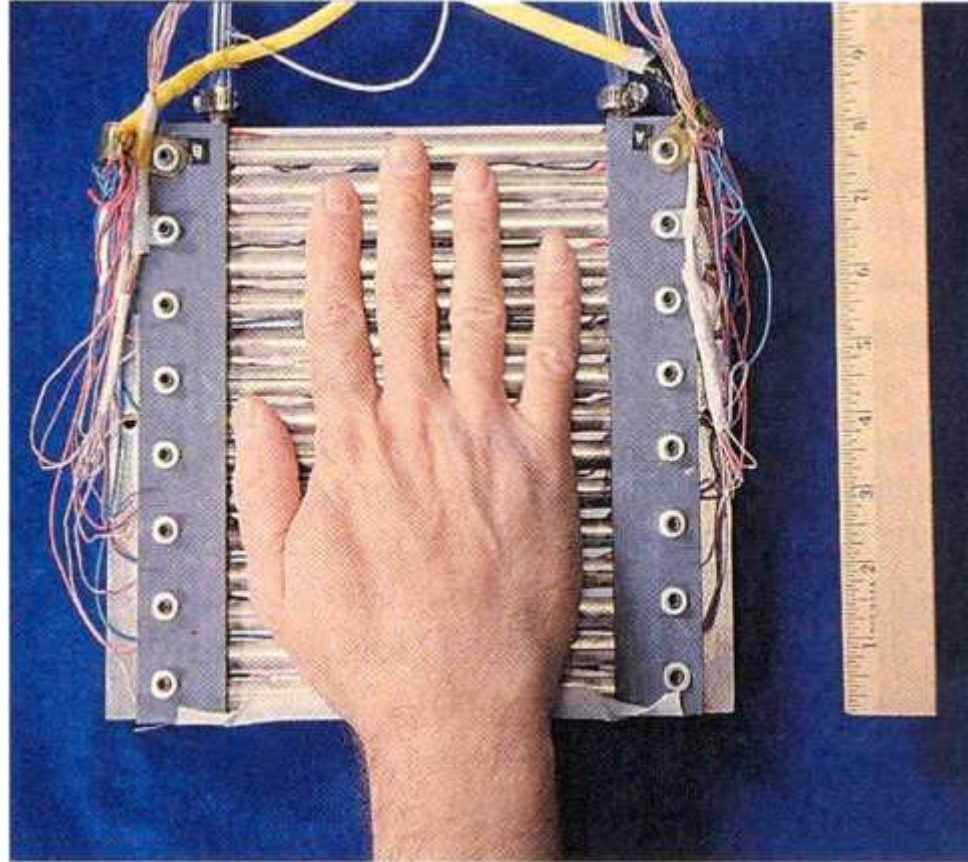


Percepția și integrarea realității

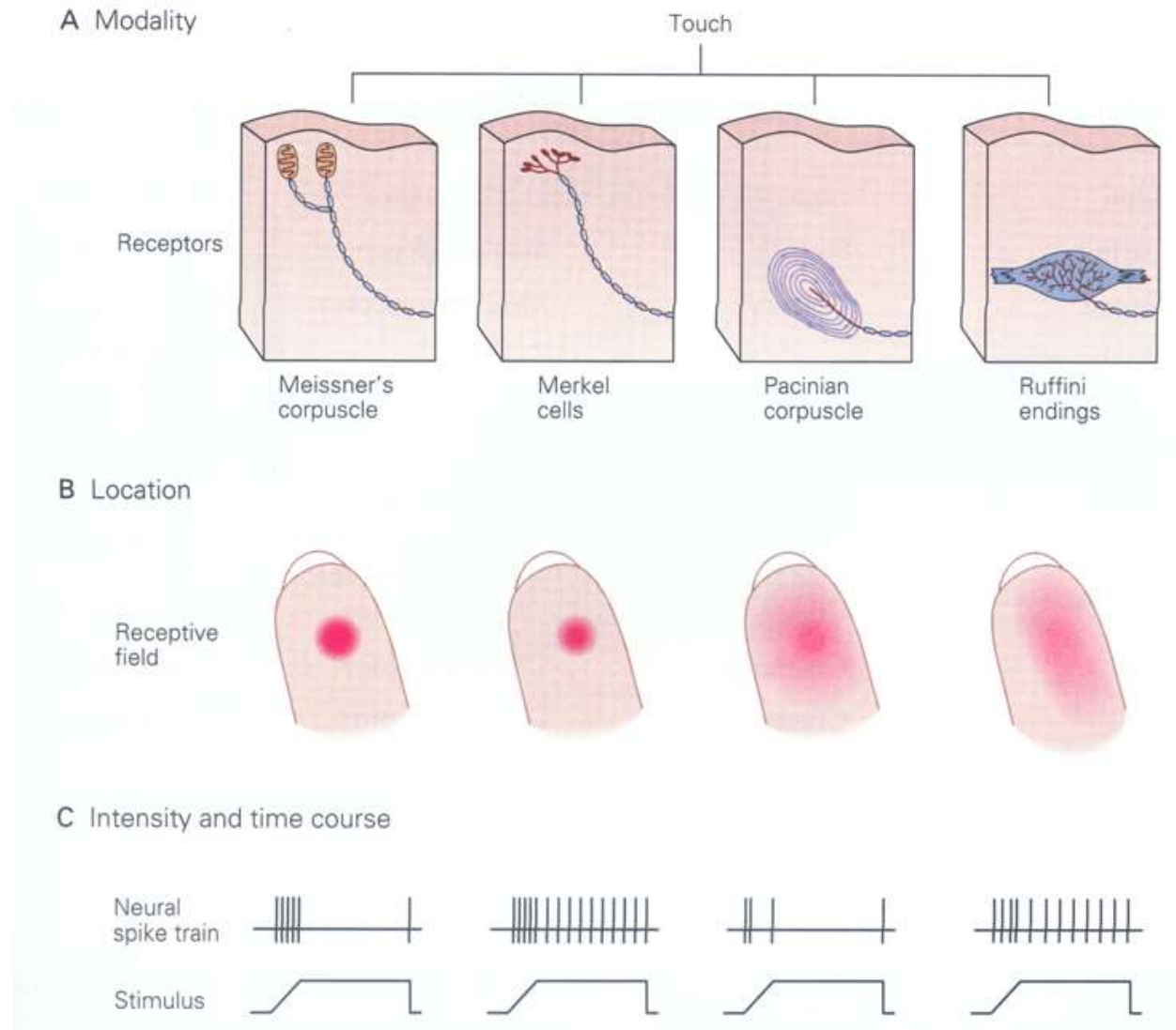


Partea I: Neuroștiințe somatosenzoriale.
Codificarea informațiilor senzoriale

Sisteme senzoriale

Codificarea unui stimul:

