Reclassification on the Long Ascending Fibers from the Spinal Cord in the Rabbit, Rat and Cat

By

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Introduction

In association with the development of silver impregnation and evoked potential techniques, the long ascending pathways from the spinal cord have been studied extensively. The pathways ascending to the posterior ventral nucleus of the thalamus have been summarized anatomically and designated under different names. They are called as the dorsolateral and ventromedial spinothalamic tracts, the direct spinothalamic tract, the classical spinothalamic tract, the lateral tract, the cervicothalamic tract, and generally known as the lateral spinothalamic tract (PNA). The pathways entering the internal medullary lamina and its associated nuclei have been designated as the diffuse tegmental pathway, the medial projection, the paleo-spinothalamic tract, and generally known as the anterior spinothalamic tract (PAN). Further, the ascending pathway including the former and/or latter groups of pathways have been referred to as the spinothalamic tract, the lateral funicular fibers and the ventral spinothalamic tract.

These various nomenclatures, which should have been unified, would indicate that there remains much confusion in the findings on the long ascending pathways. Thus, an attempt has been made in the present study to reclassify these ascending pathways depending on the position in the brain stem where degenerating fibers occupied as a result of various spinal lesions. Furthermore, it seems necessary to discuss differences of the level of origin, course and terminal of such fibers in different animals, especially between the animals which have small or uncertain lateral cervical nucleus, like rabbits and rats, and those with well developed nucleus, like cats.
Materials and Methods

Thirty-five rabbits, 9 rats and 10 cats were used. In the rabbits, lesions, partial ablation, hemisection or transection, were performed at various levels from the medulla oblongata to the sacral segment. In the rats, they were made at C2, C3, T2, T13, the uppermost sacral segment and the cerebellar hemisphere including its nuclei. In the cats, they were made at C2, C3, C4, C5, T4 and L4, and through C1 to C3. After a survival time of 7 days, the animals were perfused transcardially with 10% formalin solution and then their spinal cords and brains were removed. Following a fixation time of two to three weeks, materials were soaked in 30% sucrose solution for two to three days. These were frozen and cut serially at 30 micra, mainly frontally in the rabbits and horizontally in the rats and cats. The slices were stained with Nauta-Gygax or Fink-Heimer I methods. The previous observation on the spinothalamic tract of the cat in our laboratory\(^2\) has referred to. The drawings of the mesencephalon and diencephalon with degenerating fibers were made mainly based on the atlases of Gerhard in the rabbit\(^3\), König et al. in the rat\(^4\) and Snider et al. in the cat\(^5\).

Results

The long ascending fiber systems originating from the spinal cord of the rabbit, rat and cat were shown in Figs. 1A, 1B and 1C, respectively. Fig. 2 was a composite diagram compiling these three series of figures. A correlation between terminal sites of degenerating fibers in the thalamus and the levels of their origins in the spinal cord in the three species was illustrated in Table 1. Fig. 3 showed photographs where degenerating fibers and preterminals were found.

Ascending fibers produced by lesions in the spinal cord crossed mainly to the contralateral side at the level of injury. Such fibers were located in the ventrolateral position within the spinal cord and lower medulla oblongata. A ventrolateral fiber complex issued the short ascending fiber system\(^6\) to the bulb and cerebellum, while the remainder of this fiber complex constituted the long ascending fiber systems which ascended rostrally to the mesencephalon and diencephalon.

At the level of the trapezoid body, the long ascending fiber systems were located in the lateral three fourths of the medial lemniscus and its immediately lateral region, and then they proceeded further rostrally. Degenerating fibers in the lateral part of the long ascending fiber systems could be traced in the following three fiber groups: 1) The fibers passing through the ventral part of the pontine reticular
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formation extended into the dorsolateral field of the mesencephalic reticular formation (FR-system) (Figs. 1Aa-d, 1Ba-d, 1Ca-c, 2); 2) the fibers coursing along the medial part of the lateral lemniscus entered the intermediate and deep layers of the caudal half of the superior colliculus (spinotectal system) (Figs. 1Aa, 1Ba, 1Ca, 2); 3) the fibers passing medial to the brachium of the inferior colliculus reached the medial portion of the medial geniculate body and its adjacent medial zone (GM-system) (Figs. 1Ab-e, 1Bb-d, 1Cb-d, 2). While fibers occupying more medial part of the long ascending systems in the lateral three fourths of the medial lemniscus could be separated into two systems. One, at the rostral level of the red nucleus, leaved medially and ventrally from the medial lemniscus to terminate in the Forel's H-field, zona incerta and probably the most caudal part of the drosolateral region of the posterior hypothalamic area (ventral thalamic system) (Figs. 1Ab-e, 1Bb-d, 1Cb-d, 2), and the other reached the ventral medullary lamina of the thalamus and migrated anterolaterally in it (Figs. 3A, 3B) to terminate in the posterolateral ventral nucleus (lateral

