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Motor Nuclei of Medulla Oblongata in the European Bison

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Szteyn S., Szatkowski E. & Jatczak B., 1985: Motor nuclei of *medulla oblongata* in the European bison. Acta theriol. 30, 25: 423—433, 1985 [With Plates VII—VIII]

A description is given in respect of 4 European bison, *Bison bonasus* (Linnaeus, 1758) from the Białowieża Primeval Forest, of the position, formation and cell structure of the motor nuclei of *medulla oblongata: nuc. n. accessorii, nuc. n. hypoglossi, nuc. sublingualis sympathicus, nuc. intercalatus Staderini, nuc. praepositus Marburgi, nuc. paramedianus dorsalis, nuc. parasympathicus dorsalis nn. IX et X, nuc. ambiguus, nuc. n. facialis, nuc. n. abducentis, nuc. motorius n. trigemini* and *nuc. subtrigeminalis.*

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1. INTRODUCTION

The purpose of this study was to determine the position, formatioin and cytoarchitectonics of the motor nuclei of *medulla oblongata* in the European bison, *Bison bonasus* (Linnaeus, 1758), in view of the lack of such data in literature. These nuclei have, however, been described in certain other representatives, both wild and domesticated, of *Artiodactyla*. Such studies have been made, *inter alia*, by Chomiak (1951, 1954), Fiedoruk (1975), Goller (1965), Strzałka & Flieger (1979, 1982) and Welento (1955, 1956). In addition Zioło (1957) and Welento (1965) examined the development of motor nuclei during the ontogenetic development of pigs. A considerable amount of data is to be found in literature on motor nuclei of *medulla oblongata* in mammals belonging to other orders, which have made their comparison with the results of the present study possible.

2. MATERIAL AND METHODS

Studies were made on the *medullae oblongatae* of 4 European bisons from the Białowieża Primeval Forest. The material was fixed in formalin, dehydrated in ethyl alcohol and embedded in paraffin. The brains were sectioned to 15 μm, and every second section was taken for examination. The sections were stained with Löffler methyl blue after Nissl, and with cresyl violet and luxol fast blue after Klüver and Barrera. The abbreviations given in the captions to Plates have been used in the text of this paper.

3. RESULTS

Nucleus n. accessorii, Nac (Photos. 1, 9, 10)

Nucleus n. accessorii in the European bison is situated in the cervical part of the spinal medulla and the posterior part of *medulla oblongata*. The anterior part of this nucleus, situated in *medulla oblongata*, has been described in this paper.

The part of Nac lying in *medulla oblongata* is formed of two bands of cells, which in cross-sections appear in the form of two groups: dorsal and ventral.

The dorsal group lies laterally and slightly dorsal from the central canal (cc). In longitudinal sections it exhibits numerous narrowings similar in shape to a string of beads. In cross-sections the dorsal group, in well-developed places, takes on the form of a horizontal oval which for short distances divides into subgroups: medial and lateral. The dorsal group disappears about 100 μm to the rear of the posterior pole of Np.

The ventral group of Nac lies laterally and slightly below cc. There are numerous narrowings in its course, similar to those in the dorsal group. In cross-sections, in well-developed places, it appears as an oval formed of loosely arranged cells. The ventral band disappears at the level of the posterior pole of Np.

The dorsal band of Nac is formed by fusiform cells measuring 55—85 μm along the long axis and a small number of multipolar cells measuring 30—40 μm. The ventral band consists of multipolar cells measuring 35—45 μm and a small number of rounded cells measuring 20—25 μm. A large light-staining nucleus occurs in the cells, and a large amount of coarse-grained tigroid substance.