- Modalitate
- Locație
- Intensitate
- Sincronizare



Sisteme senzoriale

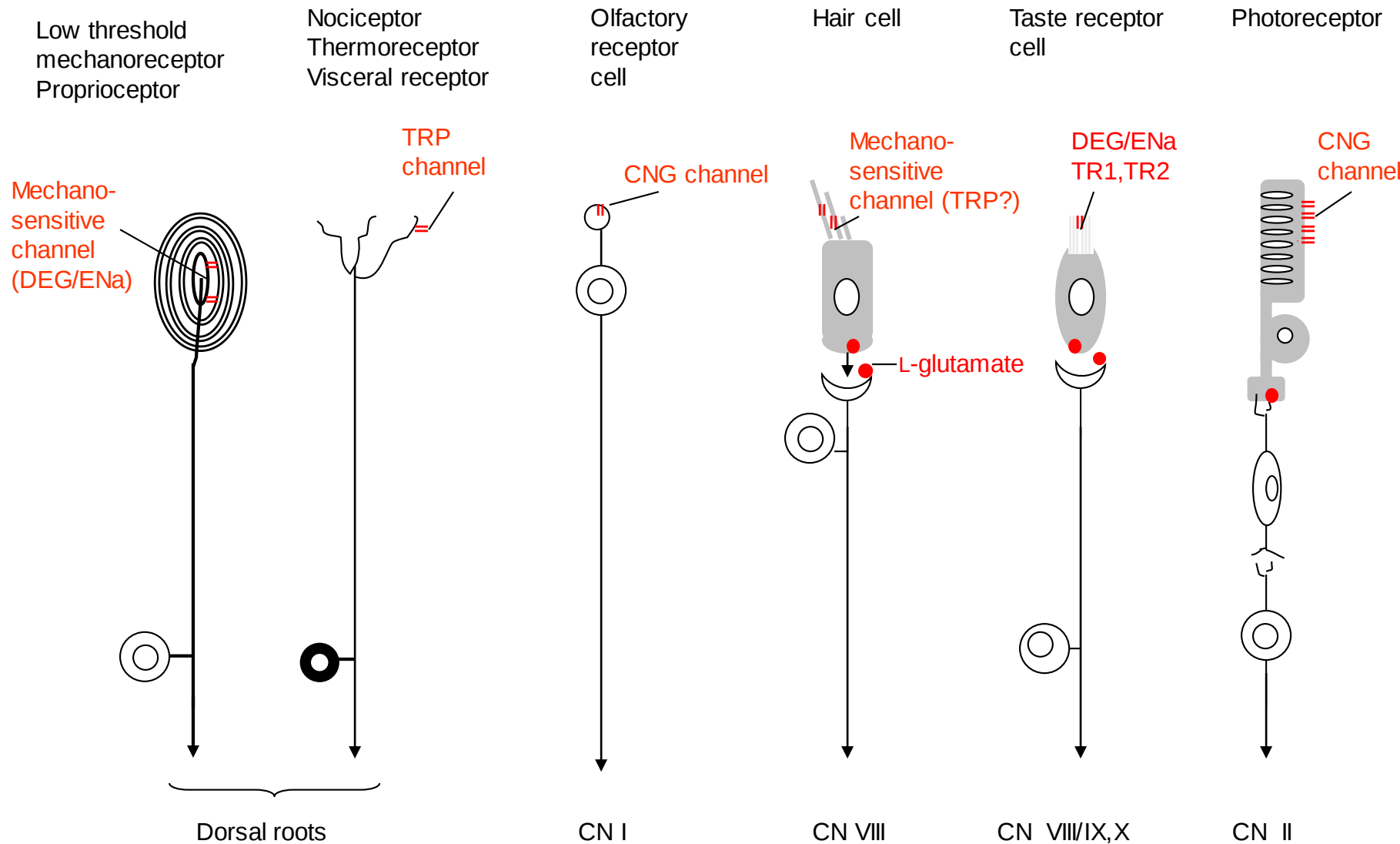
Transducția stimulului

- Potențialul de acțiune al receptorului: amplitudinea și durata sunt legate de intensitatea stimulului și de evoluția temporală
- Specializate morfologic: specificitatea receptorului
- Patru clase: mecanică, chimică, termică sau electromagnetică

Sisteme si modalități senzoriale

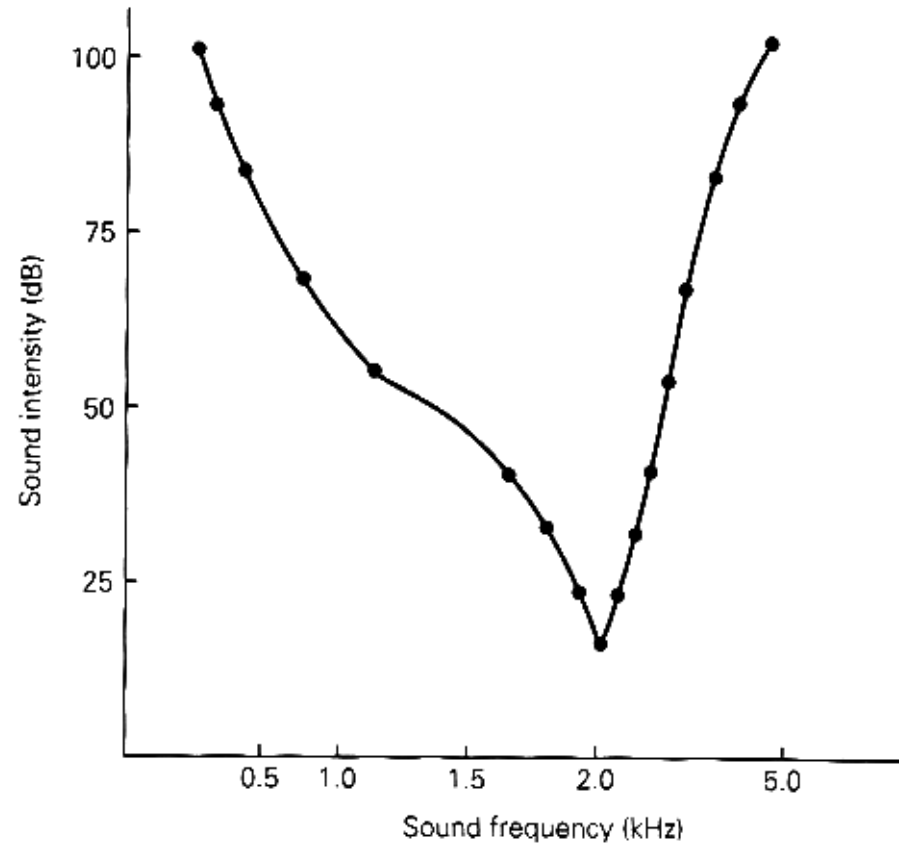
Sensory system	Modality	Stimulus energy	Receptor class ¹	Receptor cell types ²
Visual	Vision	Light	Photoreceptor	Rods, cones
Auditory	Hearing	Sound	Mechanoreceptor	Hair cells (cochlea)
Vestibular	Balance	Gravity	Mechanoreceptor	Hair cells (vestibular labyrinth)
Somatosensory	Somatic senses:			Dorsal root ganglion neurons
	Touch	Pressure	Mechanoreceptor	Cutaneous mechanoreceptors
	Proprioception	Displacement	Mechanoreceptor	Muscle and joint receptors
	Temperature sense	Thermal	Thermoreceptor	Cold and warm receptors
	Pain	Chemical, thermal, or mechanical	Chemoreceptor, thermoreceptor, or mechanoreceptor	Polymodal, thermal, and mechanical nociceptors
	Itch	Chemical	Chemoreceptor	Chemical nociceptor
Gustatory	Taste	Chemical	Chemoreceptor	Taste buds
Olfactory	Smell	Chemical	Chemoreceptor	Olfactory sensory neurons

TRANSDUCȚIE: Receptorii senzoriali transformă stimulul din mediu într-un semnal electric



Receptori Senzoriali

- *Nu sunt omogeni*
- *Filtru pentru o gamă restrânsă de energie: “lăţime de bandă” (Bandwidth)*
- *„Curba de reglare” (tuning curve)*



