TERMINOLOGIA NEUROANATOMICA

International Neuroanatomical Terminology

FIPAT

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Preface

The TNA is a recent revision of the terminology on the Central Nervous System (CNS; *Systema nervosum centrale*), the Peripheral Nervous System (PNS; *Systema nervosum periphericum*) and the Sensory Organs (*Organa sensuum*) [1]. These were abstracted from the *Terminologia Anatomica* [2] and the *Terminologia Histologica* [3] and were extensively updated by the FIPAT Neuroanatomy Working Group, and merged to form a *Terminologia Neuroanatomica* (TNA). Because of its clinical and functional significance, the TNA includes the blood supply to the CNS (*Vasa sanguinea encephali* and *Vasa sanguinea medullae spinalis*) to ensure it contains a more or less complete list of terms for the human nervous system. The document is divided into three chapters (see below). The official FIPAT terms are in Latin. This enables translation into any vernacular, in the present instance English. The Latin terms have been reviewed by members of the FIPAT Latin Subcommittee.

The following general notes outline the major changes in the CNS Section:
(1) Throughout the document, the subdivision of Neurons proposed by Bota and Swanson [4] is used, following the Brain Architecture Management System (BAMS; http://brancusi.usc.edu/bkms), and including Sensory neurons, Interneurons (Short and Long) and Motoneurons. The Short interneurons are subdivided into Excitatory and Inhibitory interneurons. The category *Interneuron longiaxonicum* comprises the Interneurons that are usually described as Projection, Commissural and Association neurons.
(2) For the White matter tracts, the Foundation Model of Connectivity [5] is followed for a better presentation. The following subdivision is used: (a) *Radices centrales* (Central roots) for the Cranial and Spinal nerve roots within the CNS; (b) *Tractus proprii* (Intrinsic tracts) remaining within a certain compartment of the CNS such as the Spinal cord;(c) *Tractus commissurales* (Commissural connections); and (d) *Tractus longi* (Longitudinal tracts) divided into *Tractus ascendentes*, *Tractus efferentes cerebelli* and *Tractus descendentes*.
(3) A Section *Vasa sanguinea* is added, a modernized version of the relevant part of the TA Section *Systema cardiovasculare*. Clinical subdivisions of the *Arteria carotis interna* (C1-C7), *Arteria cerebri anterior* (A1-A5), *Arteria cerebri media* (M1-M4), *Arteria vertebralis* (V1-V4) and *Arteria cerebri posterior* (P1-P4) are added. For consistency, it is advocated to return to PNA/NA terms for the *Arteriae cerebelli* and the *Venae cerebri*.
(4) For the Spinal cord, the order of presentation is changed from Posterior (Dorsal) to Anterior (Ventral) to be consistent with the presentation of the Rexed layers from I-X, and for consistency with other sections. The known *Typi neurales* (Neuron types) are added and the *Substantia alba* (White matter) is subdivided into *Radices centrales*, *Tractus proprii* and *Tractus longi* (*Tractus ascendentes* and *Tractus descendentes*).
(5) For the Brain stem, the various nuclei are rearranged according to their connectivity, following the third edition of Olszewski and Baxter [6]: *Nuclei somatosensorii*, *Nuclei viscerosensorii*, *Nuclei vestibulares*, *Nuclei acustici*, *Nuclei somatomotorii*, *Nuclei branchiomotorii*, *Nuclei visceromotorii*, *Nuclei reticulares*, *Nuclei neuromodulatorii* (Serotonergic, Adrenergic, Noradrenergic, Cholinergic and Dopaminergic cell groups), *Nuclei limbici* and *Nuclei precerebellares*. The TA Section *Aggregationes cellularum chemergicarum* is replaced to where these terms belong: Brain stem, Diencephalon, Hypothalamus, Basal forebrain and Olfactory bulb. The *Substantia alba* is subdivided into *Radices centrales*, *Tractus proprii* and *Tractus longi* (*Tractus ascendentes*, *Tractus efferentes cerebelli* and *Tractus descendentes*).
(6) For the Mesencephalon, the following subdivision is used: *Pedunculus cerebri* (the Long corticofugal fibres), *Tegmentum mesencephali* (including the Substantia nigra and the Ventral tegmental area), *Substantiae centrales mesencephali* and *Tectum mesencephali*.
(7) In the Section Cerebellum, the terminology of the *Lobuli* is simplified, the Zonal, sagittal organization of Corticonuclear projections is introduced and the composition of the *Pedunculi cerebellares* is added.
(8) A more natural hierarchical classification of brain structures is used for the Prosencephalon (Forebrain) as implemented in the revised version of the *Terminologia Embryologica* (TE2). The Forebrain is subdivided into the Caudal prosencephalon, giving rise to the Caudal diencephalon (Pretectum, Thalamus with Epithalamus, and Prethalamus), and a Rostral prosencephalon, giving rise to the Hypothalamus (Rostral diencephalon) and the entire Telencephalon. The Telencephalon is divided into the Pallium and the Subpallium (Striatum, Pallidum, Basal forebrain and Preoptic area). For practical

reasons, the Preoptic area is listed following the Hypothalamus.