**Abbreviations**

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<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AD</td>
<td>Dorsal anterior nucleus</td>
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<td>AM</td>
<td>Medial anterior nucleus</td>
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<td>AV</td>
<td>Ventral anterior nucleus</td>
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<tr>
<td>C</td>
<td>Cervical segment</td>
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<tr>
<td>CC</td>
<td>Cerebral peduncle</td>
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<td>CCS</td>
<td>Commissure of CS</td>
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<td>CI</td>
<td>Inferior colliculus</td>
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<td>CL</td>
<td>Lateral central nucleus</td>
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<td>CM</td>
<td>Centromedial nucleus</td>
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<td>CS</td>
<td>Superior colliculus</td>
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<td>D</td>
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<td>FR</td>
<td>Reticular formation</td>
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<td>GC</td>
<td>Periaqueductal gray matter</td>
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<td>Nucleus gelatinosus</td>
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<td>GMM</td>
<td>Medial part of GM</td>
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<td>HI</td>
<td>Habenulointerpeduncular fasciculus</td>
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<tr>
<td>L</td>
<td>Lumbar segment</td>
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<tr>
<td>LD</td>
<td>Dorsal lateral nucleus</td>
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<tr>
<td>LM</td>
<td>Medial lemniscus</td>
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<tr>
<td>NLM</td>
<td>Medial lateral nucleus</td>
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<td>LMT</td>
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<td>LMTV</td>
<td>Ventral medullary lamina of thalamus</td>
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<tr>
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<td>Posterior lateral nucleus</td>
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<tr>
<td>LPI</td>
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<td>VPLm</td>
<td>Medial part of VPL</td>
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<tr>
<td>ZI</td>
<td>Zona incerta</td>
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<tr>
<td>III</td>
<td>Oculomotor nucleus</td>
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<td>IV</td>
<td>Trochlear nucleus</td>
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Fig. 1. Series of selected sections through the midbrain and diencephalon from the rabbit (A), rat (B) and cat (C). Degenerating fibers following an approximate hemisection at C2 of the rabbit and rat, and C5 of the cat illustrated by black dots. Various brain stem structures are labelled according to the abbreviations in other part.
Fig. 2. Diagram summarizing the pattern of degenerating fibers ascending in the brain stem after lesions at various levels of the spinal cord in three species. LAFS: Long ascending fiber system. FR-S: Reticular formation system. ST-S: Spinotectal system. GC-S: The fibers terminated in the periaqueductal gray matter and passed through it (spinoperiventricular system). T-S: Lateral thalamic system. IL-S: Medial thalamic system. TV-S: Ventral thalamic system. Further definite contents of these abbreviations were referred to this text and the other abbreviations in this figure were described in other part.
Table 1. A correlation between terminal sites of degenerating fibers in the thalamic nuclei and the levels of their origins in the spinal cord. GMm: Medial part of the medial geniculate body. PF: Parafascicular nucleus. VPL: Posterolateral ventral nucleus. VL: Lateral ventral nucleus. LP1: Posterolateral complex pars lateralis.

<table>
<thead>
<tr>
<th>Location</th>
<th>GMm</th>
<th>PF</th>
<th>CL</th>
<th>VPL</th>
<th>VL</th>
<th>LP1</th>
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<td>CERVICAL</td>
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<td>SACRAL</td>
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thalamic system) (Figs. 1Ad-f, 1Bc-e, 1Ce-f, 2). Degenerating fibers terminating within the internal medullary lamina and its associated nuclei (intralaminar nuclei) were composed of the fibers from both the FR-system and GM-system which interwove mutually on the rostral-most mesencephalic reticular formation (medial thalamic system) (Figs. 3C, 3D). In addition to those systems, there were fibers which passed through the reticular formation to reach the periaqueductal gray matter (Figs. 1Aa-d, 1Ba-d, 1Ca-c, 2). In all fiber systems, the more anterior the lesion of the spinal cord was, the heavier degenerating debris appeared.