Nucleus n. hypoglossi, Nh (Photos 2, 11)

Nucleus n. hypoglossi in the European bison lies in the extraventricular part of *medulla oblongata* (about 3/7 of the posterior part) and on the floor of ventricle IV (about 4/7 of the anterior part). The posterior pole of this centre lies at the level of the posterior pole of *nucleus olivaris inferior*. The anterior pole of Nh is situated about 270 μm to the rear from the anterior pole of *nucleus olivaris inferior*. Nh is approximately 12 mm in length.

The posterior part of Nh lies laterally and slightly below cc. In its middle part the nucleus approaches the raphe and is adjacent on the dorsolateral side to *nucleus intercalatus Staderini* (Ni) and on the ventral side to *nucleus sublingualis sympathicus* (Nr). The anterior part of Nh is further away from the raphe and is adjacent on the dorsomedial side

to *nucleus praepositus Marburgi* (Nm) and on the dorsolateral side is still adjacent to Ni.

The anterior and posterior part of Nh are compact clusters of cells. In the middle part (from 1/6 of the posterior to 1/5 of the anterior part) the nucleus divides into two and then into three groups of cells: the medial, lateral and dorsal. The medial group is far more strongly developed than the other two groups.

Nh is formed of multipolar cells measuring 60—80 μm and a few fusiform cells measuring 50—70 μm along the long axis, and rounded cells measuring 20—30 μm. The cells contain a large lightstaining nucleus with a centrally positioned nucleolus and a large amount of coarse--grained tigroid substance.

Nucleus sublingualis sympathicus s. Rolleri, Nr (Photos. 2, 12)

Nr lies in the extraventricular part of *medulla oblongata* (2/7 of the posterior parts) and on the floor of ventricle IV (5/7 of the anterior parts). The posterior end of Nr lies about 1 mm to the rear of *calamus scriptorius*. Its anterior end is situated at the level of the posterior pole of Nm. Nr is about 4 mm long. Nr lies ventrally from Nh. Seen in cross-section it consists of a small group of cells of approximately oval shape. Nr consists of fusiform cells measuring 25—35 μm along the long axis and rounded cells measuring 17—20 μm. The cells contain a large, light-staining nucleus with a centrally positioned nucleolus and a few grains of tigroid substance.

Nucleus intercalatus Staderini, Ni (Photos. 2, 13)

Ni lies on the floor of ventricle IV. The posterior pole of Ni is situated at the level of the posterior boundary of 1/3 of the anterior part of Nh, and the anterior pole lies about 500 μm to the rear of the anterior pole of *nucleus olivaris inferior*. The length of this nucleus is about 6 mm.

The posterior and central sections of Ni are adjacent on the dorsomedial side to Np, and on the ventromedial side to Nh. The anterior part runs upwards and lies medially and slightly ventrally from Np, and dorsally from Nh. In cross-section Ni consists of a group of cells similar to an elongated triangle, the base of which is directed laterally.

Ni is formed of rounded cells measuring 15—20 μm and fusiform cells measuring 20—30 μm along the long axis. The cells contain a large light--staining nucleus with a centrally positioned nucleolus and considerable amount of tigroid substance.

Nucleus praepositus Marburgi, Nm (Photos. 3, 14)

Nm is situated in the dorsal part of the floor of ventricle IV. The posterior pole of Nm lies at a small distance forwards from the po-

sterior pole of Ni. The anterior pole of the nucleus is situated slightly forwards of the analogical pole of Np. Length of Nm is about 7.5 mm. In cross-sections Nm appears as a fairly large round cluster of cells. On the lateral side it is adjacent to Ni, and on the ventral-lateral side to Nh.

Nm is formed of fusiform cells measuring 45—50 μm along the long axis, rounded cells measuring 25—30 μm and a small number of multipolar cells measuring 15—20 μm. The cells contain a large, light-staining nucleus and numerous large gains of tigroid substance.

Nucleus paramedianus dorsalis s. Jacobsoni, Nd (Photos. 3, 15)

Nd lies on the floor of ventricle IV, in the immediate vicinity of the raphe. The posterior pole of Nd appears at a slight distance forwards from the posterior pole of Nm, while the anterior pole disappears in the rear of the anterior pole of Nh. Nd is about 1,2 mm in length.

