BASAL GANGLIA CEREBRAL CORTEX

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BASAL GANGLIA

GREY MATTER
EXTRAPYRAMIDAL SYSTEM

CORPUS STRIATUM
SUBSTANTIA NIGRA
LUY'S NUCLEUS

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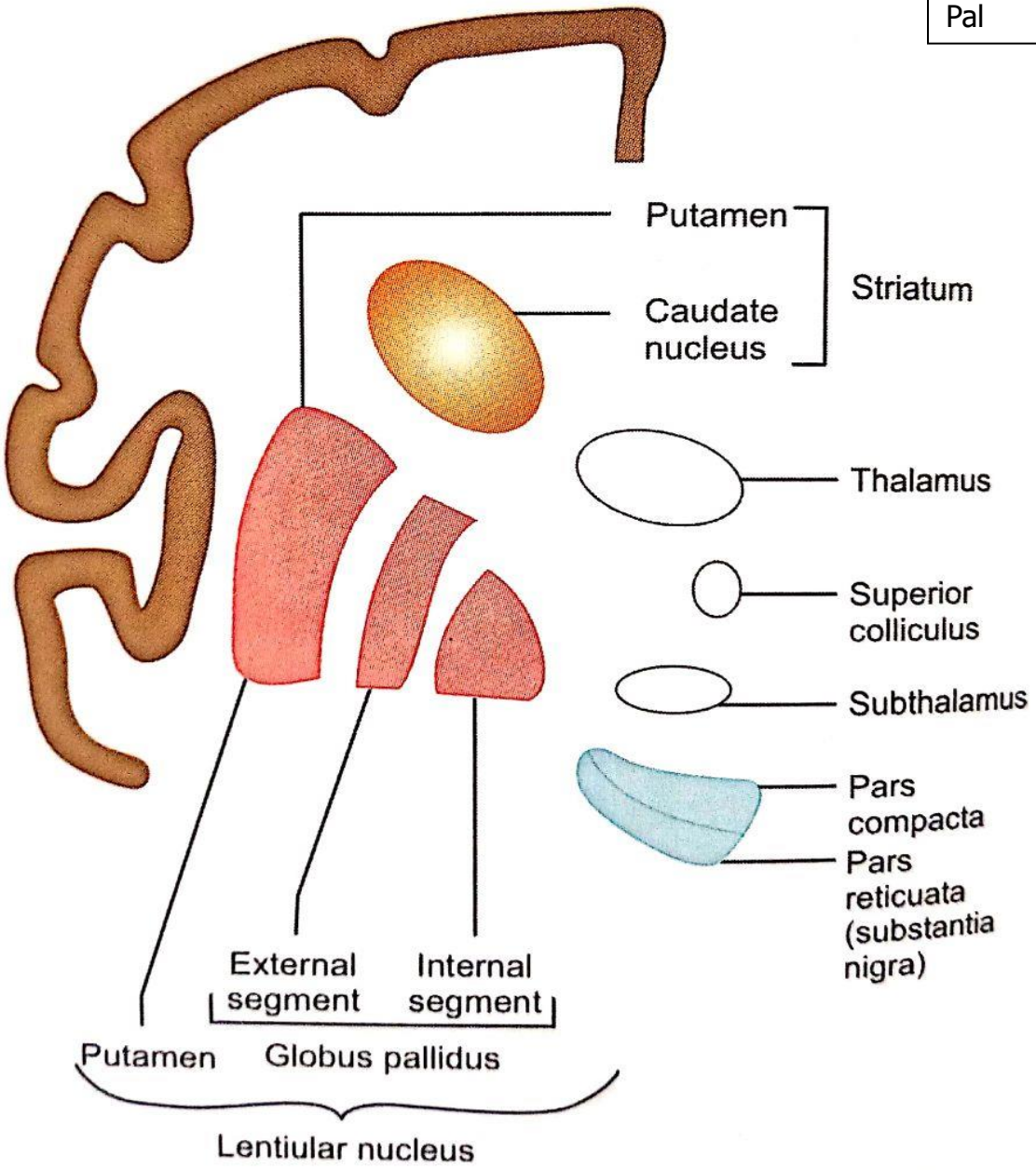

Fig. 131.1: Parts of basal ganglia.

CORPUS STRIATUM

1) CAUDATE NUCLEUS
2) LENTICULAR NUCLEUS
   i) PUTAMEN
   ii) GLOBUS PALLIDUS

- CAUDATE N. + PUTAMEN= NEOSTRIATUM AFFERENT NUCLEI

- GLOBUS PALLIDUS (INTERNAL, EXTERNAL)= PALEOSTRIATUM EFFERENT NUCLEI

Nuclei lying posterior & inferior:

- Sub thalamic nuclei (STN) or body of Luys
- Substansia nigra (SN)- pars compacta & pars reticulate