Lateral Thalamic System. At the rostral level of the medial geniculate body, some fibers of the GM-system ran ventrally to intermingle with the lateral thalamic system. In the cat, fibers from the GM-system were the main component of the fibers to the posterolateral ventral nucleus, but this was not in the rat and rabbit. The location of the preterminals observed in the posterolateral ventral nucleus of the rabbit shifted more laterally according to the lesion given rostrally to caudally on the spinal cord. In the rat, degenerations following the lesions at the level higher than T13 was wide-spread in that nucleus (Fig. 1Be-f), but its amount decreased progressively as the level of the lesion in the spinal cord was lowered, whereas following the lesion at the uppermost sacral segment the degeneration was limited to the lateral margin. In the cat, on the other hand, although degenerating preterminals were confirmed in all parts of the posterolateral ventral
nucleus following lesions of the first two cervical segments, there were
only a few preterminals in the periphery resulting from the C4, C5 or
T4 lesion. The L4 hemisection provoked no degeneration in the post-
erolateral ventral nucleus. In addition, following the C4 or C5 injury
some degenerating fibers could be seen clearly in the mediocaudal part
of that nucleus (VPLm) (Fig. 1Cd) which was projected from the cere-
bral sensory cortex for the forelimbs
21,43. In the cat, some fibers of
the lateral thalamic system in the ventral medullary lamina terminated
in the lateral ventral nucleus which was situated between the posterior
ventral and medial ventral nuclei (Figs. 1Ce-f, 3E, 3F). In the rat, the
rostralmost part of the posterior ventral nuclear complex (Fig. 1Bf)
received some fibers from the cerebellar nuclei, and also a few degen-
erating fibers following the cervical to thoracic lesions. It may well
be that the area described above is a part of the lateral ventral nu-
cleus.

GM-, FR- and Medial Thalamic System. The GM-system, which
had a position in the medial part of the medial geniculate body (GMM)
and its just medial vicinity, contained fibers of passage and preterminals.
The former deviated dorsomedially to the rostral region of the mesence-
phalic reticular formation (Fig. 3G) and became one element of the
medial thalamic system. The density of the latter within the GMM
(Figs. 1Ab, 1Bb, 1Cb-c) was proportionate to the rate of development
of the GM-system. In the rabbit with a lesion at the lower thoracic
level the GM-system became obscure, nevertheless it was observed
slightly in the rat with the uppermost sacral lesion and clearly in the
cat after the fourth lumbar injury. The amount of the fibers of the
GM-system was the heaviest in the cat and the least in the rabbit.

At the lower level of the bulb, the FR-system was located on the
dorsal surface of the long ascending fiber systems and in the ventro-
medial part of the reticular formation. This system had a triangle
shape whose base made a contact with the long ascending fiber sys-
tems, and proceeded anterolaterally, maintaining such formation. At
the level of the trapezoid body, this system departed from the long
ascending systems into the mesencephalic reticular formation as a
separated pathway, but received successively a few fibers from the
long ascending systems. It was difficult to pursue this system in the
frontal section with a lower spinal lesion. In general, the higher the
level of the lesion in the spinal cord was, the more wide-spread the
expansion of this system in the reticular formation became. Further-
more, some fibers of this system passing through the mesencephalic
reticular formation to enter into the thalamus were ascertained, es-
pecially better in the horizontal section (Fig. 3H).

The medial thalamic system was composed of some fibers from
both the FR-system and GM-system. The latter was the main element
for the medial thalamic system, because, even in the case that degenerating fibers can be seen in the GM-system but not seen in the FR-system definitely, preterminals appeared clearly in the intralaminar nuclei. The medial thalamic system gave off the preterminals to the parafascicular and lateral central nuclei in all species. In the rabbit and rat the amount of preterminals within the former nucleus was more eminent than that within the latter nucleus, but this proportion was reversed in the cat. Degenerating fibers in those nuclei were scarce in the rabbit following the uppermost thoracic lesion and not so much degenerations were found even after the uppermost cervical lesion. These degenerating fibers in the rat with the lower thoracic injury were slightly more than those in the rabbit with cervical lesions, but were not found with the uppermost sacral one. On the other hand, in the cat even following the fourth lumbar lesion, preterminals in the lateral central nucleus appeared clearly. The amount of fibers of the medial thalamic system, as in the GM-system, were most numerous in the cat and least in the rabbit. Particularly in the rat the medial thalamic system projected fibers to the lateral nucleus of the thalamus\textsuperscript{30} or the posterolateral complex pars lateralis of the thalamus\textsuperscript{39} (Fig. 1Ad-e).