In cross-sections Nd is irregular in shape, and is formed of a few cells (from 2 to 5 in a cross-section) arranged on the ventromedial side of Nm. Nd is formed of fusiform cells measuring 25—35 μm along the long axis. The cells contain a light-staining nucleus with a distinct nucleolus and a few grains of tigroid matter.

Nucleus parasympathicus dorsalis nn. IX et X, Np (Photos. 2, 16)

Np is situated in the closed part of *medulla oblongata* and on the floor of ventricle IV, where 4/7 of the anterior parts of Np lie. The posterior pole of Np lies slightly forwards of the anterior pole of Nac, and the anterior pole disappears slightly to the rear of the anterior pole of Nm. Np is about 17 mm in length.

In the extraventricular part of medulla oblongata this nucleus appears in cross-sections as a horizontal oval situated on the dorsolateral side of cc, above Nh. On the floor of ventricle IV in cross-sections Np takes on the shape of a rounded group of cells which gradually shifts laterally towards the anterior and lies on the dorsal side of Ni.

Np is formed fusiform cells measuring 40—80 μm and rounded cells measuring 25—35 μm. In the posterior segment there are a few rounded cells, but their number increases in the anterior part of Np. The cells have a large light-staining nucleus with a distinct nucleolus and large amount of coarse-grained tigroid substance.

Nucleus ambiguus, Na (Photos. 4, 17)

Na is situated in the extraventricular part of medulla oblongata (about 5/8 of the posterior parts) and on the floor of ventricle IV (about 3/8 of the anterior parts). The posterior pole of Na is situated about 2.7 mm to the rear of the posterior pole of *nucleus olivaris inferior*,

while the anterior pole disappears about 2.4 mm to the rear of the anterior pole of *nucleus olivaris inferior*. Na is about 16 mm in length.

The posterior part of Na lies ventrally and laterally from Nh and dorsally and laterally from *nucleus olivaris inferior*, the distance between Na and the nuclei referred to being approximately equal, Forwards from *calamus scriptorius* Na runs in a ventral direction and approaches *nucleus olivaris inferior*. In cross-sections the posterior part of Na is a narrow, homogenous group of cells, which is divided in the medial part into two clusters: dorsomedial and ventrolateral. In its anterior segment Na is again homogeneous, being formed by a group of oval cells.

Na is formed of multipolar cells measuring 40—80 μm and a few fusiform cells measuring 30—40 μm along the long axis. The cells contain a light-staining nucleus with a distinct nucleolus and numerous coarse grains of tigroid substance.

Nucleus n. facialis, Nf (Photos. 5, 18)

Nf lies on the floor of ventricle IV. Its posterior pole appears about 2.4 mm to the rear of the anterior pole of *nucleus olivaris inferior*, while the anterior pole disappears about 1.8 mm forwards from the posterior pole of *nucleus olivaris superior*. Nf is about 12.5 mm in length.

In cross-sections the posterior part of Nf is a homogeneous small cluster of cells, the size of which quickly increases in a forwards direction. In the medial part, from 1/4 of the posterior to 1/4 of the anterior part, Nf divides into three groups of cells: medial, median and lateral. The medial group divides for a short distance into the dorsal and ventral parts. The lateral group divides in a similar way. The anterior part of Nf is homogeneous and forms a large oval group of cells.

The anterior and posterior parts of Nf and the medial and lateral groups are formed of multipolar cells measuring 60—80 μm and a few rounded cells measuring 30—35 μm. The cells contain a large light-staining nucleus with a distinct nucleolus and a large amount of coarse-grained tigroid substance.