AFFERENT

- NEOSTRIATUM, EXCITATORY

Corticostriate
Thalamostriate fibres

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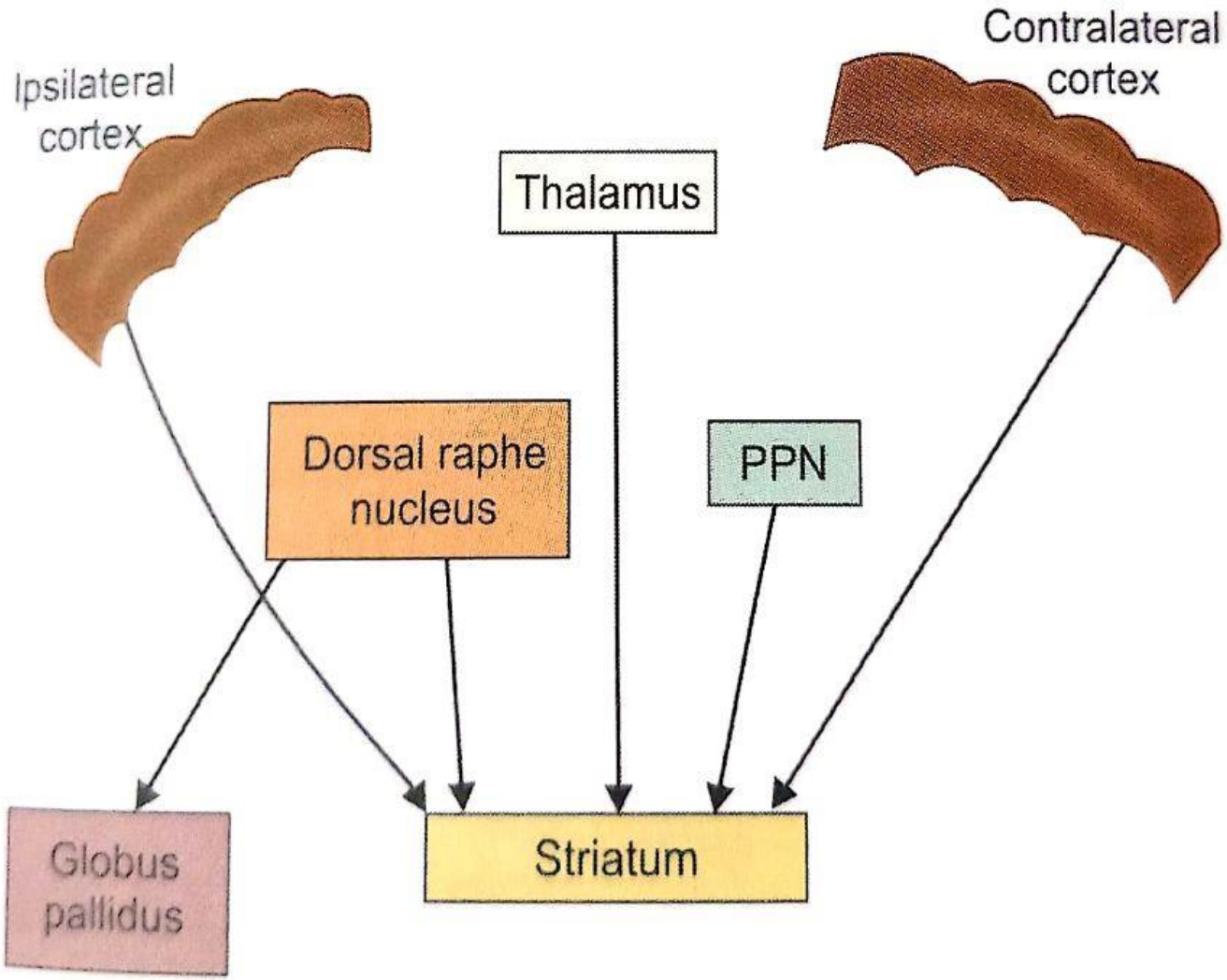

Fig. 131.2: Inputs to basal ganglia. The major input arrives from the cortex. (PPN: Pedunculopontine nucleus).

EFFERENT

- From caudate nucleus and putamen to globus pallidus from where all efferent fibres arise.

- (a) *Striothalamic fibres*.
  globus pallidus to thalamus to motor cortex.

(b) *Striosubthalamic fibres*. from globus pallidus to red nucleus, subthalamic body nuclei of reticular formation and substantia nigra.