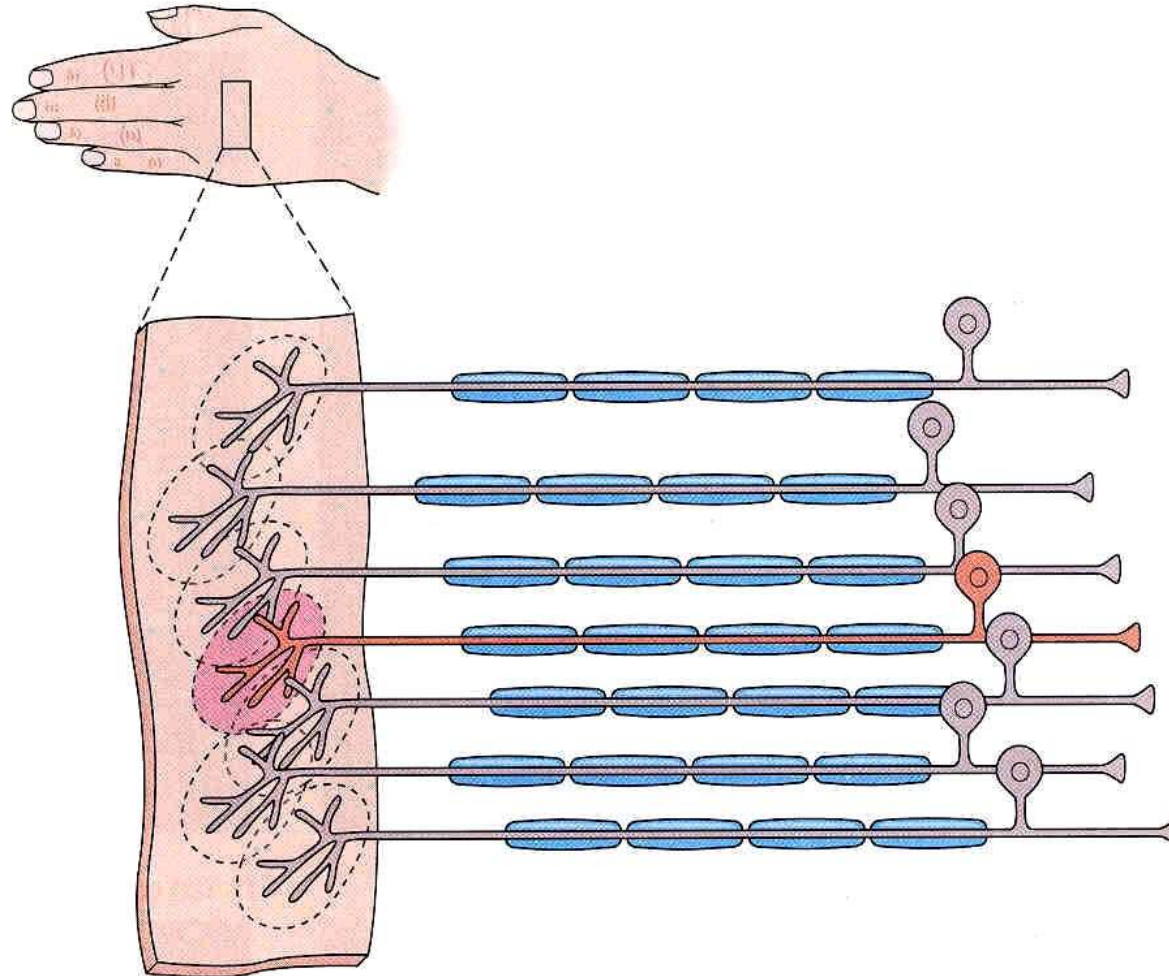
Distribuția spațială a neuronilor senzoriali activați

- *Localizarea locului stimulului pe corp sau a sursei în spațiu*
- *Discriminarea dimensiunii și forme obiectului*
- *Rezoluție detaliată fină*