Nucleus n. abducentis. Nb (Photos. 6, 19)

Nb in the European bison lies on the floor of ventricle IV, laterally from the geniculum of nerve VII. The posterior pole of Nb begins about 480 μm to the rear of the posterior pole of *nucleus olivaris superior*, and the anterior pole is situated about 480 μm to the rear of the posterior pole of Nt. Nb is about 3.7 mm in length.

The posterior and anterior parts of Nb seen in cross-section are rounded, but the medial part of Nb takes on a vertical oval shape.

The nucleus of *n. abducentis* is formed of multipolar cells measuring 50—75 μm and a few rounded cells measuring 30—35 μm. The cells contain a large light-staining nucleus and numerous grains of tigroid substance.

Nucleus motorius n. trigemini, Nt (Photos. 7, 20)

Nt lies in the anterior part of medulla oblongata and in the pons, where the anterior half of this centre is situated. The posterior pole of Nt appears about 480 μm forwards from the anterior pole of Nb, while the anterior pole disappears about 3 mm forwards from the anterior pole of nucleus olivaris superior. Nt is about 5,2 mm in length.

The posterior part of Nt in cross-sections is a homogeneous cluster of cells. It quickly increases in size in a forwards direction and takes on the shape of an obliquely positioned oval. From 1/5 of the posterior part to 1/4 of the anterior part Nt divides into three groups of cells: dorsal, ventromedial and ventrolateral. The anterior part of Nt is a homogeneous band of cells.

Nt consists of multipolar cells measuring 60—75 μm and a few rounded cells measuring 15—20 μm. The cells contain a large light-staining nucleus with a nucleolus situated centrally and numerous coarse grains of tigroid substance.

Nucleus subtrigeminalis, Ns (Photos. 8, 21)

Ns lies ventrally from Nt. It reaches from 1/5 of the posterior to 2/5 of the anterior parts of Nt. Ns is about 1.1 mm long. In cross-sections it is shaped like an oblique oval. Nt is formed of multipolar cells measuring 40—50 μm and rounded cells measuring 30—40μm. The cells contain a large light-staining nucleus and a large amout of coarse-grained tigroid matter.

4. DISCUSSION

The results of studies on the motor nuclei of *medulla oblongata* in the European bison revealed the similarity of the cytoarchitectonics of these nuclei in this species to those in the cow, pig and horse (Chomiak, 1951), goat (Chomiak, 1954), sheep (Welento, 1956), red deer, roe deer (Fiedoruk, 1975), camel (Strzałka & Flieger, 1979, 1982) and also the beaver (Galert, Szteyn & Dynowski, 1978), nutria (Szteyn, 1961, 1962), cat (Highstein *et al.*, 1982) rat (Erzurumlu & Killackey, 1979; Cooper, 1981; Connors, Sullivan & Kubb, 1983) and opossum (Hamos & King, 1980). There are, however, differences in the position and formation of these centres in the European bison as compared with other mammals.

The anterior part of Nac in the European bison is similar to the

analogical centre in other mammals. There are certain differences in Nacv, the anterior pole of which does not extend in the European bison to the posterior pole of Nh, whereas in the horse (Chomiak, 1951), goat (Chomiak, 1954), roe deer (Fiedoruk, 1975) and nutria (Szteyn, 1961, 1962) this group in a forwards direction passes into Nh. In the cow (Chomiak, 1951) the ventral group of Nac joins Na, while in the red deer (Fiedoruk, 1975) it is dispersed in the grey matter of the ventral columns of the medulla.

Nh in the European bison is located in a similar way to that in the pig and horse (Chomiak, 1951) and beaver (Galert, Szteyn x Dynowski, 1978), but is shifted forwards in comparison with Nh in cattle (Goller, 1965), goat (Chomiak, 1954), roe deer (Fiedoruk, 1975), nutria (Szteyn, 1961) and rat (Cooper, 1981). In the European bison Nh in its median part divides into three groups of cells, which may indicate the more complicated structure of this nucleus in the European bison than in other mammals, in which no such division was found.

