Development of Complex Curricula for Molecular Bionics and Infobionics Programs within a consortial* framework**

Consortium leader

PETER PAZMANY CATHOLIC UNIVERSITY

Consortium members

SEMMELWEIS UNIVERSITY, DIALOG CAMPUS PUBLISHER

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**Molekuláris bionika és Infobionika Szakok tananyagának komplex fejlesztése konzorciumi keretben

***A projekt az Európai Unió támogatásával, az Európai Szociális Alap társfinanszírozásával valósul meg.

BASICS OF NEUROBIOLOGY

Neurobiológia alapjai

INTERNAL STRUCTURE OF SPINAL CORD

(Gerincvelő belső szerkezete)

ZSOLT LIPOSITS

ORGANIZATION OF THE WHITE AND GREY MATTERS

THE GREY MATTER IS ORGANIZED INTO THREE HORNS, THE DORSAL, LATERAL AND VENTRAL HORNS AS REVEALED IN CROSS SECTIONS. IN 3D VIEW, THE HORNS ARE RATHER PERPENDICULAR COLUMNS

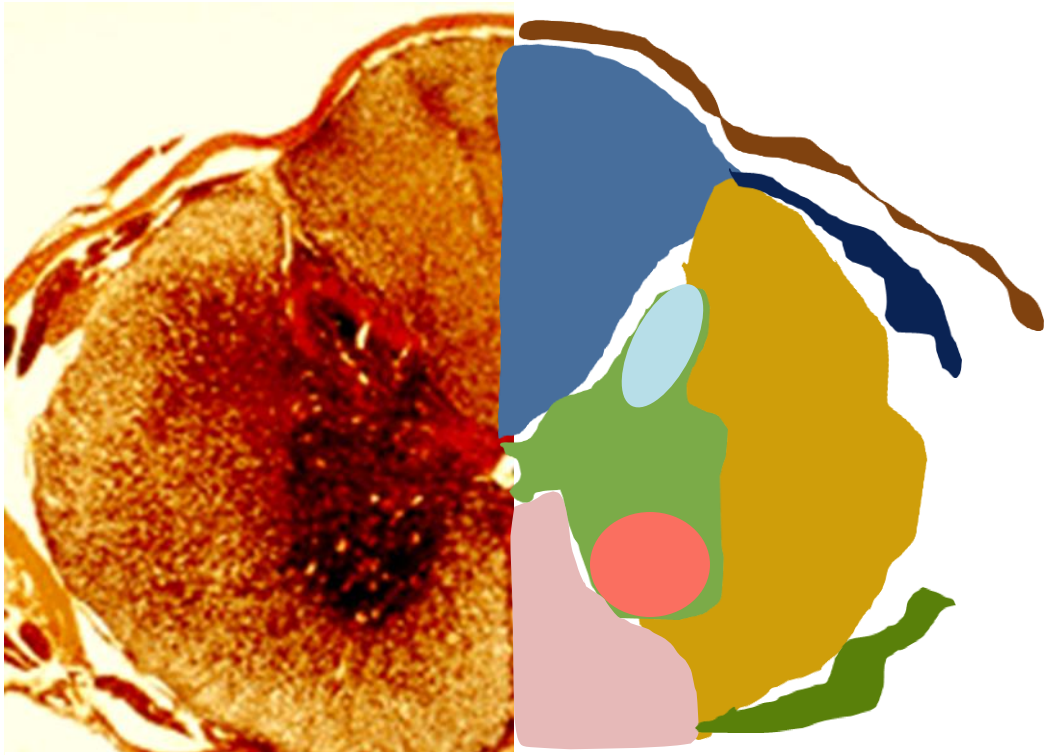
IN THE CENTER OF THE GREY MATTER, THE ORIGINAL CAVITY OF THE NEURAL TUBE, THE CANALIS CENTRALIS IS LOCATED. CRANIALLY, IT IS CONTINUOUS WITH THE 4TH CEREBRAL VENTRICLE

THE POSTERIOR HORN IS ASSOCIATED WITH SENSORY INFORMATION PROCESSING. THE SENSORY MESSAGES ARE CONVEYED VIA THE DORSAL ROOT TO THE POSTERIOR HORN