= CÂMP RECEPTIV

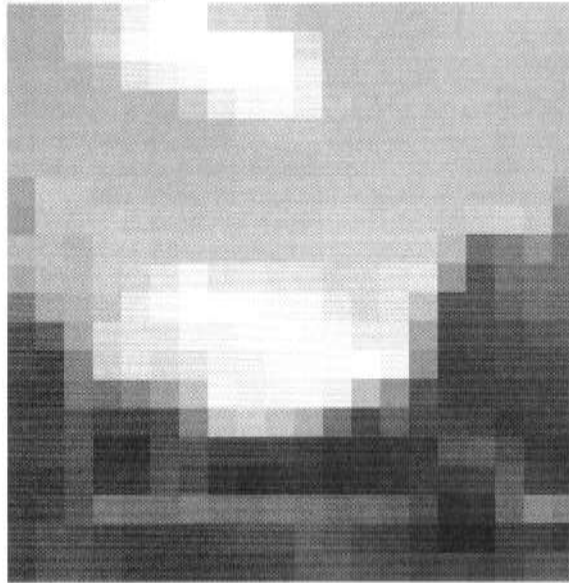
Fiecare receptor are un câmp receptiv

- Locație
- Mărime
- Formă



**Dimensiunea
câmpului
receptiv
determină
rezoluția
percepției
senzoriale**

A 400 receptors



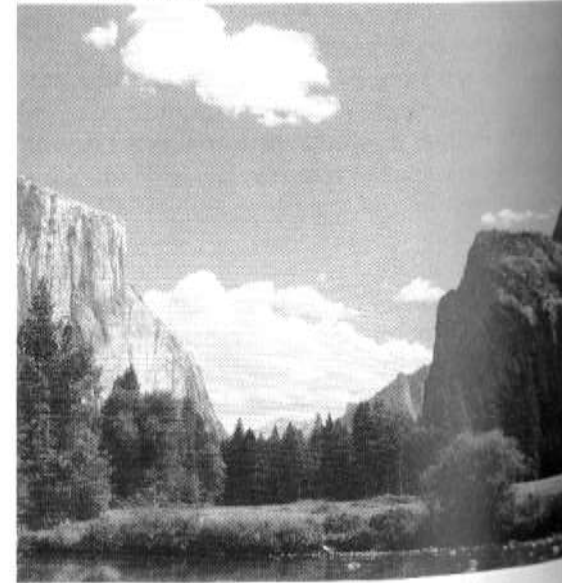
B 3,600 receptors



C 14,400 receptors



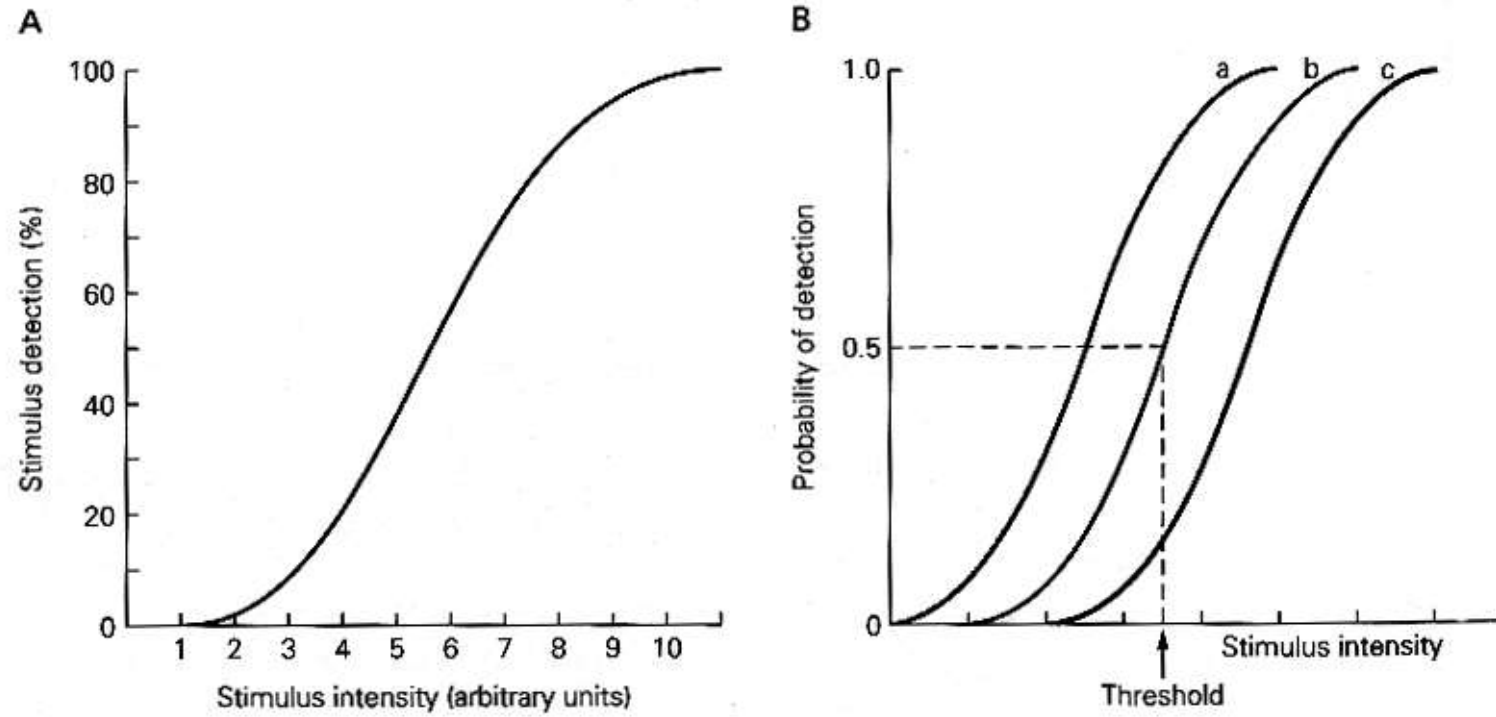
D 160,000 receptors



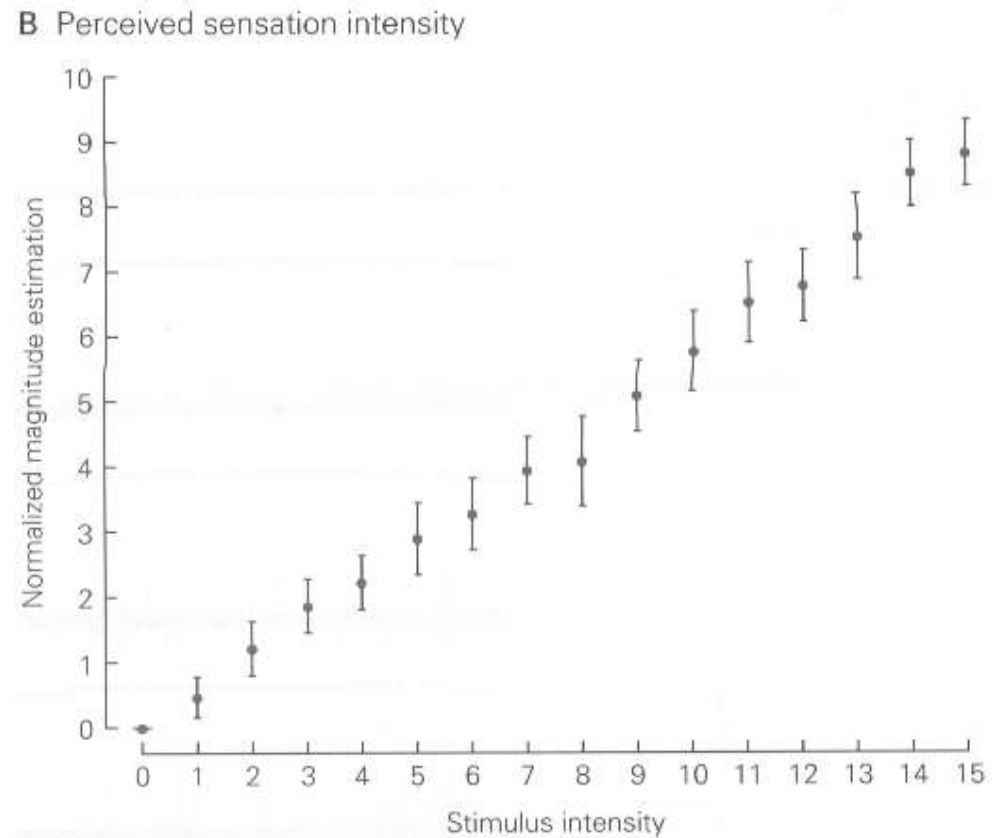
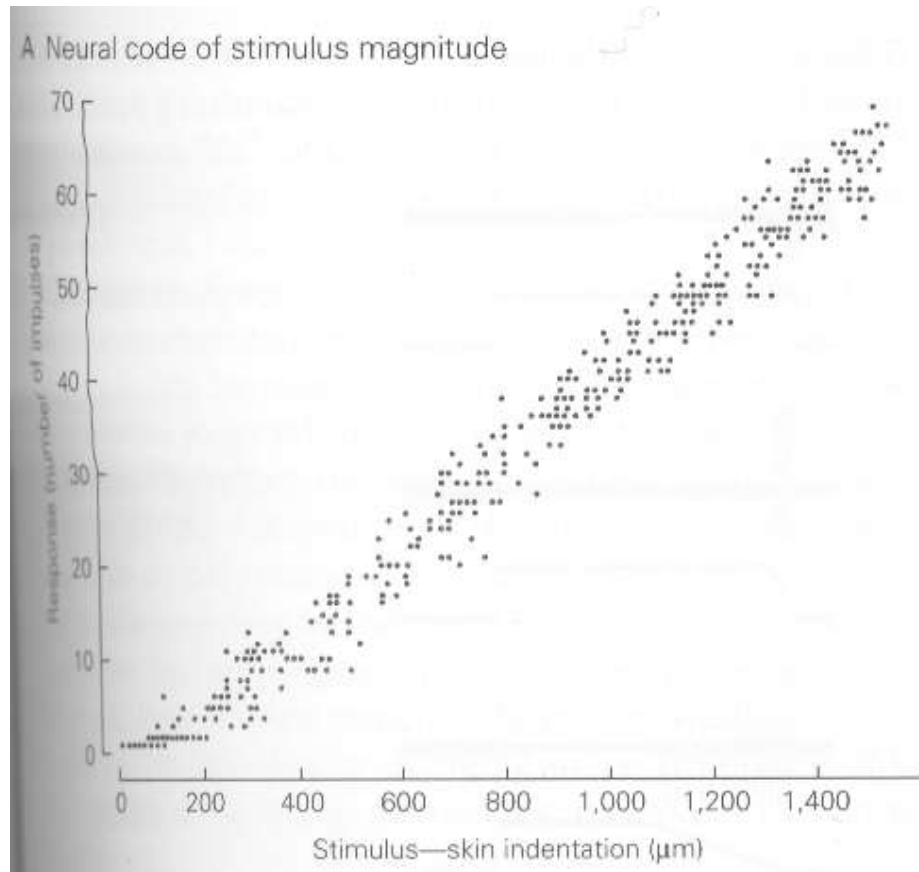
Intensitatea stimulului