Among the nuclei accompanying Nh the relatively weak development of Nd, which in cross-sections forms a group of a small number (2—5) cells, is remarkable.

Nr in the European bison is relatively longer than the corresponding centre in the cow and pig (Chomiak, 1951). It lies more forwards than Nr in the roe deer (Fiedoruk, 1975) and sheep (Welento, 1956), and more to the rear in relation to the position of this nucleus in the goat (Chomiak, 1954) and nutria (Szteyn, 1961).

Np in the European bison does not exhibit differences in respect of position and length in comparison with other mammals. As in the case of the rat (Connors, Sullivan & Kubb 1983) it consists of a homogeneous band of cells. In the cow and pig (Chomiak, 1951), goat (Chomiak, 1954) and camel (Strzałka & Flieger, 1979) Np is divided into groups.

A characteristic feature of Na in the European bison is its position. In this species it is shifted to the rear in comparison with Na in the cow and pig (Chomiak, 1951), camel (Strzałka & Flieger, 1979) and nutria (Szteyn, 1961), and particularly in the red deer and roe deer (Fiedoruk, 1975). The structure of Na is similar in the European bison and other mammals.

Nf in the European bison is relatively simple in structure — it is divided, as in the rat (Erzurumlu & Killackey, 1979) into five groups of cells. In the majority of mammals the structure of Nf is more complicated, for instance in the pig (Chomiak, 1951), roe deer (Fiedoruk, 1975) and camel (Strzałka & Flieger, 1982) this nucleus divides into six, and in the horse (Chomiak, 1951) and red deer (Fiedoruk, 1975) even into seven, clustersoof cells. It was only in cattle that Goller

(1965) and Welento (1965) described only four groups of cells, that is, a smaller number than in the European bison.

Nb in the European bison lies more dorsal as compared with the corresponding centres in other mammals, on the lateral side of genu of n. VII. In the European bison, as in the nutria (Szteyn 1961, 1962), beaver (Galert, Szteyn & Dynowski, 1978) and cat (Highstein *et al.*, 1982) Nb is a homogeneous band of cells, whereas in the cow, pig and horse (Chomiak, 1951), goat (Chomiak, 1954) and red deer and roe deer (Fiedoruk, 1975) Nb was observed to divide into a dorsal and ventral group of cells.

Nt in the European bison lies slightly more to the rear than Nt in the horse (Milart, 1958) and opossum (Hamos & King, 1980), but far more forwards in relation to this nucleus in cattle (Goller, 1965; Welento 1965), goat, sheep (Welento, 1956) and red deer and roe deer (Fiedoruk, 1975). In other ruminants it is only possible to discern two groups of cells in Nb.