In addition, the level of origin of preterminals observed in the several nuclei in the thalamus of three species was summerized in the Table 1.

**Discussion**

The long ascending pathways from the spinal cord have been examined in relation to the pathway for pain sense with the Marchi method in human\textsuperscript{9,10,15,16,43,45} and in the rabbit\textsuperscript{11,23,47,48}. However, most of those investigators did not classify the ascending fibers from the spinal cord into some fiber groups. On the other hand, in the studies with Nauta methods on the long ascending fibers, many researchers\textsuperscript{25,30,34, others\textsuperscript{a}} divided them into several fiber systems.

In the present study, the course of the ascending fibers from the spinal cord to the mesencephalon and diencephalon, especially to the posterior ventral nuclear complex and internal medullary lamina and its associated nuclei, was discussed and the ascending fibers were reclassified into some fiber systems on the base of the position in the brain stem where such fibers were found.

**THE FIBERS TO THE POSTERIOR VENTRAL NUCLEAR COMPLEX**

The fibers to the posterolateral ventral nucleus (VPL) ascended in the ventrolateral area of the spinal cord and lower medulla oblongata, and at the level of the trapezoid body they ascended within the lateral
region of the medial lemniscus. At the more rostral level, they passed through the medial part of the medial geniculate body and its medial neighbouring region to terminate in the VPL. This fiber system was generally known as the lateral spinothalamic tract (PNA), while it was called the direct spinothalamic tract, the lateral tract and the classical spinothalamic tract. Kuru designated it as the dorsolateral spinothalamic tract and Kerr named it the ventral spinothalamic tract in accordance with their findings in which each of their tracts ascended in the dorsolateral portion of the lateral funiculus in the spinal cord or in the midline part of the anterior funiculus, respectively.

In the present study, the fibers to the VPL were composed of not only fibers passing through the medial part of the medial geniculate body but also fibers coursing throughout the medial lemniscus and ventral medullary lamina. The main fibers to the VPL in the cat were the former and those in the rat and rabbit were the latter. Therefore, the fibers to the VPL, our lateral thalamic system, ascended in a wider region than that heretofore described.

Concerning to the level of origin of the fibers to the VPL, there are different descriptions in the previous authors in the various animals, and even in the same animals. In the cat and dog, it is emphasized that these fibers arise in the lateral cervical nucleus of C1 and C2. These fibers were named the cervicothalamic tract. However, Getz and Anderson et al. argued that preterminals appeared in the VPL after the thoracic or lumbar lesion. In the present study of the cat, preterminals were found to a large extent in the VPL after the Cl or C2 lesion, and a small number of them appeared along its lateral margin after the C4, C5, or T4 lesion. In this point, our findings are similar to those of Getz and Anderson et al. Furthermore, following the C4 or C5 injury, we found some degenerating fibers in the caudomedial part of the VPL which was projected from the cerebral sensory cortex for the forelimbs, and following lesions of the dorsal horn and intermediate substance through Cl to C3 no terminals were produced in the lateral cervical nucleus. We assume that the fibers from the lower level than the thoracic segments terminated in the lateral cervical nucleus and then the fibers newly originating from its nucleus terminated within the lateral part of the VPL, while the fibers from the cervical segments reached directly the medial part of the VPL.

Up to this time, although the long ascending fiber systems have been studied by many authors in the various animals, there were few papers dealing with ablation from the cervical to the sacral cords. Hazlett et al. studied this problem in the opossum and noted that the fibers to the VPL originated from all spinal segments. We found simi-
lar findings in the rabbit and rat as Hazlett et al. described.