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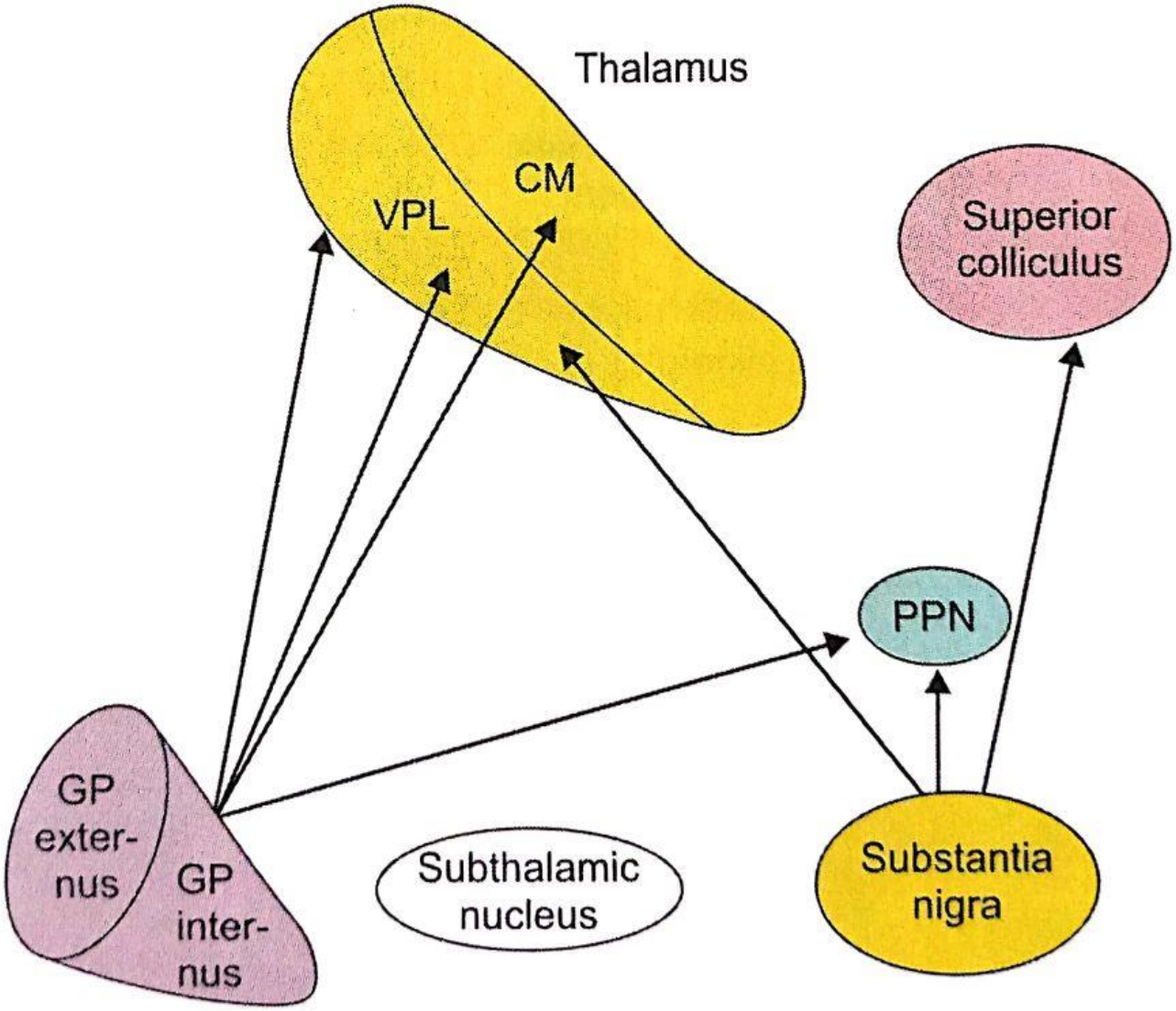

Fig. 131.3: Outputs from basal ganglia. The major outputs are to ventral-posterolateral (VPL) and centromedian (CM) nuclei of the thalamus. (PPN: Pedunculopontine nucleus).

INTERNUCLEAR CONN.

- (a) Dopaminergic *Nigrostriate fibres*: *From* substantia nigra fibres to caudate nucleus and putamen. Dopaminergic fibres.
- Damage: Parkinsonism

- (b) GABA nergic inhibitory projections: Striatonigral pathway
- Damage: Hungtinton's disease

- (c) ST N. projects into GP and SN via glutamic acid secreting excitatory neurons.

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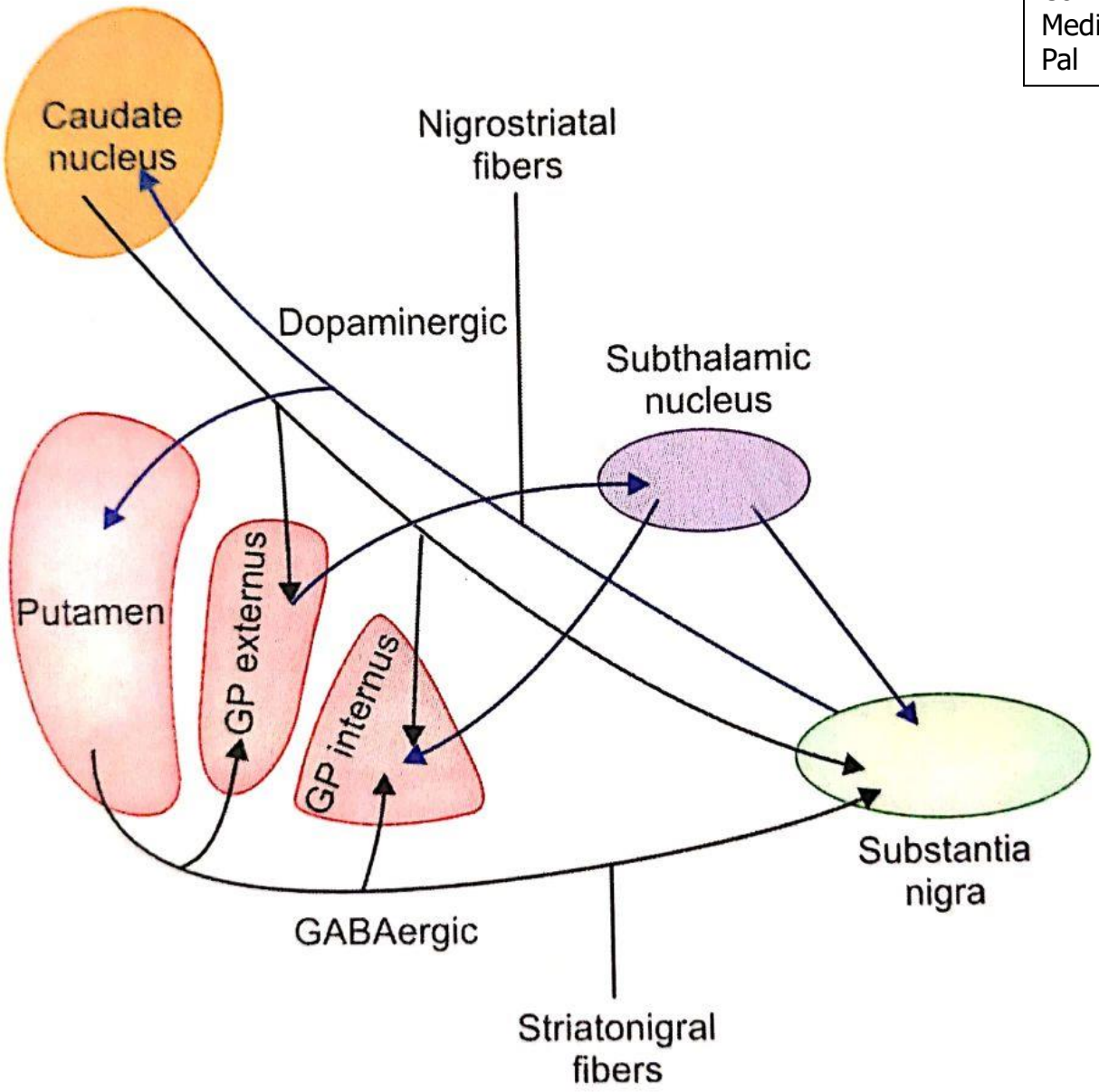