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JĄDRA RUCHOWE RDZENIA PRZEDŁUŻONEGO ŻUBRA

Streszczenie

Badania przeprowadzono na rdzeniach przedłużonych czterech żubrów. Materiał cięto na skrawki poprzeczne grubości 15 μm. Skrawki barwiono metodami Nissla oraz Kluvera i Barrery. Opisano położenie, ukształtowanie oraz budowę komórkową jąder ruchowych rodzenia przedłużonego: *nuc. n. accessorii* (Nac-ryc. 1, 9, 10), *nuc. n. hypoglossi* (Nh-ryc. 2, 11), *nuc. sublingualis sympathicus* (Nr-ryc. 2, 12), *nuc. intercalatus Staderini* (Ni-ryc. 2, 13), *nuc. praepositus Marburgi* (Nm-ryc. 3, 14), *nuc. paramedianus dorsalis* (Nd-ryc. 3, 15), *nuc. parasympathicus dorsalis nn. IX et X* (Np-ryc. 2, 16), *nuc. ambiguus* (Na-ryc. 4, 17), *nuc. n. facialis* (Nf-ryc. 5, 18), *nuc. n. abducentis* (Nb-ryc. 6, 19), *nuc. motorius n. trigemini* (Nt-ryc. 7, 20) i *nuc. subtrigeminalis* (Ns-ryc. 8, 21). Niektóre z badanych ośrodków nerwowych wykazują u żubra cechy charakterystyczne nawet w porównaniu z blisko spokrewnionymi ssakami kopytnymi. *Nuc. n. accessosrii* utworzone jest u żubra z dwóch pasm komórek: grzbietowego i brzusznego, które różnią się od siebie budową komórkową. *Nuc. n. hypoglosssi* jest silnie wykształcone i podzielone na trzy grupy. Spośród jąder towarzyszących *nuc. n. hypoglossi* najlepiej wykształcone jest *nuc. sublingualis sympathicus*, a najsłabiej *nuc. paramedianus dorsalis*. W porównaniu z innymi przeżuwaczami *nuc. ambiguus* jest u żubra wyraźnie przesunięte ku tyłowi, a *nuc. motorius n. trigemini* w kierunku przednim. To ostatnie jądro jest u żubra silnie wykształcone i podzielone na trzy grupy komórek.

EXPLANATIONS OF ABBREVIATIONS IN PHOTOGRAPHS

cc — central canal
gVII — genu of *n. facialis*
kIV — ventricle IV
Nacd — dorsal group of *nuc. n. accessorii*
Nacv — ventral group of *nuc. n. accessorii*
Nadm — dorsomedial group of *nuc. ambiguus*
Navl — ventrolateral group of *nuc. ambiguus*
Nb — *nuc. n. abducentis*
Nd — *nuc. paramedianus dorsalis*
Nfi — median group of *nuc. n. facialis*
Nfl — lateral group of *nuc. n. facialis*
Nfm — paracentral group of *nuc. n. facialis*
Nh — *nuc. n. hypoglossi*
Ni — *nuc. intercalatus Staderini*
Nm — *nuc. praepositus Marburgi*
Np — *nuc. parasympathicus dorsalis nn. IX et X*
Nr — *nuc sublingualis sympathicus*
Ns — *nuc. subtrigeminalis*
Nt — *nuc. motorius n. trigemini*
Ntd — dorsal group of *nuc. motorius n. trigemini*
Ntvl — ventrolateral group of *nuc. motorius n. trigemini*
Ntvm — ventromedial group of *nuc. motorius n. trigemini*

