On the commissura postoptica in the brain of a newt, Triturus pyrrhogaster*)

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With nineteen figures

I. Introduction

The complex commissura postoptica is represented in teleosts by the commissura transversa of Haller and likewise in mammals by the commissura supraoptica. In teleosts, this commissure has been analysed by Brickner ('29), Jansen ('29), Kudo and Suzuki ('34), Suzuki ('35) and Oki ('55). The composition of this commissural systems is so different in amphibia and mammals that exact homologies cannot be established. In amphibia and teleosts its constitution is also considerably different among the interrelating fiber pathways. The postoptic commissure in the amphibian brains has clearly been described by Röthig ('24, '26), Huber and Crosby ('29) and Kato, Kagami, Tamura and Kawakami ('52). In urodeles, especially in Amblystoma and Necturus, this complex system has accurately been analysed by Herrick ('34, '41, '44, '48).

The fibers of few of these components are assembled in well organized tracts but most of them are so dispersed and commingled that analysis is very difficult, so that their distribution after crossing baffled analysis as indicated by Herrick ('48). Moreover, the direction of conduction of most of these fibers has not been clearly determined, though most of the larger systems evidently converge from the sensory zone with the motor field. Further analysis of intervening species is requisite before these relationships can be clarified. In this paper, therefore, the fiber analysis of the commissura postoptica in urodeles, especially for Triturus pyrrhogaster, has been enterprised.

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II. Material and Methods

For this purpose, adult brains of Triturus pyrrhogaster were employed. After completely fixed with the neutral formalin (10%), the brains were cut frontally, sagittally and horizontally (ca. 15-20 μ in thickness). These serial microscopic preparations were treated with several neurohistological methods, such as Pal-carmine, Sugamo's method, pyridin silver method and Bielschowsky's silver impregnation. These serial sections of the aforesaid methods are favorably employed according to the different directions of various fiber pathways which perform the composition of the commissura postopica.

III. Abbreviation for all figures

B. .............................division B of tractus thalamo-tegmentalis dorsalis cruciatus
caud. part of com. po.......caudal part of commissura postoptica
ch. op. ......................chiasma opticum
com. p. ......................commissura posterior
com. po. .....................commissura postoptica
dec. ch. op. ..................decussation of chiasma opticum
f. l. tel. d. .................fasciculus lateralis telencephali dorsalis
f. l. tel. m. .................fasciculus lateralis telencephali medialis
f. l. tel. v. ...................fasciculus lateralis telencephali ventralis
f. med. n. op. ..............fasciculus medialis nervi optici
f. med. t. ....................fasciculus medialis telencephali
f. retrofl ....................fasciculus retroflexus
lem. l. ......................lemniscus lateralis
med. foreb. b. ..............medial forebrain bundle
nuc. hab. ....................nucleus habenulae
nuc. preop. ..................nucleus preopticus
olf. pr. tr. ...................olfactory projection tract
p. d. th. .....................pars dorsalis thalami
ped. ........................peduncle
p. p. d. ......................primordium palli dorsalis
p. v. h. ......................pars ventralis hypothalami
p. v. th. .....................pars ventralis thalami
rec. preop. ...................recessus preopticus
s. m. .........................sulcus medialis
s. v. ........................sulcus ventralis
s. v. a. .......................sulcus ventralis anterior
s. shab. ........................................ sulcus subhabenularis

tr. h. ped. teg. .................................. tractus hypothalamo-peduncularis et tegmentalis

tr. h. teg. ........................................ tractus hypothalamo-tegmentalis

tr. ol. ped. ........................................ tractus olfacto-peduncularis

tr. op. b. ........................................ basal bundle of tractus opticus

tr. op. l. ........................................ tractus opticus lateralis

tr. op. med. ...................................... medial bundle of tractus opticus

tr. ped. h. ........................................ tractus pedunculo-hypothalamicus

tr. pret. h. ....................................... tractus pretecto-pypothalamicus