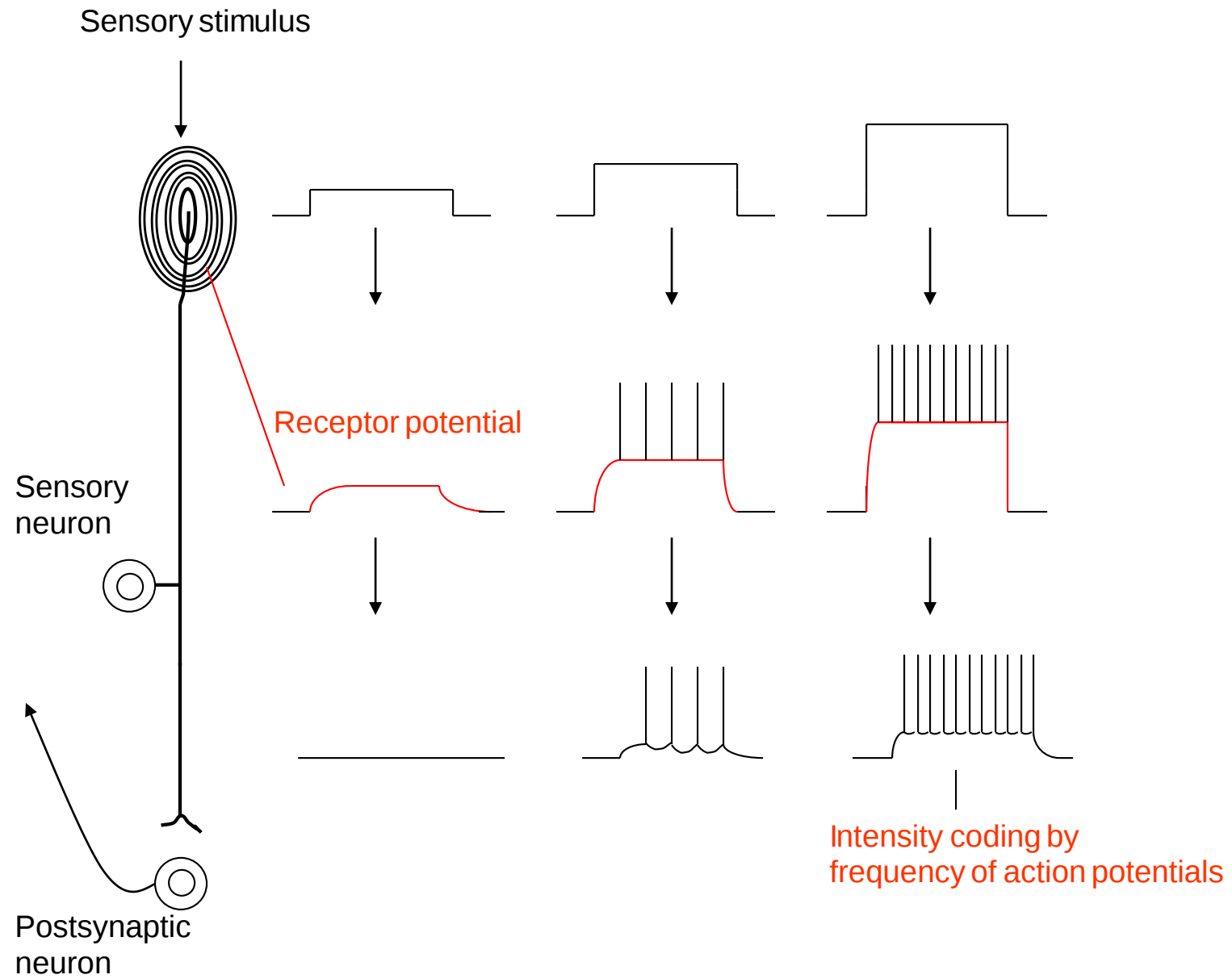
- Pragul senzorial pentru o modalitate este limitat de sensibilitatea receptorilor
- Pragurile sunt modificate de factori psihologici și farmacologici
- Codificată de frecvența potențialelor de acțiune în nervii senzoriali

Pragul senzorial



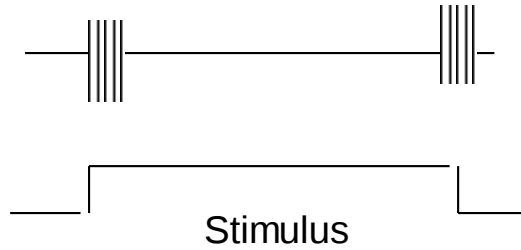
Codificarea magnitudinii stimulului



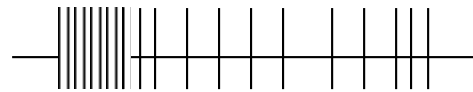


Adaptarea receptorilor

Rapidly adapting receptor



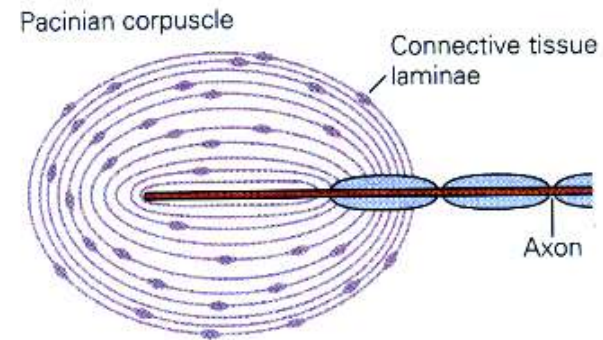
Slowly adapting receptor



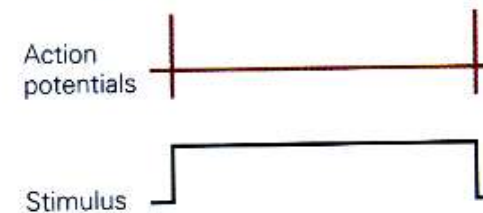
Morfologia și adaptarea receptorilor

Corpuscul Pacini

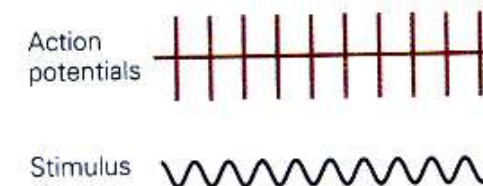
- adaptarea rapidă a mecanoreceptorului pentru o presiune constantă
- adaptarea lentă a mecanoreceptorului pentru **vibrații** (presiune vibratorie)



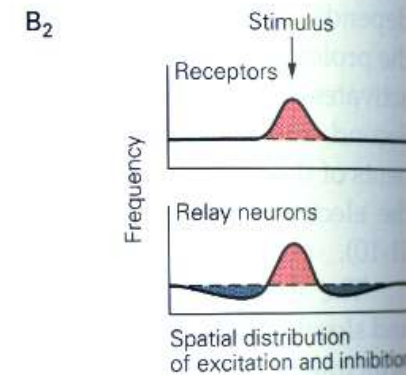
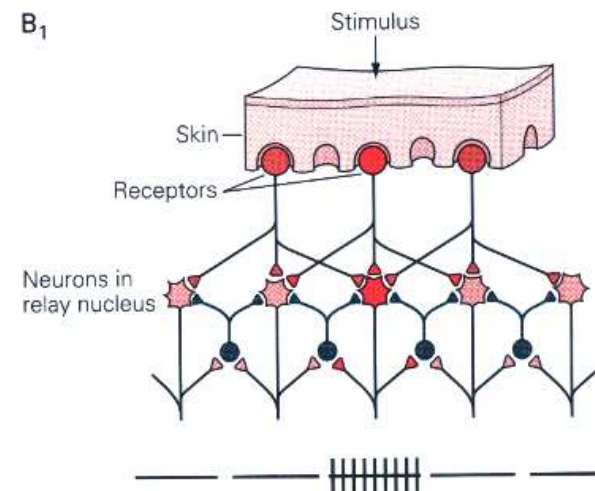
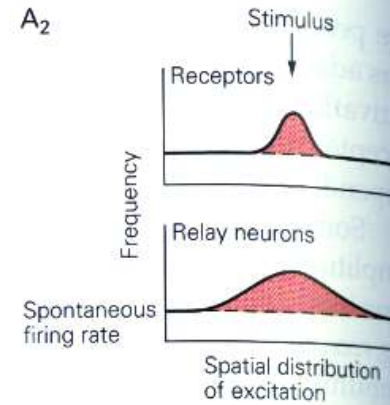
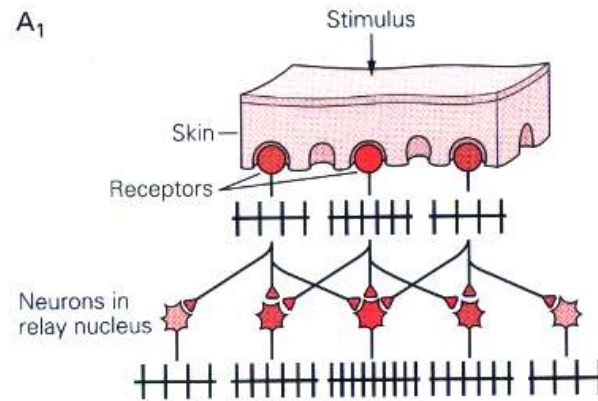
A Steady pressure