(9) The Diencephalon in its classic, columnar view was divided into four dorsoventrally arranged columns separated by ventricular sulci: the Epithalamus, the Dorsal thalamus, the Ventral thalamus and the Hypothalamus. Extensive embryological studies made it clear that the thalamic 'columns' are derived from transversely oriented zones, the Prosomeres (see TE2). Currently, the (Caudal) Diencephalon is subdivided into three segmental units, which from caudal to rostral, contain in their alar domains the Pretectum (Prosomere 1 or P1), the Epithalamus and the Thalamus (P2) and the Ventral thalamus or Prethalamus (P3). The diencephalic basal plate (P1-P3) contains the rostral part of the Substantia nigra – VTA complex and the *Nucleus interstitialis* (Nucleus of Cajal), the *Nucleus interstitialis rostralis fasciculi longitudinalis medialis*, and the *Nucleus ellipticus* (Nucleus of Darkschewitsch), collectively forming the Diencephalic or Prerubral tegmentum between the Mesencephalon and the Hypothalamus. The entire Hypothalamus arises from the alar and basal components of the Secondary prosencephalon. The Preoptic area is one of the subpallial developmental domains.

(10) For the Thalamic nuclei, a new subdivision based on Hirai and Jones [7] and updated by Morel et al. [8] is introduced.

(11) The description of the *Morphologia externa* (External features) of the Cerebral hemisphere is extended, including many newly discovered subdivisions. Macroscopically visible Olfactory structures are included here. A more extensive discussion of the Allocortex is provided.

(12) The description of the *Morphologia interna* (Internal features) of the Cerebral cortex follows the embryological subdivision of the Pallium into four parts. The *Pallium dorsale* gives rise to the Isocortex or Neocortex, the *Pallium laterale* to the Claustro-insular complex, the *Pallium mediale* to the Formatio hippocampi and the *Pallium ventrale* to the Olfactory cortex and the Pallial amygdala. Where possible, *Typi neurales* are added, starting from the TH terminology. Isocortical neurons are subdivided into Pyramidal neurons (Projection, Commissural and Association neurons) and Excitatory and Inhibitory interneurons. For the Inhibitory, mainly GABAergic, interneurons, the Petilla terminology [9] is introduced. The terminology of *Fibrae associationes telencephali* has been modernized, implementing DTI studies.

(13) Under the heading Subpallium, the *Corpus amygdaloideum*, the *Pars basalis telencephali proprii* and the *Nuclei basales* are listed with *Typi neurales* and *Substantia alba*.

The following general notes outline the major changes in the PNS Section:

(1) The *Terminationes effectoriae* (Effector nerve endings) and *Receptores sensorii* (Sensory receptors) were added to the *Nomina generalia* of PNS, and not treated as a separate Section. Some terms were taken from the Section *Integumentum commune* or the *Systema musculare*.

(2) All Communicating branches that are readily apparent and all those known to have functional significance are included. Any Communicating branches that are difficult to demonstrate or have no known function are deleted. The Communicating branches are listed as branches of the nerve at their central (proximal) end. Following the proposal of the Informatics Working Group [10], their naming is simplified, eliminating prepositions (*ad* and *cum*); TA terms are added as Related terms.

(3) Branches of Parasympathetic ganglia are listed in the Section *Divisio autonomica* (Autonomic nervous system), although some are mixed nerves.

(4) To the Section *Pars thoracolumbalis*, the *Pars sympathica* of the *Divisio autonomica*, two additional Subsections are added to include other parts of the Autonomic division that contain sympathetic neurons and postganglionic sympathetic fibres: (a) The *Ganglia paravertebralia* of the Thorax and Abdomen; and (b) Perivascular plexuses and their branches that contain postganglionic fibres.

(5) The Section *Pars craniosacralis*, the *Pars parasympathica* of the *Divisio autonomica*, includes three subdivisions that contain parasympathetic ganglia and nerve branches that contain parasympathetic fibres to visceral organs: (a) Cranial parasympathetic ganglia and their branches; (b) the two Vagal trunks and their branches; and (c) the Pelvic splanchnic nerves. The Pelvic ganglia are replaced in the Section *Plexus viscerales* because they are not classic parasympathetic ganglia.

(6) The Section *Plexus viscerales* includes Visceral plexuses that contain sympathetic and parasympathetic fibres and small ganglia associated with these plexuses. These ganglia were formerly considered parasympathetic ganglia, but have been shown to contain also many neurons that are not classically sympathetic or parasympathetic.

(7) The *Plexus entericus* was separated from the *Plexus viscerales et ganglia visceralia* of TA because this intramural plexus of the digestive canal is usually considered a nervous system separate from the

Autonomic or Peripheral nervous system: the *Systema nervosum entericum* (Enteric nervous system). As this Plexus is located within organs of the Digestive system.

References
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User Guide

In accordance with the decision at the Istanbul meeting of FIPAT (2015), and as with the other FIPAT terminologies, a new, 6-column format has been adopted. The six columns comprise the official Latin term, Latin synonym(s) where relevant, English (UK and US) terms and English synonym(s) where relevant. The final column includes related terms, eponyms, directional notes, and references to endnotes. The endnotes are placed in a separate section at the end of each Chapter.

Each term is in the singular, except where it is a heading of a list, in which case the plural is appropriate. Parentheses are used to enclose terms for structurres which are inconstant. Where a structure is sexually dimorphic, the female homolog is identified by ♀ and the male homolog by ♂.

Indenting and styles of heading are used to indicate the relations of terms to one another (see below). Headings 5, 7, 8 and 9 are only used where more than five hierarchical levels of headings is required.

Top Heading
Heading 2
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Non-term heading
Term
Term
Term