tr. st. ped. ........................................ tractus strio-peduncularis

tr. st. t. ........................................ tractus strio-tectalis

tr. t. ped. c. ..................................... tractus tecto-peduncularis cruciatus

tr. t. h. a. ......................................... tractus tecto-hypothalamicus anterior

tr. t. teg. r. ...................................... tractus tecto-tegmentalis rectus

tr. t. th. h. c. a. .................................. tractus tecto-thalamicus et hypothalamicus cruciatus anterior

tr. t. th. h. c. p. .................................. tractus tecto-thalamicus et hypothalamicus cruciatus posterior

tr. th. h. ........................................... tractus thalamo-hypothalamicus

tr. th. h. d. c. a. .................................. tractus thalamo-hypothalamicus dorsalis cruciatus anterior

tr. th. ped. v. ..................................... tractus thalamo-peduncularis ventralis

tr. th. front. ...................................... tractus thalamo-frontalis

tr. th. h. d. c. a. .................................. tractus thalamo-hypothalamicus dorsalis cruciatus anterior

tr. th. teg. d. c. B. ................................ tractus thalamo-tegmentalis dorsalis cruciatus B

tr. th. teg. v. c. .................................. tractus thalamo-tegmentalis ventralis cruciatus

IV. Description

1. Findings on the transverse series of Bielschowsky's silver impregnation (Figs. 1-5).

The foremost commissural part of the commissura postoptica may favorably be observed with the transverse series. This commissural portion is situated rather posterior than that of Amblystoma tigrinum (comp. Herrick, '48, p. 375, fig. 95), so that it begins to appear at the level where the commissura habenularum is almost out of sight (fig. 1.).
In this section the basal bundle of the lateral optic tract of both sides are estranged from each other. The commissural fibers transit the ventro-medial part of the diencephalon beneath the pretectal area. The fibers of the fasciculus medialis nervi optici appear immediately ventral to the nucleus preopticus. The crossing fibers of the fasciculus medialis telencephali ventralis et dorsalis can scarcely be observed being distributed in the descending fiber bundles of the tractus thalamo-hypothalamicus cruciatus anterior. The crossing fiber groups of the tractus strio-peduncularis or fasciculus lateralis telencephali are situated at the level of the pars ventralis thalami.

Three sections more caudally (fig. 2), the crossing fibers of the tractus thalamo-peduncularis appear at the level of the pars dorsalis thalami. The fibers of the tractus tecto-thalamicus et hypothalamicus cruciatus anterior and the tractus thalamo-hypothalamicus cruciatus descend ventro-medially in parallel with the fibers of the medial part of the tractus opticus. The crossing fiber bundles of the tractus strio-peduncularis lies at the level of the sulcus ventralis.

Two sections more caudally (fig. 3), the fibers of the tractus tecto-thalamicus et hypothalamicus cruciatus posterior and the tractus thalamo-hypothalamicus cruciatus descend ventro-medially but it is difficult to be separated from each other in these series. The fibers of the fasciculus medialis nervi optici decussate at the ventro-medial region under the preoptic area.

Two sections more caudally (fig. 4), the fibers of the tractus tecto-thalamicus et hypothalamicus cruciatus anterior et posterior and the tractus thalamo-hypothalamicus stream ventro-medially to reach the postoptic complex. The tractus thalamo-tegmentalis dorsalis cruciatus B appears at the level of the pars ventralis thalami above the pathway of the fasciculus lateralis telencephali.

Three sections more caudally (fig. 5), the crossing fibers of the tractus strio-peduncularis, the tractus strio-tegmentalis and the tractus olfacto-peduncularis are well recognized as shown by Herrick in Amblystoma tigrinum. In this section the fibers of the tractus thalamo-peduncularis run vertically in parallel with the fibers of the tractus thalamo-hypothalamicus cruciatus anterior. The tractus tecto-thalamicus et hypothalamicus anterior performs a somewhat thick commissuration in the postoptic commissure. In this section, both of the sulcus ventralis and sulcus ventralis anterior are clearly marked. The cell-arrangement of the periventricular area is scarcely distinguished by these sulci.
2. Findings on the sagittal series of Sugamo's method and Weigert-Pal series (Figs. 6-12).