Fig. 131.4: Connections within the nuclei of basal ganglia. Note the dopaminergic nigrostriatal projections and GABAergic striatonigral projections.

FUNCTIONS OF BASAL GANGLIA

- **Reflex Movements of Proximal Limbs & Trunk Muscles. A**ttitudinal and gross fixative movements. Eg. Hammering, writing.
- **Subconscious execution of learned motor patterns.**

  eg. cutting paper with scissors, shooting a basketball through a hoop
- **Stabilizes motor system & Prevent abnormal motor movements.**
- **Execution of automatic associated movements.**

  eg. swinging of arms while walking, facial expressions while talking.

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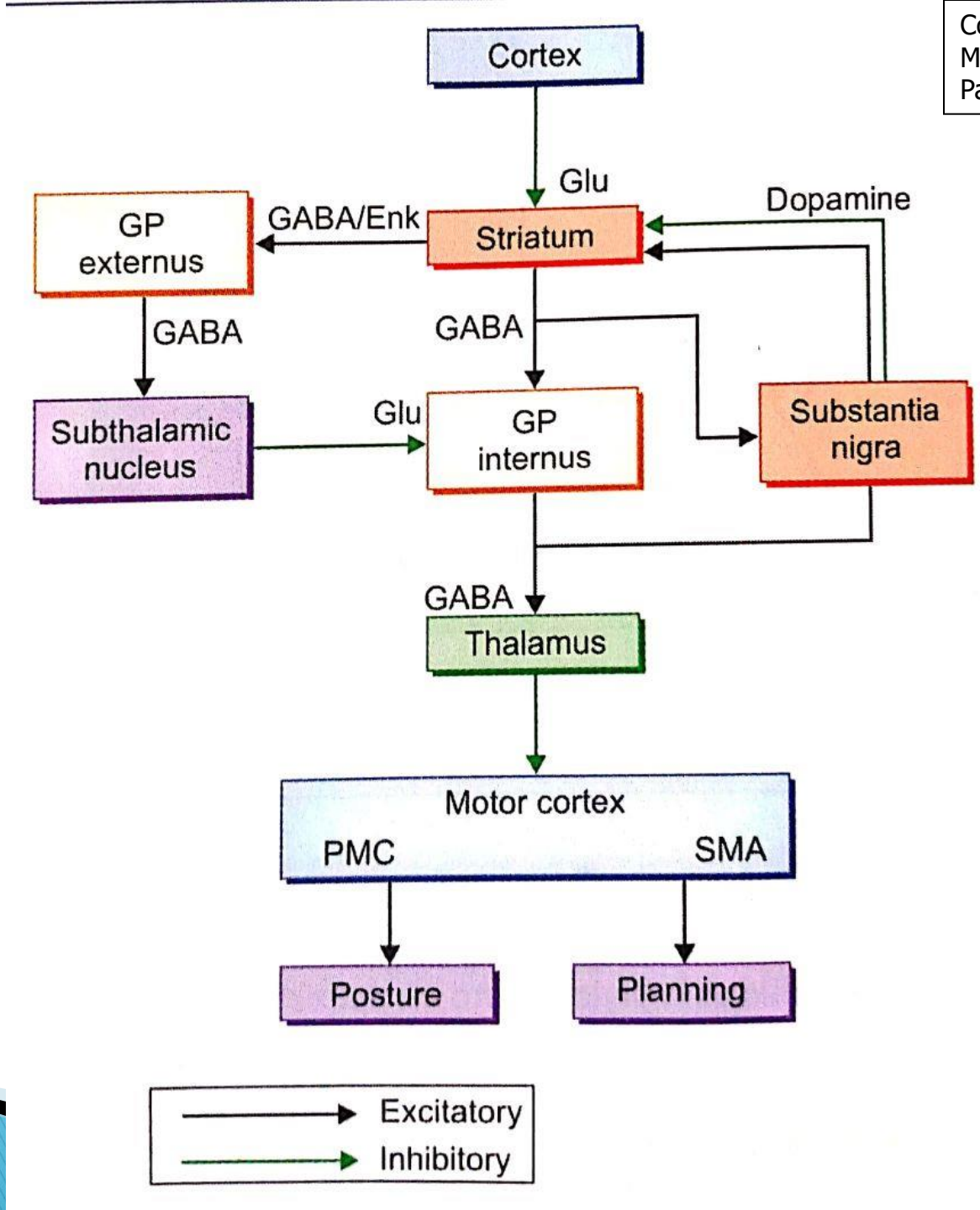

FUNCTIONS OF BASAL GANGLIA

- Cognitive control of motor activities.
- Time & scale intensity of motor movements.
- Orientation of body & body parts in the space. (with Posterior parietal lobe.)
- Concern with emotion & behavior (limbic system).
- Role in Tone, Posture regulation (extra pyramidal system).