THE LATERAL HORN IS EXPLICIT AT CERTAIN THORACO-LUMBAR (T1-L3) AND SACRAL (S2-S4) SEGMENTS FROM WHERE THE SYMPATHETIC AND PARASYMPA-THETIC OUTFLOWS OCCUR. ACCORDINGLY, THE LATERAL HORN IS PACKED BY AUTONOMIC, PREGANGLIONIC CELLS. THEIR AXONS LEAVE THE SPINAL CORD AND ENTER THE VENTRAL ROOT

THE ANTERIOR HORN CONSISTS OF LARGE, SOMATIC MOTONEURONS AND INTERNEURONS. THE AXONAL PROJECTION OF MOTONEURONS USES THE VENTRAL ROOT AND THE SPINAL NERVE FOR EXITING

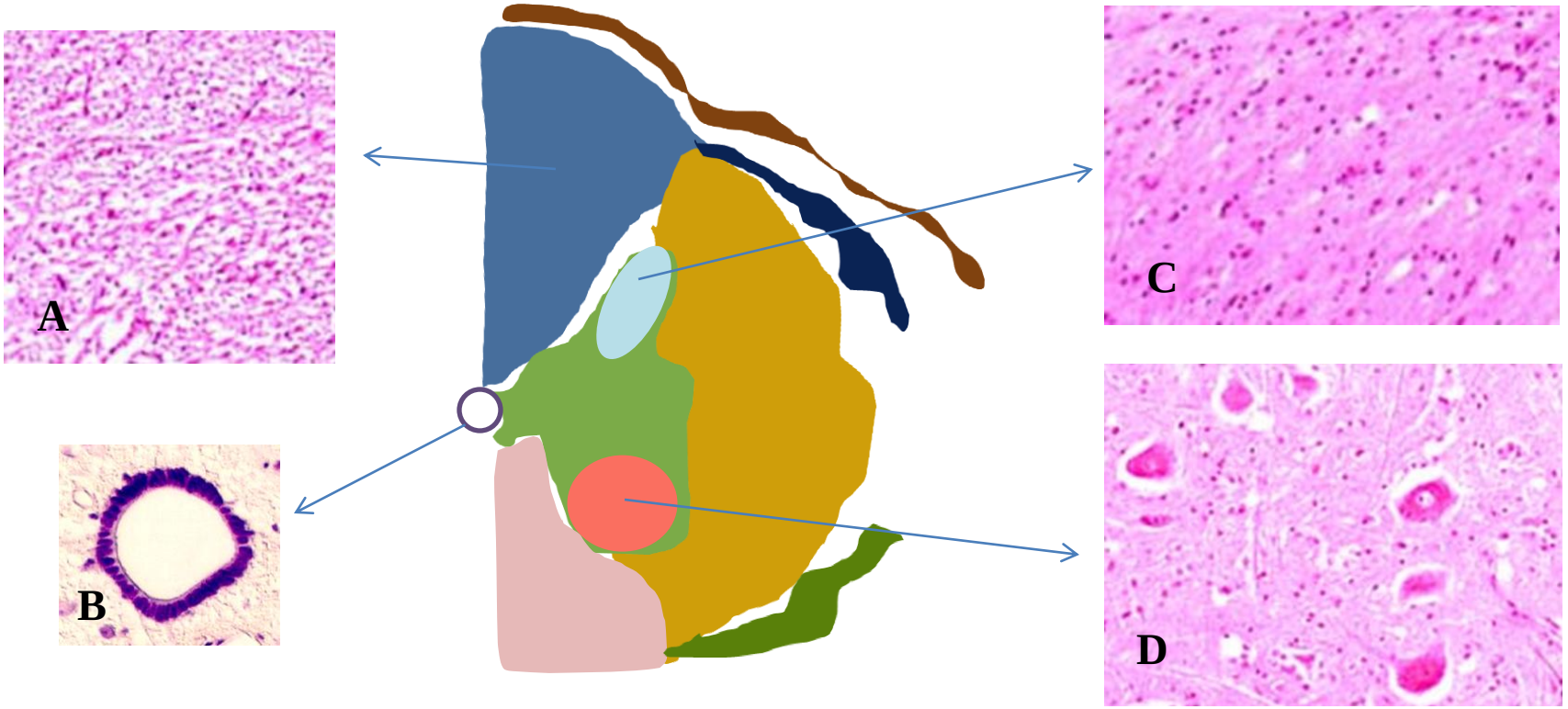
CROSS-SECTION OF THE SPINAL CORD



MENINX
DORSAL FUNICULUS
GREY MATTER
DORSAL HORN
DORSAL ROOT
LATERAL FUNICULUS
VENTRAL HORN
VENTRAL ROOT
VENTRAL FUNICULUS