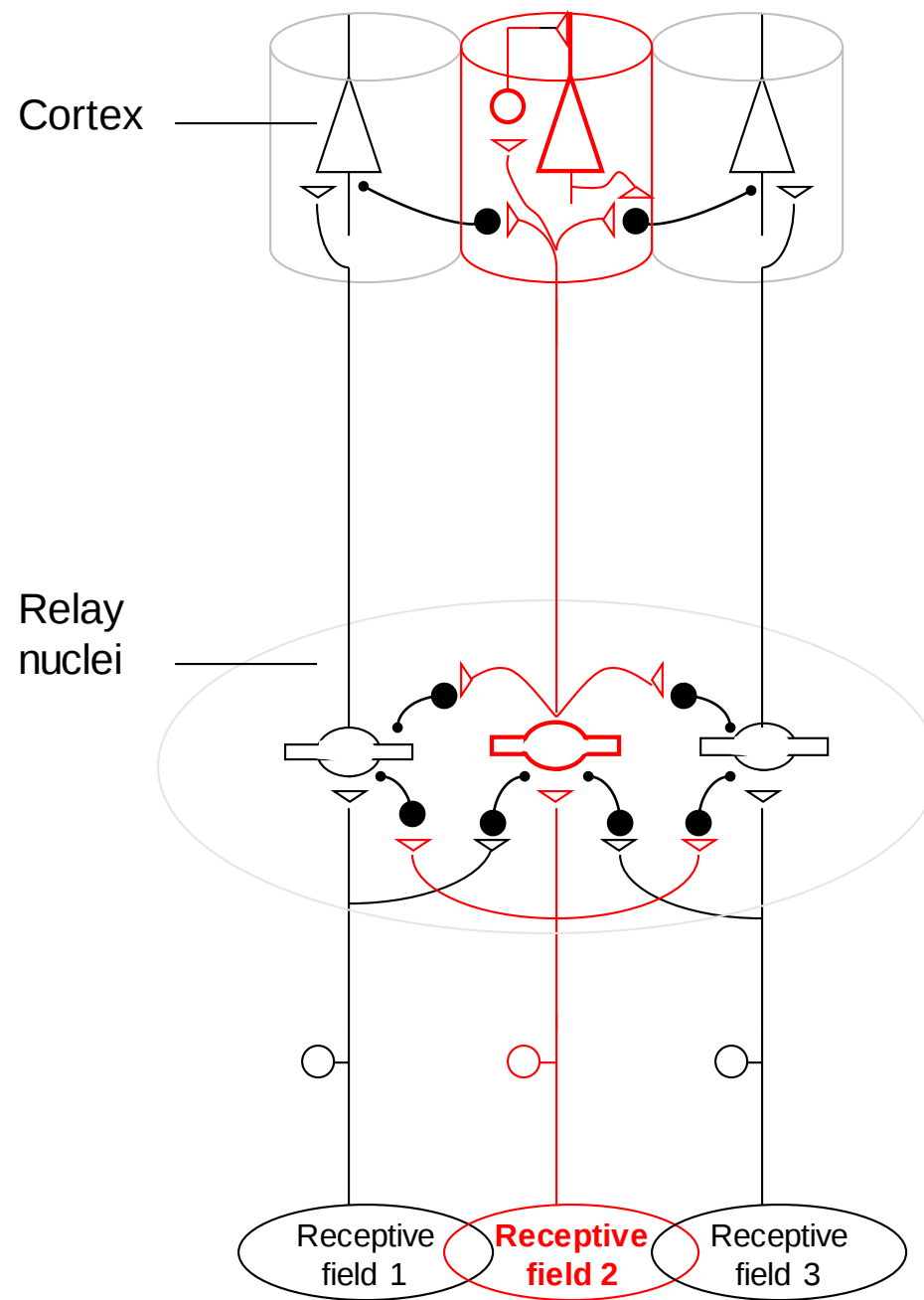
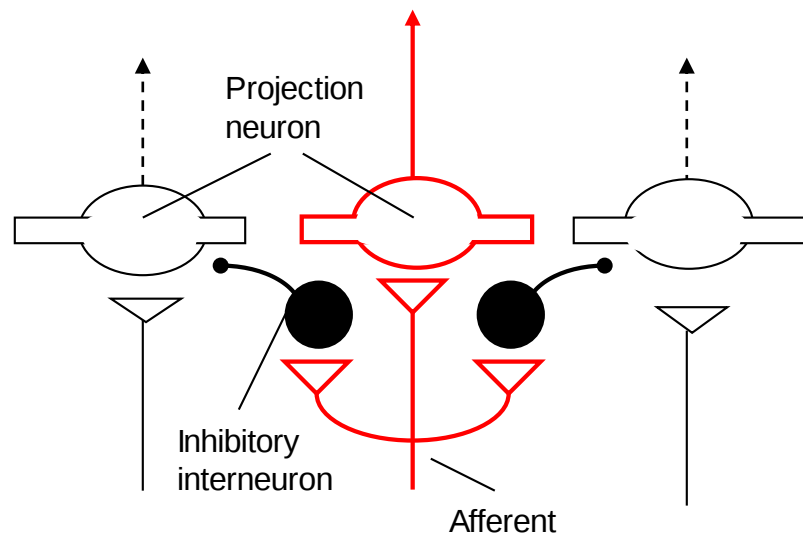
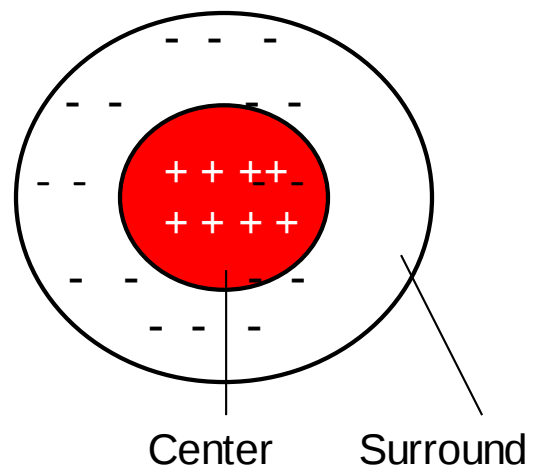