DIRECT AND INDIRECT PATHWAYS

- Direct pathway is stimulatory.
- Indirect pathway (via subthalamic nuclei) is inhibitory.
- Direct and indirect pathways have opposite effects and normally there is balance between these two pathways.
- Damage to any of the pathway produce hyper or hypokinetic features.

NEUROTRANSMITTERS

- DOPAMINE: SUBSTANTIA NIGRA TO CORPUS STRIATUM
- DOPAMINERGIC NIGRO STRIATAL FIBERS
- INHIBITORY NEUROTRANSMITTER
- DAMAGE TO THIS PATHWAY: PARKINSONISM

PARKINSON'S DISEASE / PARALYTIC AGITANS / SHAKING PALSY

- SLOW PROGRESSIVE DEGENERATIVE DISEASE OF NERVOUS SYSTEM
- DESTRUCTION OF NIGRO STRIATAL PATHWAY
- DEFICIENCY OF DOPAMINE

- HYPOKINESIA / AKINESIA, RIGIDITY, TREMORS

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Scientist contributed

James Parkinson (1755–1824) was an English surgeon, most famous for his 1817 work, *An Essay on the Shaking Palsy* in which he was the first to describe "**paralysis agitans**", a condition that was later renamed Parkinson's disease.

James Parkinson
(1755–1824)

CLINICAL FEATURES

- HYPOKINETIC MOVEMENTS
- FESTINANT GAIT / SHUFFLING GAIT
- MONOTONOUS SPEECH
- LOSS OF AUTOMATIC ASSOCIATIVE MOV.
- MASK LIKE FACE
- RESTING TREMORS
- RIGIDITY: lead pipe / cog wheel type
- DEMENTIA

- TREATMENT: L- DOPA

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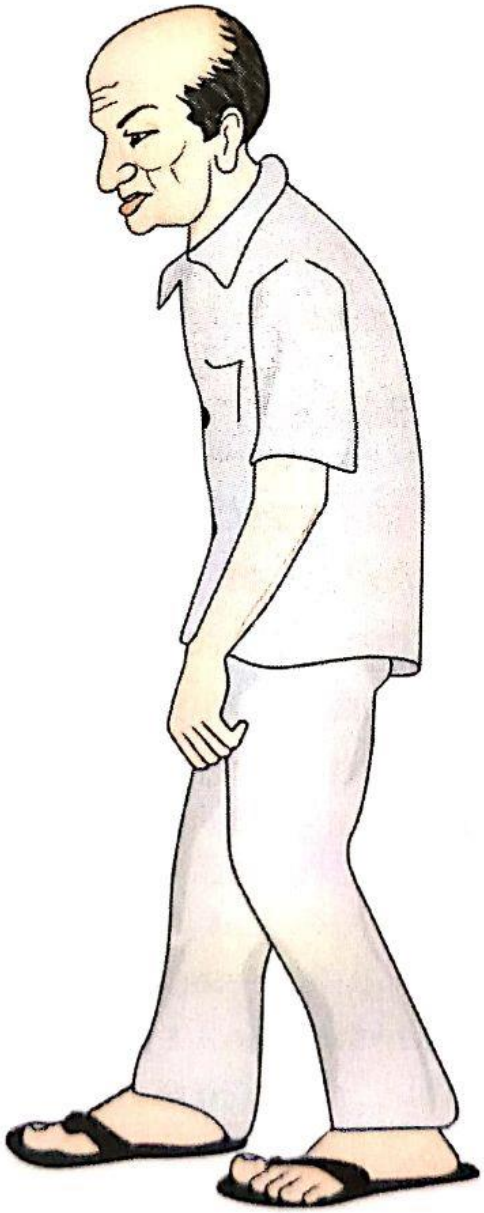

Fig. 131.6: Festinant gait of Parkinsonism. Note the patient takes short shuffling steps and bends forward trying to catch center of gravity in front of him. There is rigidity and resting tremor.

OTHERS

- WILSON'S DISEASE:

Deficiency of ceruloplasmin, disorder in copper metabolism, deposition of Cu in lentiform nucleus.

- KERNICTERUS:

Deposition of unconjugated bilirubin in lentiform nucleus.

DISORDERS OF BASAL GANGLIA

1) **Parkinsonism**: Substantia nigra (dopamine)

Tremors, Rigidity, akinesia,

2) **Chorea** *:* caudate nucleus (GABA)

rapid, jerky, short range, St. Vitus' dance like move of neck, leg & wrist

3) **Athetosis***:* globus pallidus (GABA)

slow worm-like, longer range, writhing, snake charmers move.

4) **Hemiballismus** : sub thalamus. (GABA)

sudden flailing movements of large muscle group like an entire limb

CEREBRAL CORTEX

CEREBRAL CORTEX

- 2.2 SQ. MT.
- presence of sulci and gyri
- both hemispheres connected by corpus callosum
- 3 surfaces: lateral, medial, inferior
- 4 lobes: frontal, parietal, occipital, temporal.