It is known that there is a direct spinal projection to the lateral ventral nucleus in the cat, the phalanger, and the opossum. A more detailed discussion of this has been made by Boivie. He described that the fibers to the lateral ventral nucleus coursed in the mesencephalic reticular formation and then passed through Forel's field H and external medullary lamina which formed the ventral border of the lateral and medial parts of the VPL. We found such fibers in the cat ascended in the medial lemniscus and entered the ventral medullary lamina. Therefore, the course of those fibers that we found is different from the course of Boivie's description. On the other hand, the lateral ventral nucleus of the rat was not illustrated in the atlas and the figures. Boivie speculated that the location of the spinothalamic degeneration in the VPL of the rats as described by Lund et al. and Mehler appeared to correspond to that in the lateral ventral nucleus described here in the cat. The area speculated by Boivie is the rostralmost part of the ventral nuclear complex. In the present study, because this area received degenerating fibers from the cerebellar nuclei and spinal cord, we consider this area to be one part of the lateral ventral nucleus. In the rabbit no debris could be seen within this nucleus.

THE FIBERS TO THE INTERNAL MEDULLARY LAMINA AND ITS ASSOCIATED NUCLEI

It has been recently reported that fibers from the spinal cord reached directly to the internal medullary lamina and its associated nuclei (intralaminar nuclei). However, the course of the fibers to these nuclei in the brain stem has not been consistent among the previous observations. It was considered that fibers diverging from the fibers to the posterolateral ventral nucleus at the caudal level of the diencephalon reached the intralaminar nuclei. On the other hand, it is emphasized that the fibers to the intralaminar nuclei ascend through the reticular formation. In the diffuse tegmental pathway by Nauta et al. in the cat, some fibers of the medial and lateral spino-reticular tracts passing through the reticular formation in the bulb received a few fibers travelling toward the posterolateral ventral nucleus within the lateral part of the medial lemniscus and its lateral vicinity at the mesencephalic level, before the mixed fibers entered the intralaminar nuclei.

In the paleo-spinothalamic tract in the monkey (Mehler et al.) and in various animals (Mehler), at the level of the mesencephalon, some fibers of the fibers to the posterolateral ventral nucleus added to the medial spinoreticular tract ascending in the medial portion of the lower reticular formation, and the caudal level of the medial
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geniculate body these mixed fibers ran dorsomedially to the intralaminar nuclei. According to the results of Anderson et al.\textsuperscript{9} in the cat, at the caudal level of the mesencephalon, his lateral tract (which was situated in the lateral part of the medial lemniscus) projected medially some fibers into the region of the mesencephalic reticular formation where the central tegmental fasciculus was located, and these fibers coursing medially were his medial projection which ascended through the reticular formation to the intralaminar nuclei. Furthermore, although the ventromedial tract by Kuru\textsuperscript{40} in man ascended through the reticular formation, it did not terminate in the intralaminar nuclei but in the posterolateral ventral nucleus. Bowsher\textsuperscript{40} described that the spino-reticulo-thalamic tract terminated in the intralaminar nuclei in man. However, his tract was composed of the spino-reticular and reticulo-thalamic tracts and thus did not terminate in those nuclei directly.

In the present study, fibers ascending in the ventromedial region of the lower reticular formation, with coursing in the brain stem more rostrally, migrated gradually lateralward with contacting on the dorsal surface of the long ascending fiber systems. At the level of the trapezoid body, they emanated from the long ascending systems to reach the dorsolateral area of the mesencephalic reticular formation. They were named the FR-system by us. Although the spinoreticular tract was divided into two fibers groups\textsuperscript{44,46}, based on the above-mentioned facts we consider that the FR-system is only one component. The medial projection\textsuperscript{22} and spinoreticular projection\textsuperscript{40} seem to coincide with some of fibers of the FR-system which pass independently and without contacting the long ascending systems through the mesencephalic reticular formation.

Fibers emerging from the lateral part of the long ascending fiber systems at the level of the trapezoid body, after passing medial to the brachium of the inferior colliculus, reached the medial part of the medial geniculate body and medial adjacent region to it. We called them the GM-system. Although it is reported that collaterals of the fibers to the posterolateral ventral nucleus terminate in the medial part of the medial geniculate body\textsuperscript{1,5,21,25,27,28,30,40,49}, we regarded the fibers to its medial part, our GM-system, as the independent fiber system.