F

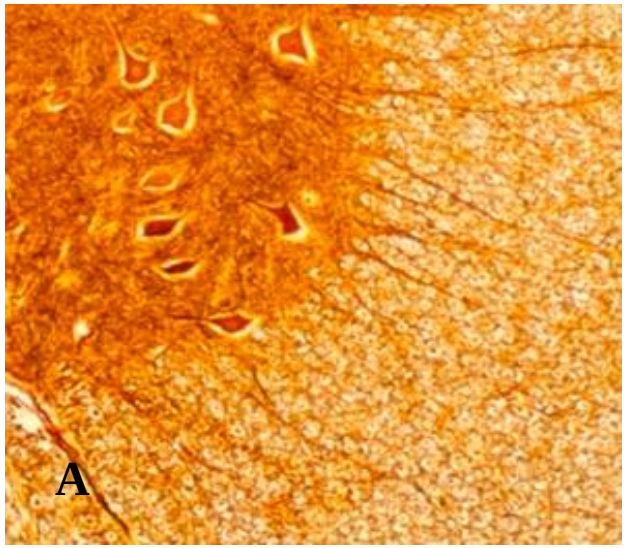
HISTOLOGICAL FEATURES OF THE SPINAL CORD
HEMATOXYLIN-EOSIN STAINING

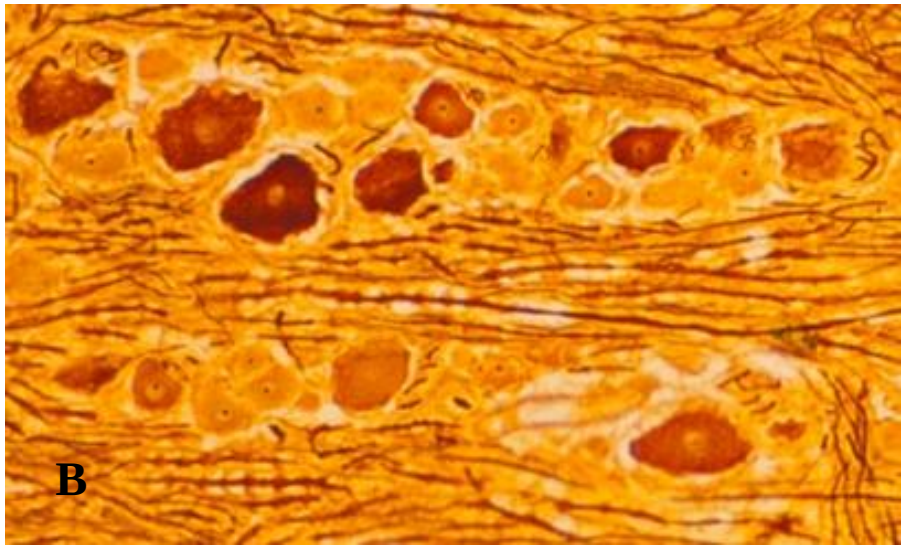


A. MYELINATED FIBERS IN THE DORSAL FUNICULUS. B. EPENDYMAL CELLS LINING THE CENTRAL CANAL. C. DENSELY PACKED, SMALL-SIZED NEURONS IN THE DORSAL HORN. D. MULTIPOLAR, LARGE MOTONEURONS IN THE VENTRAL HORN