B 110 Hz vibration



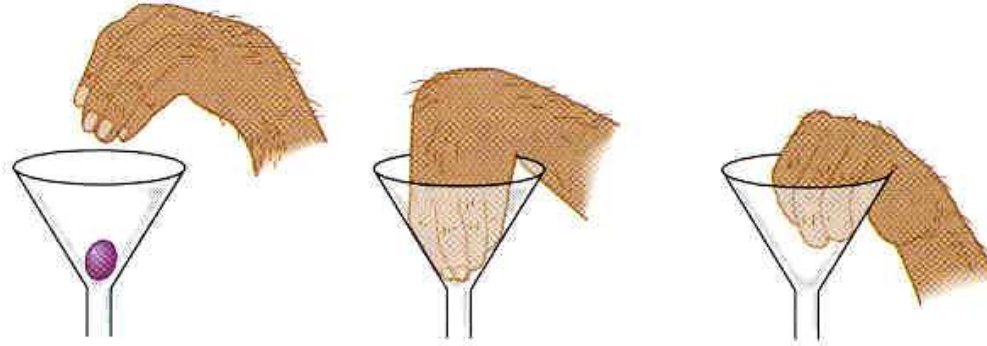
Organizarea rețelelor senzoriale



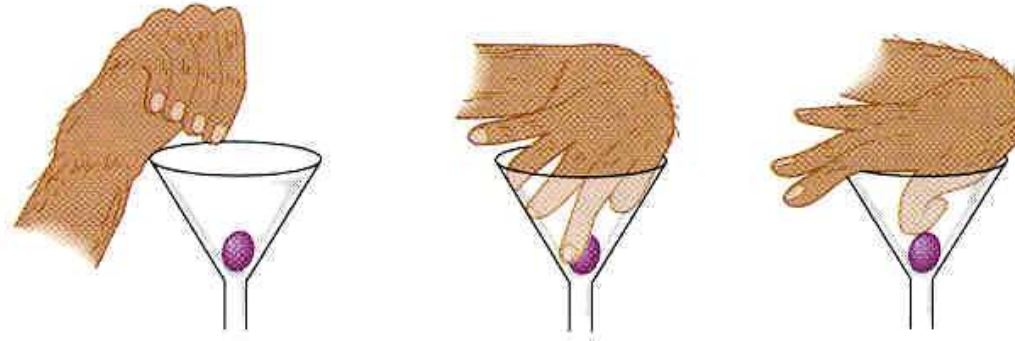


Pertubarea detecției complexe a caracteristicilor

Ipsilateral hand



Contralateral hand

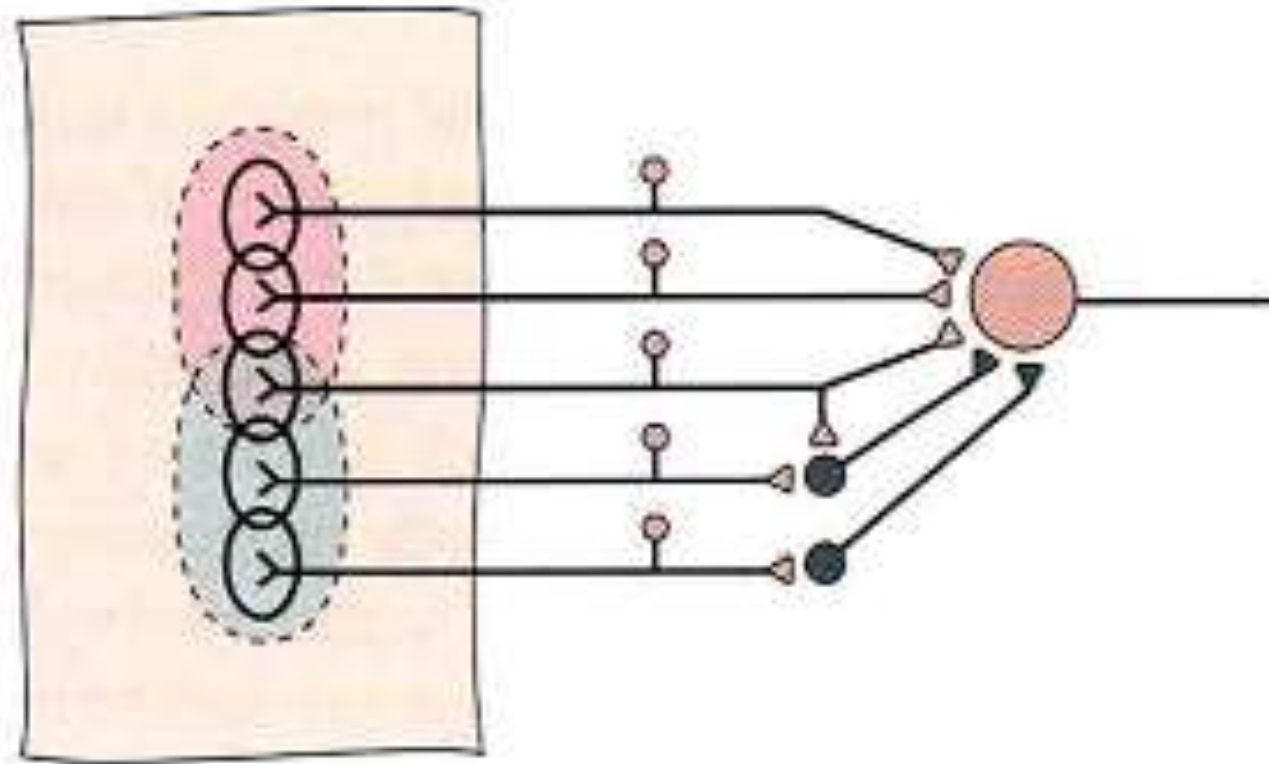


WHY?

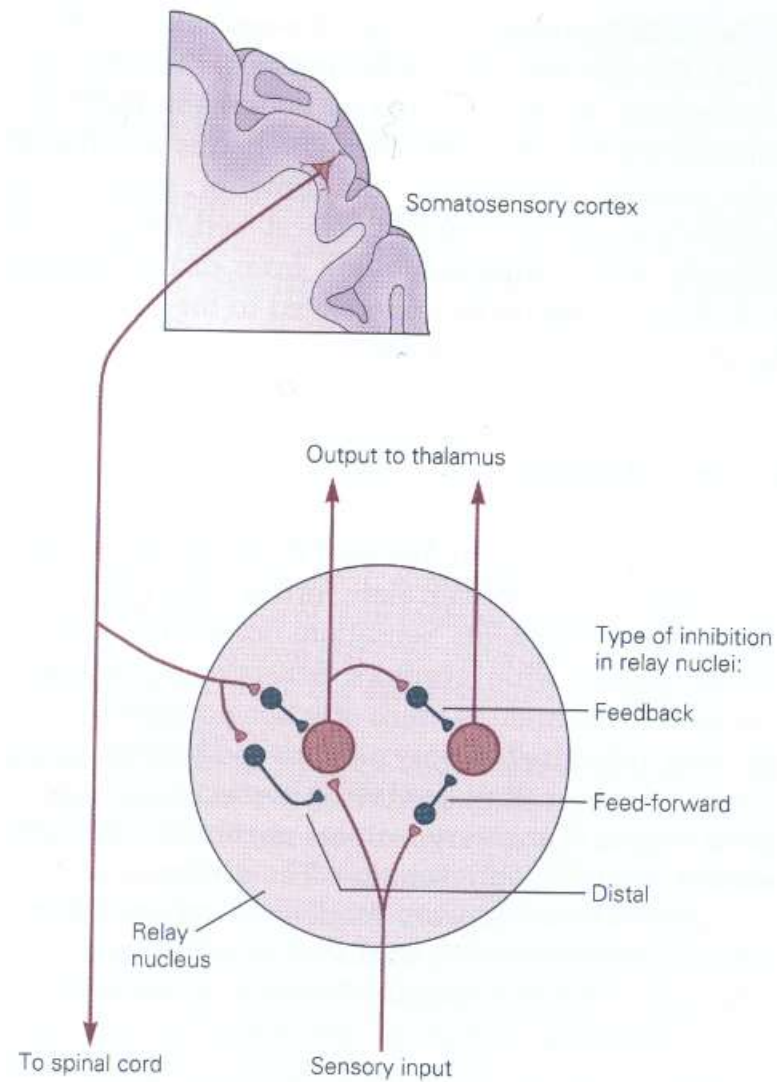
Unilateral injection of muscimol (GABA antagonist) into area 2.