Some of fibers diverging medially from the GM-system interwove with the FR-system in the rostral mesencephalic reticular formation. These mixed fibers made up the medial thalamic system which terminated in the intralaminar nuclei. Further, a small number of fibers from the long ascending fiber systems in the medial lemniscus swept continuously into the reticular formation and intermingled with the FR-system, but it is difficult to decide whether the sweeping fibers terminated in the reticular formation or passed through it. Thus, we
think that the medial thalamic system do not pass through a limited area in the brain stem as only one compact pathway. At this point, this system is similar to the diffuse tegmental pathway of Nauta et al. and the paleo-spinothalamic tract after Mehler et al. and Mehler, however, the components of our medial thalamic system are different from these of their tracts. In other words, there appear some differences in the interpretation of the fibers found in the bulbar reticular formation and the fibers locating medial to the medial geniculate body.

Our intralaminar nuclei where terminals were found were consisted of the parafascicular and lateral central nuclei but the centre médian nucleus. In the cat, the medial thalamic system projected further numerous fibers to the lateral central nucleus than the parafascicular nucleus, however, in the rabbit and rat to the latter nucleus than the former. Although Mehler described that the phylogenetical development of the fibers to the intralaminar nuclei was much better in the lower mammals than in the higher ones, we can see further numerous degenerating fibers in the medial thalamic system in the cat than in the rabbit.

Summary

Applying silver impregnation methods, the long ascending fibers from the spinal cord were reclassified according to the location of degenerating fibers in the brain stem as a result of lesions in the spinal cord in the rabbit, rat and cat. In the bulb, the long ascending fiber systems ascended in the medial lemniscus and lateral to it, and at the level of the trapezoid body diverged into following fiber system: The lateral thalamic system and ventral thalamic system ran through the medial lemniscus, and the former terminated in the posterior ventral nucleus and the latter terminated in the zona incerta, Forel's H-field and posterior hypothalamic area. The FR-system ascended through the reticular formation and terminated in it, and the GM-system ascended medial to the brachium of the inferior colliculus to reach the medial part of the medial geniculate body. Some fibers of these two system interweaving with each other in the rostral mesencephalic reticular formation made up the medial thalamic system which terminated in the internal medullary lamina and its associated nuclei (parafascicular and lateral central nuclei). The spino-ectal system terminated in the superior colliculus and passed through it. Further, there occurred the fibers terminating in the periaqueductal gray matter and passing through it.

Terminals in the posterior ventral nucleus were observed following the all spinal lesions in the rabbit and rat, and in the cat numerously after the first two cervical lesions and scarcely after the other cervical
and upper thoracic ones. In the cat, probably in the rat, some fibers of the lateral thalamic system terminated in the lateral ventral nucleus.

Development of the medial thalamic system was most prominent in the cat and least prominent in the rabbit in three species. Degréenerating fibers in the internal medullary lamina and its associated nuclei were scarce in the rabbit following the uppermost thoracic lesion and not so much degeneration was found even after the uppermost cervical lesion. These degenerating fibers in the rat were slightly more following a lower thoracic injury than those in the rabbit with some cervical lesion, and were not found with the uppermost sacral one. On the other hand, in the cat even following the fourth lumbar lesion, preterminals in the lateral central nucleus appeared clearly.

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Plate I

Fig. 3-A. A lower power photomicrograph of a frontal section of the caudal diencephalon of the rat shows the reticular formation (FR), habenulopeduncular fasciculus (HI), posterior ventral nucleus (VP), ventral medullary lamina (LMTV) and medial geniculate nucleus (GM). Nauta-Gygax method (N-G). ×20

-B. A high power photomicrograph of a frontal section of the area outlined by the rectangle in the Fig. A. ×200

-C. A lower power photomicrograph of a horizontal section of the rostral midbrain and the caudal diencephalon of the rat. N-G. ×20

-D. The degenerating fibers illustrated in the Figs. G, H intermingle with each other within the region outlined by the rectangle in the Fig. C. N-G ×20

-E. A lower power photomicrograph of the posterolateral ventral (VPL), lateral ventral (VL), medial ventral (VM) nuclei and ventral medullary lamina (LMTV) of the cat. N-G. ×20

-F. The degenerating fibers in a part of the VL outlined by the rectangle in the Fig. E. N-G. ×200

-G. The degenerating fibers passing within the mesencephalic reticular formation of the horizontal section of the rat. N-G. ×200

-H. The degenerating fibers passing through the medial part of the medial geniculate nucleus run dorsolaterally to reach the rostral mesencephalic reticular formation in the horizontal section of the rat. N-G. ×200