HISTOLOGY: 6 LAYERS

1) MOLECULAR / PLEXIFORM

2) EXTERNAL GRANULAR LAYER

3) OUTER PYRAMIDAL LAYER
PYRAMIDAL CELLS–MEDIUM AND LARGE SIZE

4) INNER GRANULAR LAYER

5) GANGLIONIC LAYER

6) FUSIFORM CELL LAYER

FRONTAL LOBE

- FORMS 1/3 RD OF CORTICAL SURFACE
- 2 FUNCTIONAL PARTS:
  PRECENTRAL CORTEX
  PREFRONTAL CORTEX

PRECENTRAL CORTEX

- **PRIMARY MOTOR AREA (AREA 4):**
  LARGE PYRAMIDAL CELLS
  MOTOR HOMONCULUS

  FUNCTIONS: VOLUNTARY MOVEMENTS AND SPEECH

  Area 4S: Suppressor area

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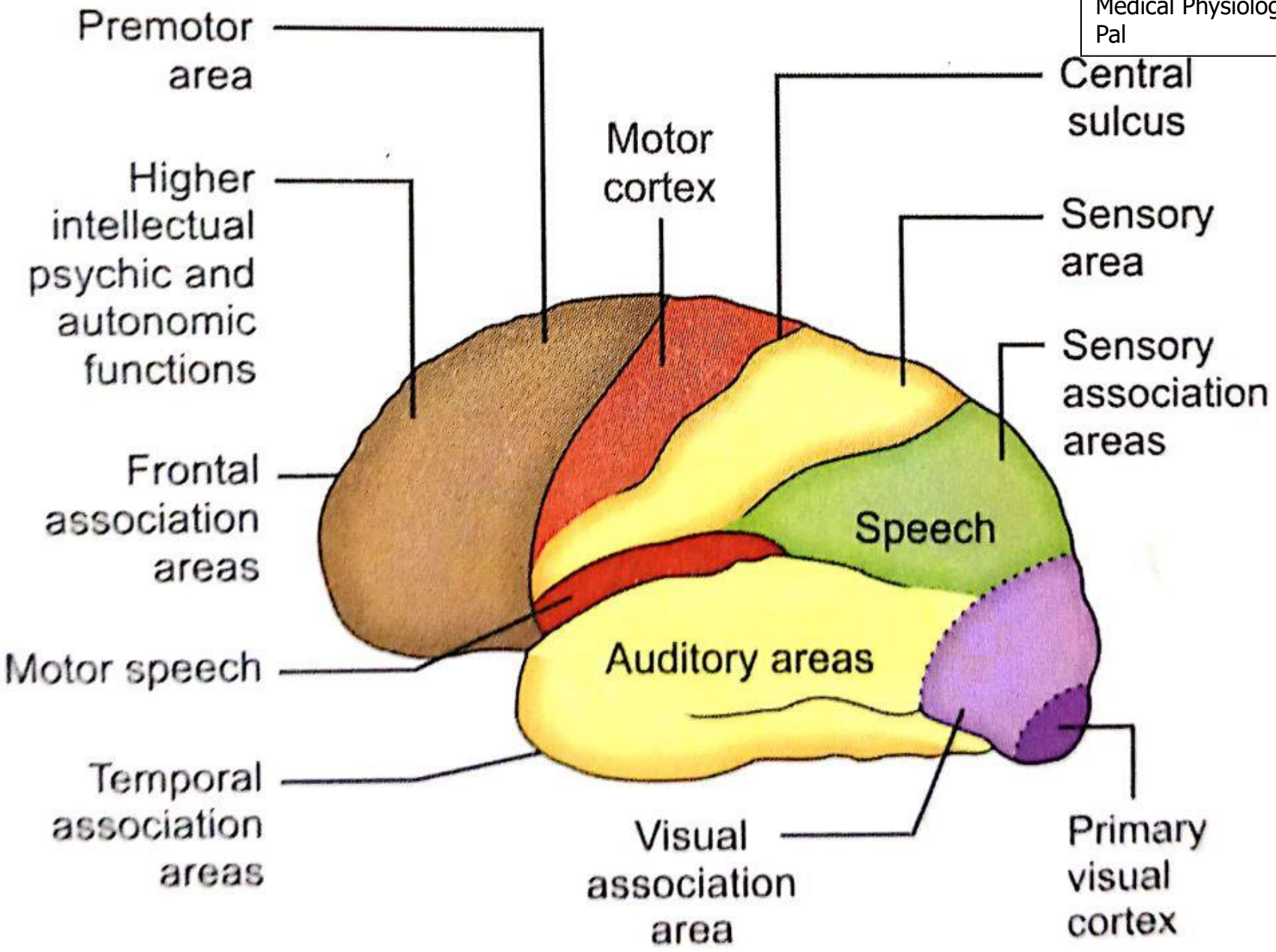

Fig. 140.6: Major functions of different lobes of brain.

- PREMOTOR AREA: (AREAS 6,8,44,45)

AREA 6- coordination of movements. skilled, accurate

AREA 8 (FRONTAL EYE FIELD)-
conjugate movements of eyeballs, movements of eyelids

AREAS 44 & 45 (BROCA'S AREA)
motor are for speech
movements of tongue, lips and larynx for speech
located in left hemisphere (dominant) in rt.handed

PREFRONTAL CORTEX

- IN FRONT OF AREAS 8 AND 44.
- AREAS 9-14,
- AREAS 23,24,29,32(MEDIAL SURFACE)
- HAS CONNECTIONS WITH THALAMUS, HYPOTHALAMUS, MIDBRAIN, PONS, BASAL GANGLIA
- AREA 13 WITH LIMBIC SYSTEM: EMOTIONAL REACTIONS.

- FUNCTIONS

  EMOTIONS, LEARNING, MEMORY, PLANNED ACTIONS. SEAT OF INTELLIGENCE.