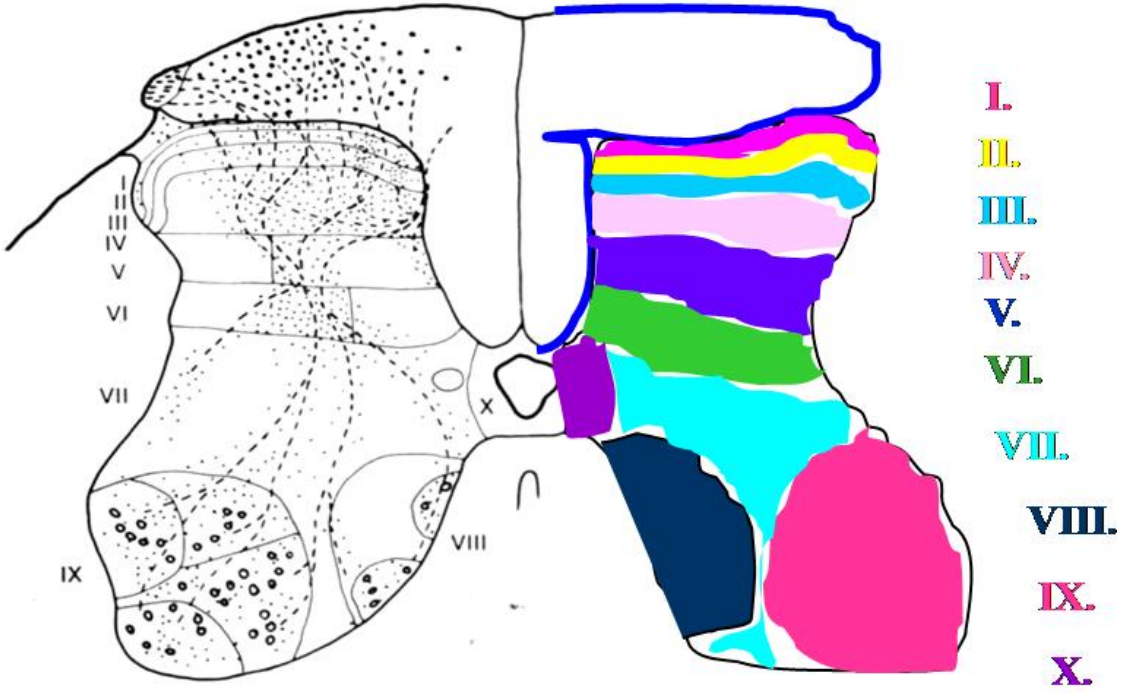
SPINAL NEURONS IN SILVER-IMPREGNATED SPECIMEN

SPECIAL SILVER IMPREGNATION TECHNIQUES (GOLGI, CAJAL, BIELSCHOWSKY METHODS) ALLOW THE VISUALIZATION OF THE PERIKARYA AND THE PROCESSES OF NEURONS. PICTURE A DEPICTS SOMATOMOTOR NEURONS OF THE VENTRAL HORN AND THE AXON OUTFLOW THROUGH THE VENTRAL FUNICULUS. PICTURE B SHOWS LARGE, PSEUDOUNIPOLAR CELL BODIES THAT ARE EMBEDDED AMONG SENSORY AXON BUNDLES IN THE DORSAL ROOT GANGLION





LAMINAR ORGANIZATION OF THE SPINAL CORD



BASED UPON CYTOARCHITECTONIC AND TOPOGRAPHICAL CHARACTERISTICS OF SPINAL NEURONS (LEFT HALF OF THE PICTURE) A LAMINAR ORGANIZATION (RIGHT HALF OF THE PICTURE) OF THE SPINAL CORD HAS BEEN PROPOSED BY REXED. THERE ARE TEN LAYERS (I.-X.) AS DEPICTED IN THE DRAWING. SOME VARIATIONS OCCUR IN DEIFFERENT SPECIES

CYTOARCHITECTURE OF THE GREY MATTER

LAMINA I. THIN LAYER THAT CAPS THE POSTERIOR SURFACE OF THE DORSAL HORN. IT CONSISTS OF SMALL AND MEDIUM-SIZED CELLS THAT FORM THE POSTEROMARGINAL NUCLEUS. IT MAINLY RECEIVES PRIMARY AFFERENTS AND AXONS OF LAMINA II CELLS. THIS LAMINA RESPONDS TO NOXIOUS STIMULI

