched and simple branched terminations therein. Theirs was indeed a mighty contribution to our knowledge on the sensory innervation (and the vegetative innervation) of the pancreas.

In my study on the innervation, especially, the sensory innervation, of the pancreas of cat, the time-honored theme of study by the predecessors cited above, I have succeeded in obtaining the following results upon detailed observations. A considerable number of medullated sensory fibres originating in the nn. splanchnici are found penetrating into the pancreatic head through its dorsal side, a part of them running thence toward the ductus choledochus and the pancreatic ducts (on the latter I will report in the future) and another part peripheralwards through the interlobular connective tissue of the pancreas.

First on the vegetative fibres in the pancreas. Small ganglia are frequently found in the nerve bundles therein, the nerve cells in these ganglia being of more infantile type than those found in the AUERBACH's plexus in the duodenum, but showing the multipolarity characteristic of sympathetic cells intact in most cases (Fig. 16). Not a few among them, however, are found to be apolar. Here also, as in the duodenum and the choledochus, the vegetative fibres are always found ending in STÖHR's terminal reticula and spreading out widely in the parenchyma.

Among the terminations of the sensory fibres in the pancreas, I must
first take up the PACINIan bodies found in relatively large number in its parenchyma. These are mostly of the large-size type and as shown in Fig. 17, are marked off from the surrounding pancreatic glands by thin layers of connective tissue. In such a large PACINIan body, 20—25 lamellae are found and into the narrow inner bulb containing specific cell nuclei located at the center runs single sensory fibre after losing its myelin sheath and running peripheralwards showing change in size, ends bluntly or sharply without branching out in the distal end of the inner bulb.

Fig. 18 shows perhaps two PACINIan bodies encased in common connective tissue capsule, similarly located in the pancreatic parenchyma. Rather small-typed ones are also found among the PACINIan bodies. For example, the one shown in Fig. 19 may be found a fitting sample of such a small-sized corpuscle. In such small PACINIan bodies, the lamellae number only around 10 sheets apiece. In this figure, the inner bulb and the sensory fibre running in it are very clearly illustrated.

In the pancreas of cat; such specific terminal bodies somewhat different in form from the common PACINIan bodies, having wide inner bulbs containing a large number of specific nuclei and branched terminations of sensory fibres, as found by SETIO and UTSUSHI in the pancreas of human embryos, were never observed. Unbranched and simple branched terminations, however, were found in the pancreas of cat, as much as in the human embryonic pancreas. E.g., in Fig. 17, you see a bifurcated termination found in the interlobular connective tissue septum and having terminal branches running wavy courses while showing change in size.
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Frequently, the terminal fibers of such terminations run into the interlobular connective tissue before ending.

Summary.

In the pars pylorica of cat, the tunica muscularis is much better developed than the same of the duodenum, but as the pylorus is approached, its outer longitudinal layer becomes much worse developed, sometimes to utter deficiency, in the dorsal side. In the proximal part of the
duodenum the outer layer of the muscularis is likewise very ill developed. In the pars pylorica many longitudinal mucous folds are in formation but in the duodenum such folds are almost absent. The villi intestinales of the duodenum are much lower but the crypts are much longer in cat than in man. The duodenal glands are much poorer in development in cat than in hedgehog, and become even worse developed gradually distalwards, utterly going out below the level of the opening of the ductus choledochus. Upon approaching the duodenum, the ductus choledochus comes to be surrounded by a tunica muscularis originating in the duodenal muscularis. This muscularis, however, unlike in the case of duodenum, consists here of an outer circular and an inner longitudinal layers. The part of the choledochus running through the duodenal wall is provided by a lamina muscularis mucosae, which makes transit into that of the duodenum.

In the pars pylorica of cat the AUERBACH’s plexus is much better developed than in the duodenum, and what is of interest, ganglia are found here and there in the well-developed inner circular muscle layer of the pars pylorica, and small ganglia are found in sporadic existence in the outer longitudinal layer of the duodenum as well. MEISSNER’s plexus is formed in the mucous folds of the pars pylorica, containing some small ganglion cells, but since in the duodenum, no circular folds are found, the plexus is far more inferior in development, ganglion cells being only rarely seen therein. The ganglion cells in the AUERBACH’s and the MEISSNER’s plexus, showing multipolarity and sometimes distinguishable into the DOGIEL’s Type I and Type II, belong to the category of sympathetic cells. Sometimes, however, infantile cells of apolar type are also found. The vegetative fibres always end in STÖHR’s terminal reticula in the muscularis, the submucosa and the mucous membrane too, coming into control by contact over the supplied cells.