In the plane which includes almost the whole length of the tractus tecto-thalamicus et hypothalamicus cruciatus anterior (fig. 6), the fibers of the lateral optic tract pass along the fronto-lateral margin of the diencephalon. In this section, the fibers of the tractus tecto-thalamicus et hypothalamicus cruciatus anterior and the tractus tecto-hypothalamicus anterior can well be traced in the internal zone of the tractus pretecto-hypothalamicus. Further internal to the above-mentioned pathways, a few of fibers of the tractus thalamo-hypothalamicus are diffusively arranged and ventrally participate to perform the postoptic complex. The somewhat highly myelinated fibers of the tractus hypothalamo-peduncularis et tegmental is are loosely arranged being commingled with the fibers of the lateral lemniscus. The fibers of the tractus thalamo-peduncularis cruciatus pass caudo-ventrally in the peduncle being intersected with the descending fibers of the tractus tecto-thalamicus et hypothalamicus anterior.

Four sections more laterally (fig. 7), the fibers of the fasciculus lateralis telencephali dorsalis et ventralis run into the frontal area of the diencephalon and some of them extend caudally to consist of a part of the postoptic commissure. In this section, a part of the tractus thalamo-hypothalamicus dorsalis cruciatus anterior run vertically to make a component of the commissura postoptica. Along the internal zone of the aforesaid bundle, the fibers of the tractus tecto-thalamicus et hypothalamicus cruciatus posterior are loosely arranged, being intersected with the fibers of the tractus thalamo-peduncularis cruciatus. A few of fibers of the tractus hypothalamo-peduncularis et tegmental is can scarcely be traced. The fronto-ventral component of the lateral optic tract and the commissura postoptica are irregularly pierced by the fibers of the medial forebrain bundle.

Seven sections more laterally (fig. 8), the fibers of the fasciculus lateralis telencephali dorsalis et ventralis stream caudo-dorsalward and intermingle with the fibers of the tractus tecto-thalamicus et hypothalamicus cruciatus posterior. The feeble fibers of the olfactory projection tract pass through the ventral portion of the commissura postoptica. A small number of the tractus hypothalamo-peduncularis can be traced. At the tegmental area, the complex commissure is consisted of the fibers of the tractus thalamo-tegmentalis dorsalis cruciatus and the lateral lemniscus. The fibers which arised from the dorsal thalamus
take two directions of pathways toward the peduncle and the hypothalamus. The former is the tractus thalamo-peduncularis cruciatus and the latter is the tractus thalmo-frontalis.

Four sections more laterally (fig. 9), the fiber bundles of the commissura posterior and the fasciculus retroflexus can well be traced. The fibers of the medial forebrain bundle or fasciculus medialis telencephali run caudo-ventrally to commingle with the commissura postoptica. The fibers of the tractus thalamo-tegmentalis ventralis run caudally to make a peduncular complex. In this section, the fibers of the tractus pedunculo-hypothalamicus stream fronto-ventrally to make a component of the commissura postoptica. The crossing fibers of the chiasma opticum and the diagonal fibers of the fasciculus medialis nervi optici can be found.

Six sections more laterally (fig. 10), where the chiasma opticum is cut in the median plane, the fibers of the fasciculus medialis nervi optici appear at the dorso-medial ridge of the chiasma opticum.

Twenty sections more laterally (fig. 11), after past through the median plane, where the commissura posterior includes almost the whole length of it, the tractus thalamo-tegmentalis ventralis cruciatus can well be estimated in a slender fiber bundle being intermingled with the fibers of the fasciculus retroflexus, the tractus hypothalamo-peduncularis et tegmentalis et and a small number fibers of the tractus olfacto-peduncularis. The feeble fibers of the tractus tecto-thalamicus et hypothalamicus posterior swing medio-ventrally to stream into the caudal part of the commissura postoptica.