  RESPONSIBLE FOR AUTONOMIC CHANGES DURING EMOTIONS (VIA HYPOTHALAMUS)

FRONTAL LOBE syndrome

Loss of Motor Planning of complex motor activity – useless activities

Loss of Elaboration of thoughts (intelligence) working memory

Loss of Prolonged concentration- easy distraction in mts

Loss of Emotion, behavior- well being but wild mood swing (sweet to psychotic) & don't follow moral & ethical laws for hygiene & excretion

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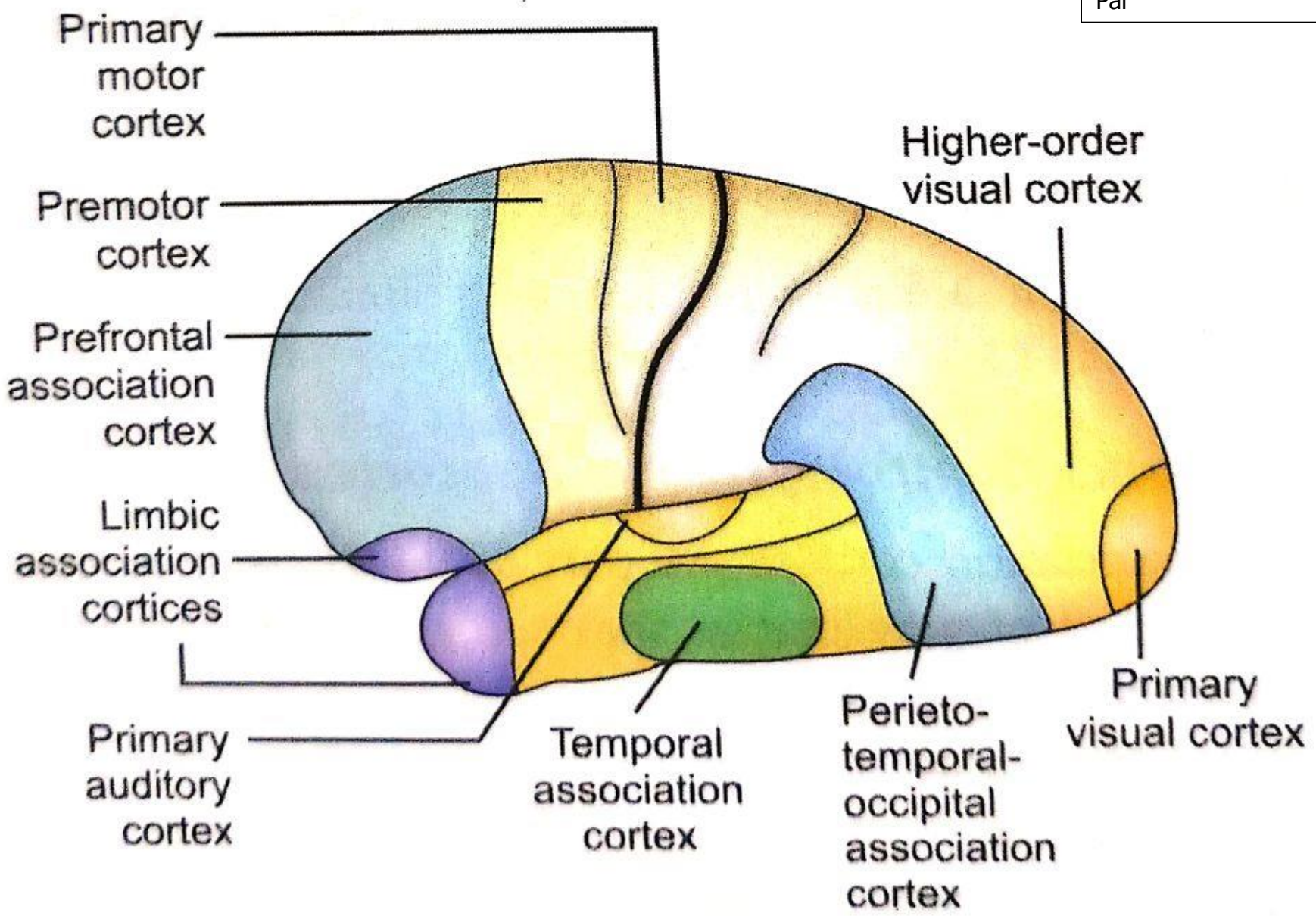

Fig. 140.1: Cortical association areas.