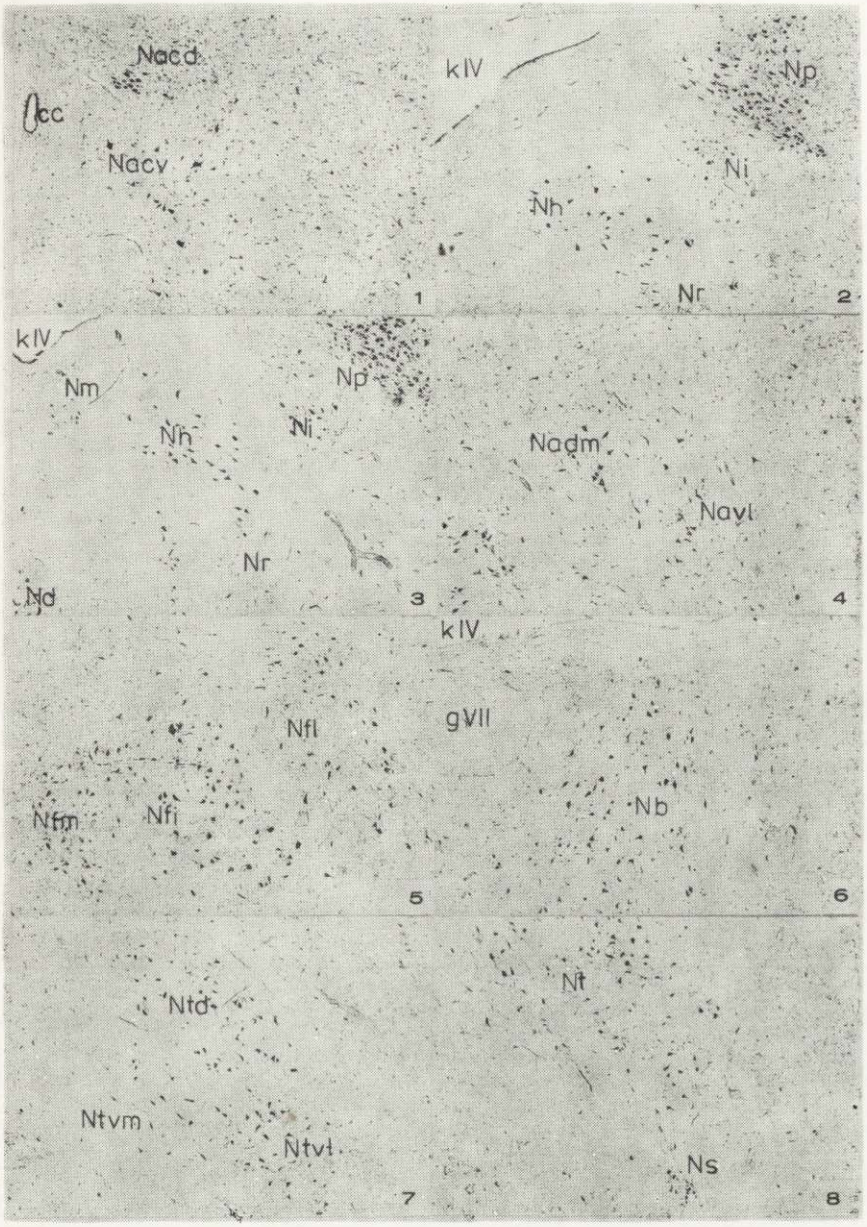
EXPLANATION OF PLATES

Plate VII

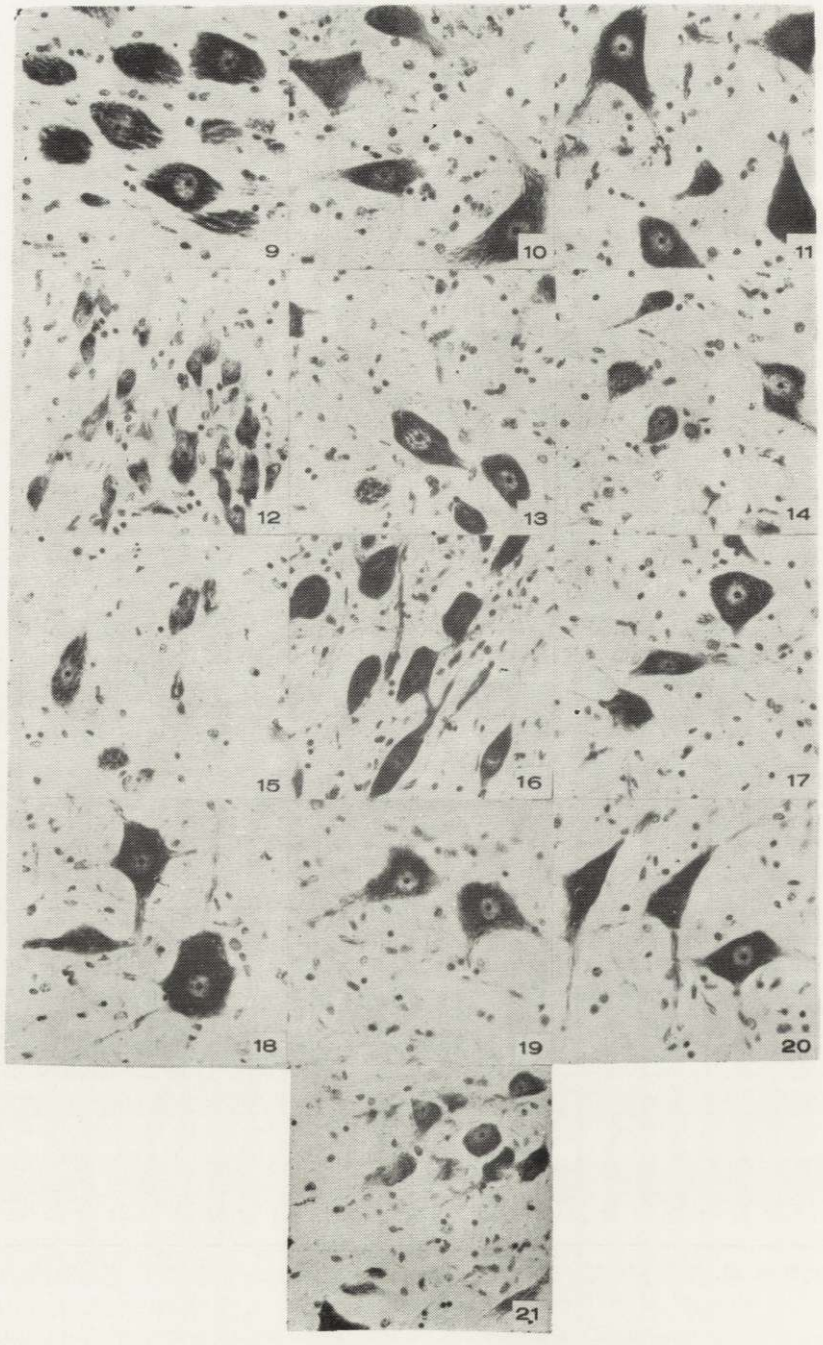
Photo. 1. Cross-section of a *medulla oblongata* at the level of the anterior part of *nuc. n. accessorii.*
Photo. 2. Cross-section of a *medulla oblongata* at the level of the anterior part of *nuc. n. hypoglossi.*
Photo. 3. Cross-section of a *medulla oblongata* at the level of the posterior part of *nuc. praepositus Marburgi.*
Photo. 4. Cross-section of a *medulla oblongata* at the level of the median part of *nuc. ambiguus.*
Photo. 5. Cross-section of a *medulla oblongata* at the level of the median part of *nuc. n. facialis.*
Photo. 6. Cross-section of a *medulla oblongata* at the level of the median part of *nuc. n. abducentis.*
Photo. 7. Cross-section of a *medulla oblongata* at the level of the median part of *nuc. motorius n. trigemini.*
Photo. 8. Cross-section of a *medulla oblongata* at the level of the median part of *nuc. subtrigeminalis.*

Plate VIII

Photo. 9. Cells of the dorsal group of *nuc. n. accessorii.*
Photo. 10. Cells of the ventral group of *nuc. n. accessorii.*
Photo. 11. Cells of *nuc. n. hypoglossi.*
Photo. 12. Cells of *nuc. sublingualis sympathicus s. Rolleri.*
Photo. 13. Cells of *nuc. intercalatus Staderini.*
Photo. 14. Cells of *nuc. praepositus Marburgi.*
Photo. 15. Cells of *nuc. paramedianus dorsalis s. Jacobsoni.*
Photo. 16. Cells of *nuc. parasympathicus dorsalis nn. IX et X.*
Photo. 17. Cells of *nuc. ambiguus.*
Photo. 18. Cells of *nuc. n. facialis.*
Photo. 19. Cells of *nuc. n. abducentis.*
Photo. 20. Cells of *nuc. motorius n. trigemini*
Photo. 20. Cells of *nuc. motorius n. trigemini.*
Photo 21. Cells of *nuc. subtrigeminalis.*



. Szteyn *et al.* *auctores phot.*



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