Two sections more laterally (fig. 12), the fibers of the tractus tecto-thalamicus et hypothalamicus cruciatus posterior can well be traced. The fibers of the tractus olfacto-peduncularis feebly stream caudalward to enter the peduncular complex.

3. Findings on the sagittal series of pyridin silver method (Figs. 13–15).

In the plane which includes almost the whole length of the commissura posterior and the fasciculus retroflexus (fig. 13), the fibers of the tractus hypothalamo-peduncularis et tegmentalis can clearly be traced in a curved course between the tegmentum and the hypothalamus. The fine fibers of the tractus olfacto-peduncularis which arised from the strio-amygdaloid area extend caudally in parallel with the fasciculus lateralis telencephali. Some of them extend to the peduncle after in-
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4. Findings on the horizontal series of Pal-carmine deying (Figs. 16–19).

At the level of the pars ventralis hypothalami where the hypophysis is horizontally cut (fig. 16), the decussation of the chiasma opticum can be recognized at the anterior border of the chiasma and there is commingling of optic fibers with those of the commissura postoptica at the posterior ridge.

Seven sections more dorsally (fig. 17), a few of fibers of the fasciculus medialis nervi optici decussate near the basal region of the recessus preopticus. The chiasma opticum and the basal bundle of the lateral optic tract can well be designated. The crossing fibers of the tractus hypothalamo-tegmentalis ventralis cruciatius and the tractus tecto-thalamicus et hypothalamicus cruciatius posterior can scarcely be

termingled with the commissura postoptica and the others spread in the pars ventralis hypothalami to intermingled with the commissura postoptica. The fibers of the tractus tecto-thalamicus et hypothalamicus appear being cut off in its path by the fibers of the olfactory projection tract. The fibers of the fasciculus medialis nervi optici occupy the medio-dorsal ridge of the chiasma opticum.

Four sections more laterally (fig. 14), the fibers of the fasciculus lateralis telencephali dorsalis et ventralis elongate caudo-dorsally in a compound thick bundle being commingled with the fibers of the tractus tecto-thalamicus et hypothalamicus cruciatius posterior. The fibers of the tractus olfacto-peduncularis take nearly a parallel course with the fasciculus lateralis telencephali and elongate to the pedunculum region (fig. 15). The fibers of the tractus tecto-thalamicus et hypothalamicus cruciatius anterior et posterior descend antero-ventrally and consist of the chief part of the commissura postoptica. The feeble fibers of the medialis forebrain bundle pass through the fiber course of the commissura postoptica and some of them spread in the pars ventralis hypothalami. The fibers of the tractus pretecto-hypothalamicus leave the pretectal region and stream ventrally in parallel with the fibers of the tractus thalamo-hypothalamicus. These fibers are, however, difficult to clearly distinguished from the fibers of the tractus tecto-thalamicus et hypothalamicus cruciatius anterior et posterior. The fibers of the tractus thalamo-peduncularis cruciatius arise from the dorsal thalamus and descend ventro-caudally to the peduncle almost in parallel with the commissura posterior.
observed. The accurate analysis of the postoptic neuropil is uncertain in this section.

Seven sections more dorsally (fig. 18), the tractus opticus lateralis and the basal bundle of the tractus opticus are situated at the diencephalic lateral margin. The fibers of the fasciculus medialis nervi optici make a thick fiber decussation and the fibers of the commissural portion of the commissura postoptica are somewhat densely arranged. A few of fibers of the tractus tecto-thalamicus et hypothalamicus cruciatus posterior commingle to perform the postoptica complex. Among these fibers of this commissure, the crossing fibers of the tractus thalamo-tegmentalis ventralis cruciatus are well defined.

Fifteen sections more dorsally (fig. 19), at the level of the decussation of the fasciculus medialis telencephali, the commissural portion is quite absent, so that the crossing fibers of the tractus tecto-thalamicus et hypothalamicus cruciatus are diagonally cut but it is difficult to be distinguished into two constitutions of pars anterior et posterior.