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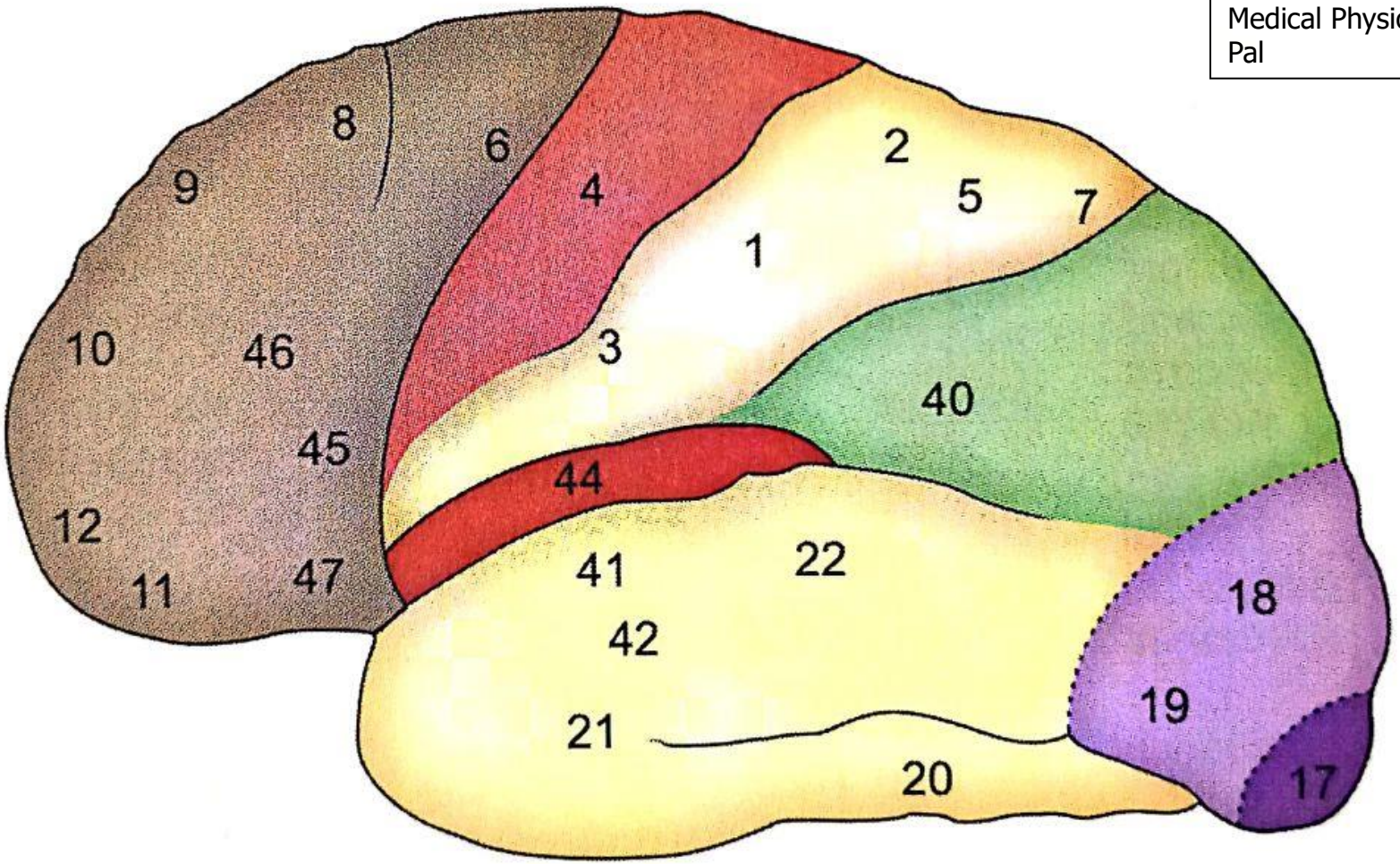

Fig. 140.5: Brodmann's areas in the cerebral cortex. Function of each area has been described in different chapters in neurophysiology section. Notably important are motor areas (areas 4, 6), sensory areas (areas 1–3, 5 and 7), visual areas (areas 17, 18), motor speech area (area 44), sensory speech area (area 22) and auditory areas (41, 42).

PARIETAL LOBE

- SOMESTHETIC SENSORY AREA
- SOMESTHETIC SENSORY ASSOCIATION AREA

SOMESTHETIC SENSORY AREA

- AREAS 3,2,1
- RECEIVES FIBERS FOM THALAMUS

- FUNCTIONS: receives sensory inputs from receptors from opposite side.
  sends sensory feedback to motor area

  AREA 1 FOR PRIMARY SENSATIONS AND AREAS 2,3 FOR INTEGRATION

SENSORY HOMONCULUS

* EFFECT OF LESION: LOSS OF SENSATIONS ON OPPOSITE SIDE OF BODY

SOMESTHETIC ASSOCIATION (AREAS 5,7)

- SYNTHESIS OF SENSATIONS PERCEIVED BY SENSORY AREA
- AREA FOR COMBINED SENSATIONS LIKE STEREOGNOSIS
- DAMAGE: ASTEREOGNOSIS

- Gives an idea of the state of the body as a whole.

- Damage of these areas produces a sensory deficit called ‘amorphosynthesis’ in which condition the person neglects about one-half of the body and therefore cannot perform complicated motor acts satisfactorily.

TEMPORAL LOBE: AUDITORY AREAS

- AREAS 41, 42 (Primary)
- FUNCTION: HEARING.
  SOUND- PITCH, INTENSITY AND SOURCE

- Areas 21 and 20: Auditory association areas.
- Responsible for analysis, interpretation and integration of auditory impulses.

- WERNICKE'S AREA (22): interpreting the meaning of what is heard.

OCCIPITAL LOBE

- PRIMARY VISUAL AREA (17): Lateral Geniculate body: reception & initial comprehension of V information
- VISUAL ASSOCIATION AREA (18): further level of comprehension of V information
  e.g. meaning of written language
- OCCIPITAL EYE FIELD (19): regulation of involuntary eye movements
- Inferior surface: recognition of human faces

DOMINANT HEMISPHERE

* Wernicke's area and the angular gyrus, and also the functions of speech and motor control areas are usually much more highly developed in one cerebral hemisphere.

* The dominance is primarily for language or verbal symbolism-related intellectual function; the opposite hemisphere is dominant for other types of intelligence – music, special / visual memory.

- **Left hemisphere**
  - Precise motor movements of hands
  - Word formation and language
  - Logical interpretation of the processed information
  - Rational and analytical thinking
  - Mathematical amplitude

- **Right hemisphere**
  - Complex and parallel procession of information
  - Nonverbal auditory experience
  - Non verbal visual
  - Non verbal communication
  - Emotional, nonverbal, intuitive thinking

THANK YOU