LAMINA II. CONTAINS TIGHTLY PACKED ROUND CELLS. THE LAYER CORRESPONDS TO THE SUBSTANTIA GELATINOSA. THIS LAYER SEEMS TO RECEIVE INNOCUOUS MECHANORECEPTOR STIMULI. THE AXON PROJECTIONS OF THIS LAYER TARGETS NEIGHBORING LAMINAE. SUBSTANCE P AND OPIOD RECEPTOR ARE EXPRESSED IN THIS LAYER

LAMINA III. THE CELLS SHOW A WIDE PHENOTYPIC VARIETY. THEY SEEM TO ESTABLISH LOCAL CONNECTIONS AND ACT AS INTERNEURONS

LAMINA IV. THICKEST LAYER IN THE REGION. THE CELLS RESPOND TO LIGHT TOUCH STIMULI. THE CELLS FORM THE PROPER SENSORY NUCLEUS. IT PROJECTS IN THE CONTRALATERAL SIDE TO THE THALAMUS

LAMINA V. BROAD ZONE AT THE ORIGIN OF THE POSTERIOR HORN. SOME CELLS PROJECT TO LAMINA II.

CYTOARCHITECTURE OF THE GREY MATTER

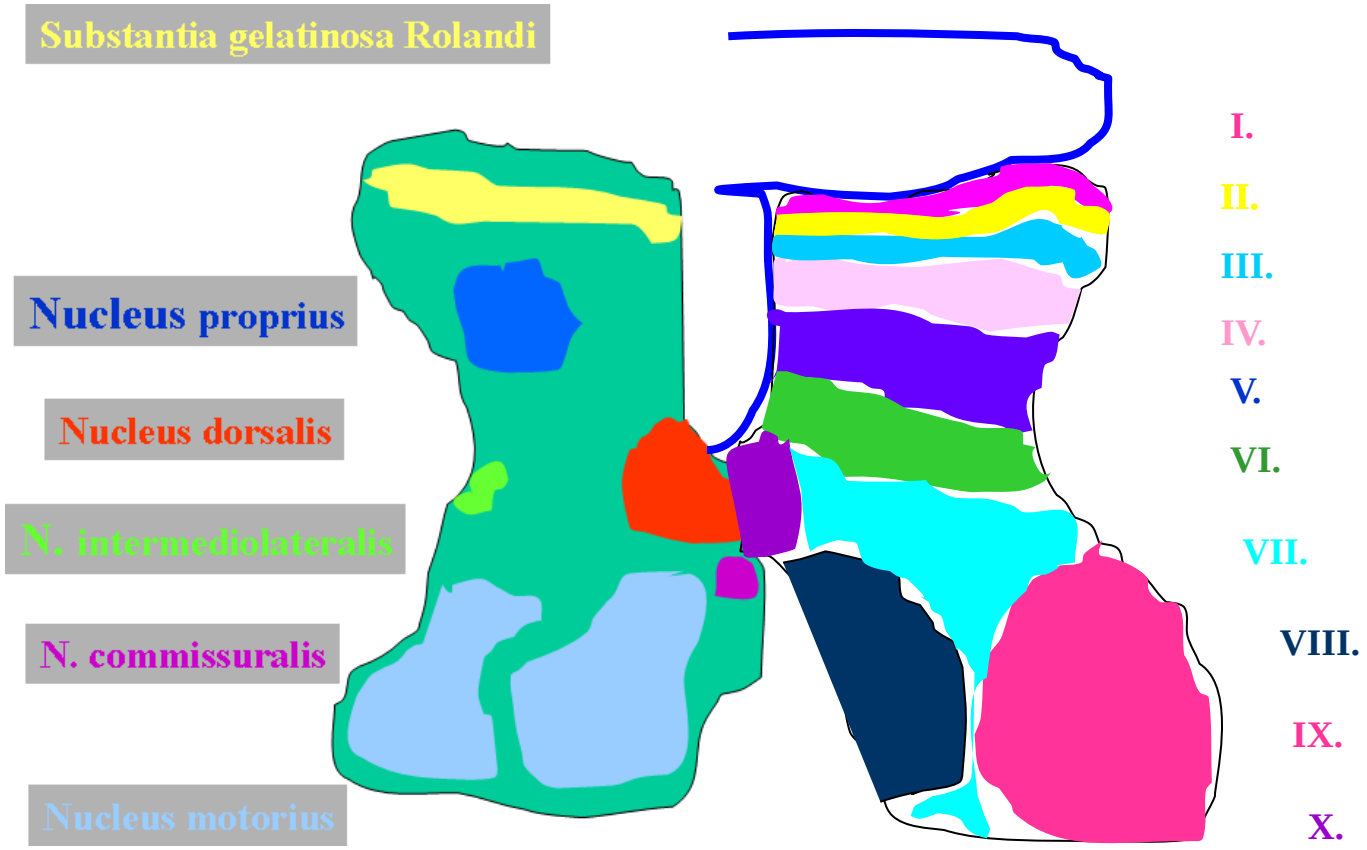
LAMINA VI. THIS LAYER IS OBVIOUS IN THE ENLARGEMENTS OF THE SPINAL CORD AND RECEIVES GROUP I MUSCLE AFFERENTS. IT PROJECTS IPSILATERALLY TO THE CEREBELLUM