Sensory fibres, partly originating in the nn. splanchnici but more often in the n. vagus are found running into the pars pylorica in the case of cat too, seemingly somewhat larger in number than in the case of man. These fibres end in unbranched and simple branched terminations in the propria mucosae. Their terminal fibres often show marked change in size and wavy courses and end in sharp points, not rarely running up to the bases of the epithelium and the pyloric glands but never into them. Into the duodenum of cat are found running some sensory fibres originating in nn. splanchnici, in a quantity larger than those coming into the pyloric part. The number of their terminations is the larger, the more cranial the position in the duodenum, where the duodenal glands are also better developed, diminishing rather drastically in its caudal part. This finding would be sufficient in suggesting the importance of the reflex act stimulating secretion from the duodenal glands in connection with the
digestive function. These terminations are partly formed in the submucosa but in most part in the propria. Their terminations, quite as in the pars pylorica, consist in unbranched and simple branched types, but are much more sparsely diffused and comprise some branched terminations a little more complicated than those in the pyloric part. No more complex formations, such as glomerular terminations, were found either in the pars pylorica or the duodenum of cat.

In the muscularis in the caudal part of the ductus choledochus of cat is found AUERBACH’s plexus containing ganglion cells like those in the stomach and the duodenum. The vegetative fibres end in terminal reticula here too. Sensory fibres originating in the nn. splanchnici are found running into this part also, in a rather large number and ending in the mucous membrane. Their terminations consist here also in unbranched and simple branched terminations of the same nature as those in the duodenum.

Small ganglia are formed alongside nerve bundles in the pancreas of cat too. The ganglion cells here, however, chiefly of infantile type, and the vegetative fibres here also go over into terminal reticula to spread out widely in the parenchyma. Sensory nerve fibres originating in the nn. splanchnici are found distributed in the pancreas too. As their terminations, usually large-type, but sometimes smaller, PACINian bodies are first to be mentioned. The sensory fibres running into the narrow bulb of such a body mostly end bluntly or sometimes sharply without branching out. No such specific terminal bodies as found in the pancreas of human embryos (SETO and UTSUSHI) could be found in the pancreas of cat. Secondarily, unbranched and simple branched terminations were not rarely in existence in the pancreas of cat as much as in that of human embryos.
は発達劣勢、神経細胞も稀に見られるに過ぎない、神経細胞は発極性によって交感神経に所属するが、尚無極性の幼若型細胞も所々に発見される。植物線維は何れも Stöhr 氏終末に移行し、各層内に拡散する。

猫幽門部にも知覚線維の進人が認められる。此線維は単に粘膜固有膜に来て非分歧性及び単純性分歧性終末に終る。其終末線維は太さの変化と波状走行を示し、先端は尖鋭状に終るが、屡々上皮及び幽門腺の基底部に逓達する事もある。

十二指腸には内臓神経に由来する可なり多くの知覚線維の進人が見る、其終末は十二指腸線の発達良好な十二指腸の近位部多量に見られ、膜の少い下方程少量となる。此事は消化作用の反射機能と重大関係を示すものと思われる。本終末は一部は粘膜下膜内に、多くは粘膜内に形成され、幽門部の夫と同様非分歧性及び単純性分歧性終末で表われる。但しその拡散範囲は幽門部のものよりも遙かに広い。

総胆管の開口部近くでは筋層内に Auerbach 神経叢の形成を見る。其中には幽門部や十二指腸に於ける同様な神経細胞群を見、植物線維はここでも終末に於る、又内臓神経に由来する知覚線維の進人が認められ、其終末は粘膜内に十二指腸に於けると同様に形成される。

猫腸にも神経束に沿って小神経叢が存在する。神経細胞は発極幼若型の交感性細胞から成り、植物線維は終末となって実質内に拡散する。腸にも内臓神経からの知覚線維が進入し、其終末は大小の Pacini 氏小体の外、非分歧性及び単純性分歧性終末として表われる。人胎児腸内に見られる特殊終末小体（瀬戸及び宇津志）は発見されなかった。

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References.