5. General observation

The fiber components which participate in the performance of the commissura postoptica in the brain of Triturus pyrrhogaster are estimated as follows:

1) Tractus tecto-thalamicus et hypothalamicus cruciatus anterior which arised from the dorso-medial part of the tectum opticum descend across the thalamus to enter the postoptic commissure. This tract perform a chief component of the commissura postoptica. Almost the whole length of this tract can well be traced in the sagittal sections of Sugamo's method (fig. 6) and the transverse sections of silver impregnation (figs. 2, 3).

2) Tractus pretecto-hypothalamicus which arised from the pretectal area descends across the thalamus and elongates in the postoptic neuropil accompanying with the fibers of the tractus pretecto-thalamicus. This tract is also clearly visible in the sagittal sections of silver impregnation (fig. 15) and Sugamo's method (fig. 6).

3) Tractus tecto-thalamicus et hypothalamicus cruciatus posterior which arised from the caudal part of the tectum opticum and stream antero-ventrally to consist of a chief component of the commissura postoptica with the tractus tecto-thalamicus et hypothalamicus cruciatus anterior. This tract can well be traced in the sagittal sections of silver impregnation (figs. 14 and 15), but the commissural part of this tract
can scarcely be distinguished from that of the tractus tecto-thalamicus et -hypothalamicus cruciatus anterior.

4) Tractus tecto-tegmentalis cruciatus which may arise from the posterior part of the tectum opticum descends antero-ventrally in company with the fibers of the tractus tecto-thalamicus et-hypothalamicus cruciatus posterior. They are scarcely distinguished from the fibers of the latter tract.

5) Tractus thalamo-peduncularis cruciatus which arised from the dorsal thalamus takes a dispersed course to the peduncle. This pathway is considerably well recognized in the sagittal sections of Sugamo's method (fig. 8) and silver impregnation (fig. 15).

6) Tractus thalamo-hypothalamicus cruciatus which takes the common origin with the above-mentioned tract is difficult to be distinguished from that of the tractus tecto-thalamicus et-hypothalamicus cruciatus anterior et posterior. This tract is indicated in the sagittal sections of Sugamo's method (figs. 6 and 7) and also in silver impregnation (figs. 14 and 15).

7) Tractus thalamo-tegmentalis ventralis cruciatus can tolerably well be observed in the sagittal section of Sugamo's method (fig. 8).

8) Tractus hypothalamo-peduncularis et-tegmentalis which connects the pars ventralis hypothalami and the peduncle or tegmentum can well be traced in the sagittal sections of silver impregnation (figs. 13 and 14) and Sugamo's method (figs. 7, 8, 9 and 11).

9) Tractus olfacto-peduncularis which arised from the strio-amygdaloid area pass caudalward in parallel with the fasciculus lateralis telencephali. Some of them extend to the peduncle and the others spread in the pars ventralis hypothalami. The latter fibers intermingle with the postoptic neuropil. This tract can well be found in the sagittal sections of silver impregnation (figs. 12, 13, 14 and 15).

10) Medial forebrain bundle is interlaced with all components of the commissura postoptica. Many of these fibers enter the postoptic neuropil and participate in its performation (figs. 14 and 15).

V. Concluding Remarks

1. The fiber components of the commissura postoptica has been analysed for Triturus pyrrhogaster. For this purpose, the serial preparations were made of transverse, sagittal and horizontal sections (ca. 15–20μ in thickness) and treated with several neurohistological methods, such as Pal-carmine, Sugamo's method, pyridin silver impregnation.
2. The fiber bundles which consist of the commissura postoptica can be estimated as follows; tr. tecto-thalamicus et -hypothalamicus cruciatus anterior et posterior, tr. tecto-hypothalamicus anterior, tr. pretecto-hypothalamicus, tr. tecto-hypothalamicus posterior, tr. thalamo-hypothalamicus et peduncularis cruciatus, tr. thalamo-hypothalamicus, tr. hypothalamo-peduncularis et -tegmantalis, olfactory projection tract and medial forebrain bundle. Among these tracts, the fibers of the tractus tecto-thalamicus et -hypothalamicus cruciatus anterior et posterior make a chief component of the commissura postoptica, while the others participate respectively in the performance of the commissure. Some of them, therefore, take a similar course with the chief bundle for a short distance having nothing to do with the commissuration itself.