LAMINA VII. IT IS CALLED FREQUENTLY AS INTERMEDIATE ZONE. SOME OF ITS CELLS ESTABLISH COLUMNS. AMONG THESE THE MOST NOTABLE IS THE DORSAL NUCLEUS OF CLARKE (CLARKE COLUMN). IT RECEIVES MECHANO-INFORMATION FROM MUSCLES AND TENDONS AND RELAY THEM VIA THE DORSAL SPINOCEREBEL-LAR TRACT. THE OTHER COLUMNAR ORGANIZATION CORRESPONDS TO THE INTERMEDIOLATERAL NUCLEUS, STRUCTURE THAT CONTAINS THE PREGANGLIONIC VEGETATIVE NEURONS. THE INTERMEDIOMEDIAL NUCLEUS RECEIVES VISCERAL SENSORY INFORMATION

LAMINA VIII. LOCUS OF HETEROGENEOUS CELL POPULATIONS RECEIVING SEVERAL DESCENDING TRACTS

LAMINA IX. CONTAINS LARGE, MULTIPOLAR SOMATIC MOTOR NEURONS (ALPHA CELLS) AND SMALLER MOTONEURONS (GAMMA CELLS). GAMMA NEURONS INNERVATE THE MUSCLE SPINDLE FIBERS. THE CELLS ARE ORGANIZED INTO MEDIAL AND LATERAL GROUPS

COMPARISON OF DEFINITIVE SPINAL NUCLEI WITH SPINAL LAYERS



BEHAVIOR OF DORSAL ROOT AFFERENTS

DORSAL ROOT FIBERS APPROACH THE DORSOLATERAL SURFACE OF THE SPINAL CORD. THEY BELONG TO TWO CATEGORIES: 1. THICK MYELINATED AXON GROUP, AND 2. THIN, MYELINATED OR NON-MYELINATED AXON GROUP

THE THICK, MYELINATED AXONS ENTERING THE SPINAL CORD DIVIDE INTO ASCENDING AND DESCENDING BRANCHES THAT FURTHER GIVE RISE TO COLLATERAL BRANCHES. THE ASCENDING BRANCHES ENTER THE DORSAL FUNICULUS AND PROJECT TO THE MEDULLA. ANOTHER TERMINATION SITE FOR MYELINATED IPSILATER DORSAL ROOT FIBERS IS THE CLARKE NUCLEUS. THE THICK MYELINATED FIBERS CARRY INFORMATION FROM ENCAPSULATED RECEPTORS (MUSCLE SPINDLE, GOLGI TENDON ORGAN)

THE THIN MYELINATED AND NON-MYELINATED AXONS CARRY INFORMATION ASSOCIATED WITH LIGHT TOUCH, PAIN AND THERMAL STIMULI. THEY ENTER A THIN FIBER COMPARTMENT, CALLED THE LISSAUER ZONE THAT COVERS THE SURFACE OF THE POSTERIOR HORN. FIBERS ENTERING THE GREY MATTER MOST FREQUENTLY TERMINATE IN LAYERS I AND II. THIS KIND OF SENSORY INFORMATION IS RELAYED FURTHER TO THE THALAMUS VIA THE CROSSED SPINOTHALAMIC TRACT

THE ENTRY OF SENSORY DORSAL ROOT FIBERS INTO THE SPINAL CORD