3. The spatial or interrelating fiber bundles with the commissura postoptica are estimated as follows; tr. olfacto-peduncularis, fasciculus lateralis telencephali dorsalis et ventralis, tr. thalamo-frontalis, tr. thalamo-tegmentalis dorsalis et ventralis, fasciculus retroflexus, lemniscus lateralis and commissura posterior.

4. These fiber systems connect with the extensive fields of the intermediate and motor zones, including the strio-amygdaloid area, nucleus preopticus, pars ventralis hypothalami, thalamus dorsalis et ventralis, tegmentum, peduncle and bulbar tegmentum. But there may be found no intimate relation with the geniculate neuropil or optic fibers with the commissura postoptica.

VI. References


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ibid., vol. 78, no. 2.


Fig. 1. Transverse section through the commissura postoptica in the brain of Triturus pyrrhogaster. Bielschowsky's silver impregnation.

Fig. 2. Transverse section through the commissura postoptica (three sections more caudal to the section of Fig. 1). Bielschowsky's silver impregnation.

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Fig. 3. Transverse section through the commissura postoptica (two sections more caudal to the section of Fig. 2). Bielschowsky's silver impregnation.

Fig. 4. Transverse section through the commissura postoptica (two sections more caudal to the section of Fig. 3). Bielschowsky's silver impregnation.

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Plate III

Fig. 5. Transverse section through the commissura postoptica (two sections more caudal to the section of Fig. 4). Bielschowsky's silver impregnation.

Fig. 6. Sagittal section which includes almost the whole length of the tractus tectothalamicus et hypothalamicus cruciatus anterior. Sugamo's method.

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Plate IV

Fig. 7. Sagittal section through the median plane of the chiasma opticum (four sections more lateral to the section of Fig. 6). Sugamo's method.

Fig. 8. Sagittal section which includes almost the whole length of the fasciculus lateralis telencephali (seven sections more lateral to the section of Fig. 7). Sugamo's method.

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Fig. 9. Sagittal section through the median plane which includes almost the whole length of the commissura posterior (four sections more lateral to the section of Fig. 8). Sugamo's method.

Fig. 10. Sagittal section through the median plane of the chiasma opticum (six sections more lateral to the section of Fig. 9). Sugamo's method.

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Fig. 11. Sagittal section which includes almost the whole length of the commissura postoptica (twenty five sections more lateral to the section of Fig. 10). Sugamo's method.

Fig. 12. Sagittal section which includes the fasciculus lateralis telencephali (two sections more lateral to the section of Fig. 11). Sugamo's method.

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Fig. 13. Sagittal section which includes almost the whole length of the com-
missura posterior. pyridin silver method.

Fig. 14. Sagittal section which includes almost the whole length of the fasci-
culus lateralis telencephali dorsalis et ventralis (four sections more lateral to the section of Fig. 13). pyridin silver method.

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Fig. 15. Sagittal section which includes almost the whole length of the tractus olfacto-peduncularis (two sections more lateral to the section of Fig. 14). Pyridin silver method.

Fig. 16. Horizontal section through the plane of the pars ventralis hypothalami where the hypophysis is horizontally cut. Pal-carmine deying.
Fig. 17. Horizontal section through the ventro-medial postoptic neuropil. Pal-carmine deying.

Fig. 18. Horizontal section through the ventro-medial part of the commissura postoptica (seven sections more dorsal to the section of Fig. 17). Pal-carmine deying.
Fig. 19. Horizontal section more dorsally (fifteen sections) at the level of the decussation of the fasciculus medialis telencephali. Pal-carmine dyeing.