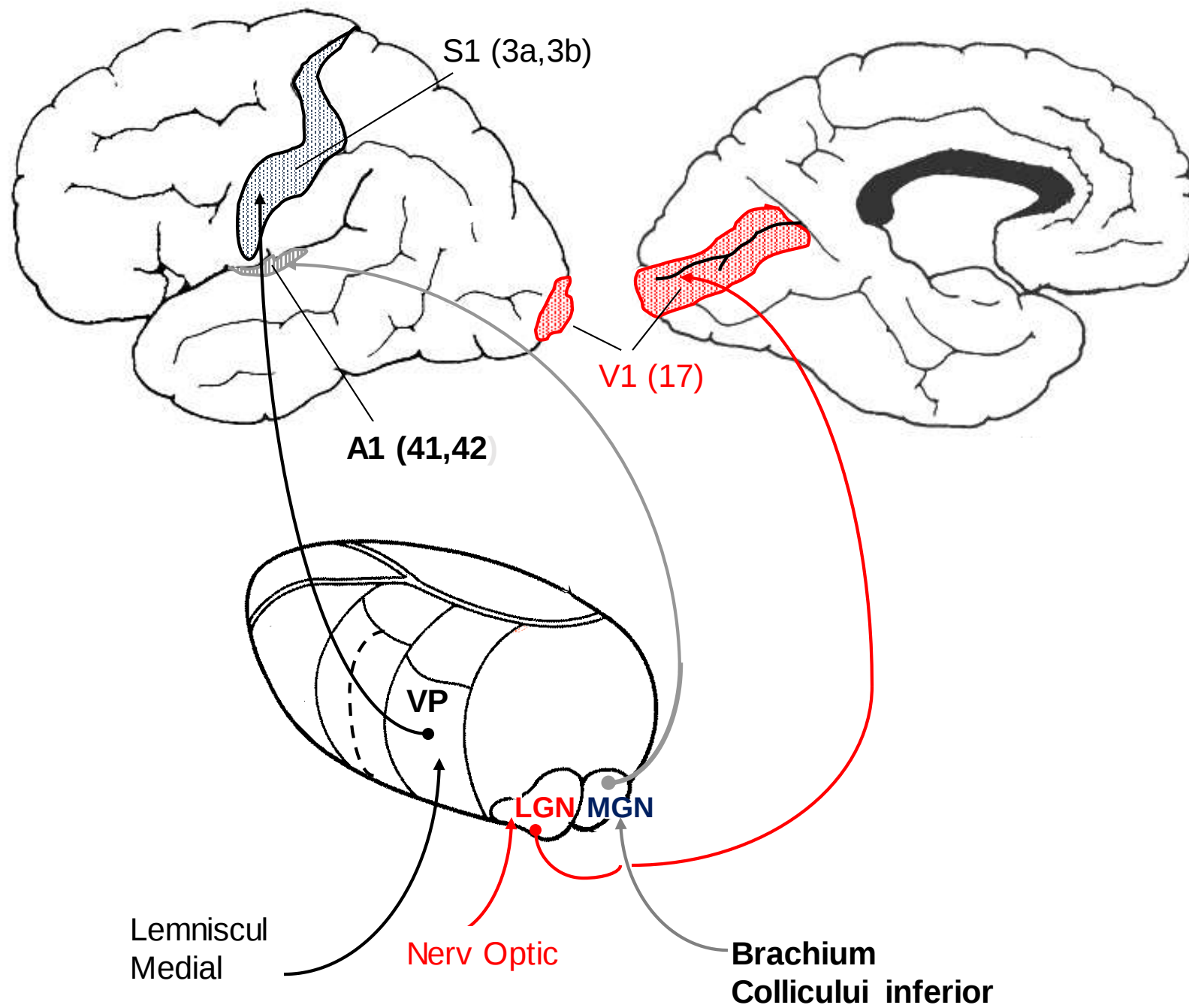
Lateral Inhibition

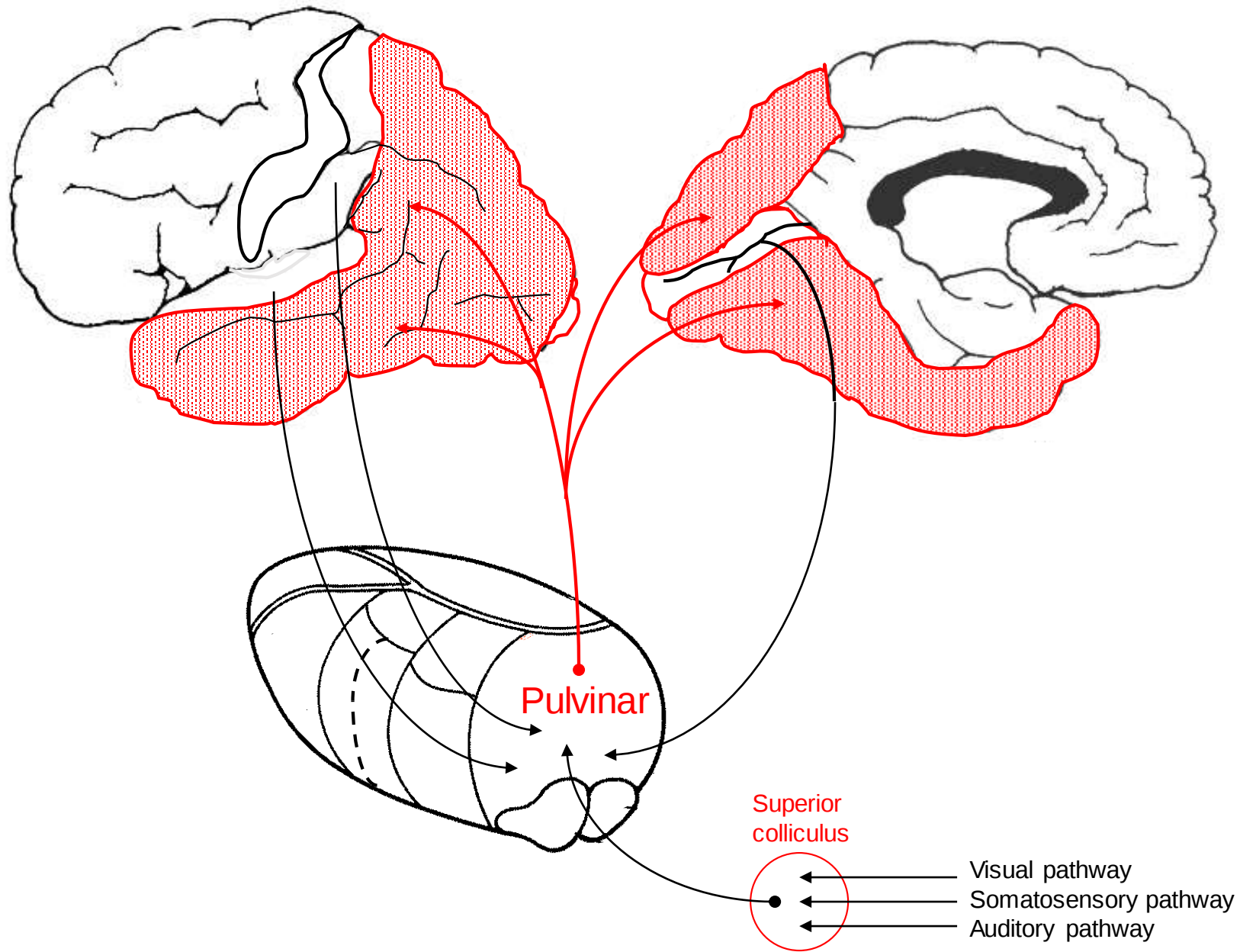
C Lateral inhibition

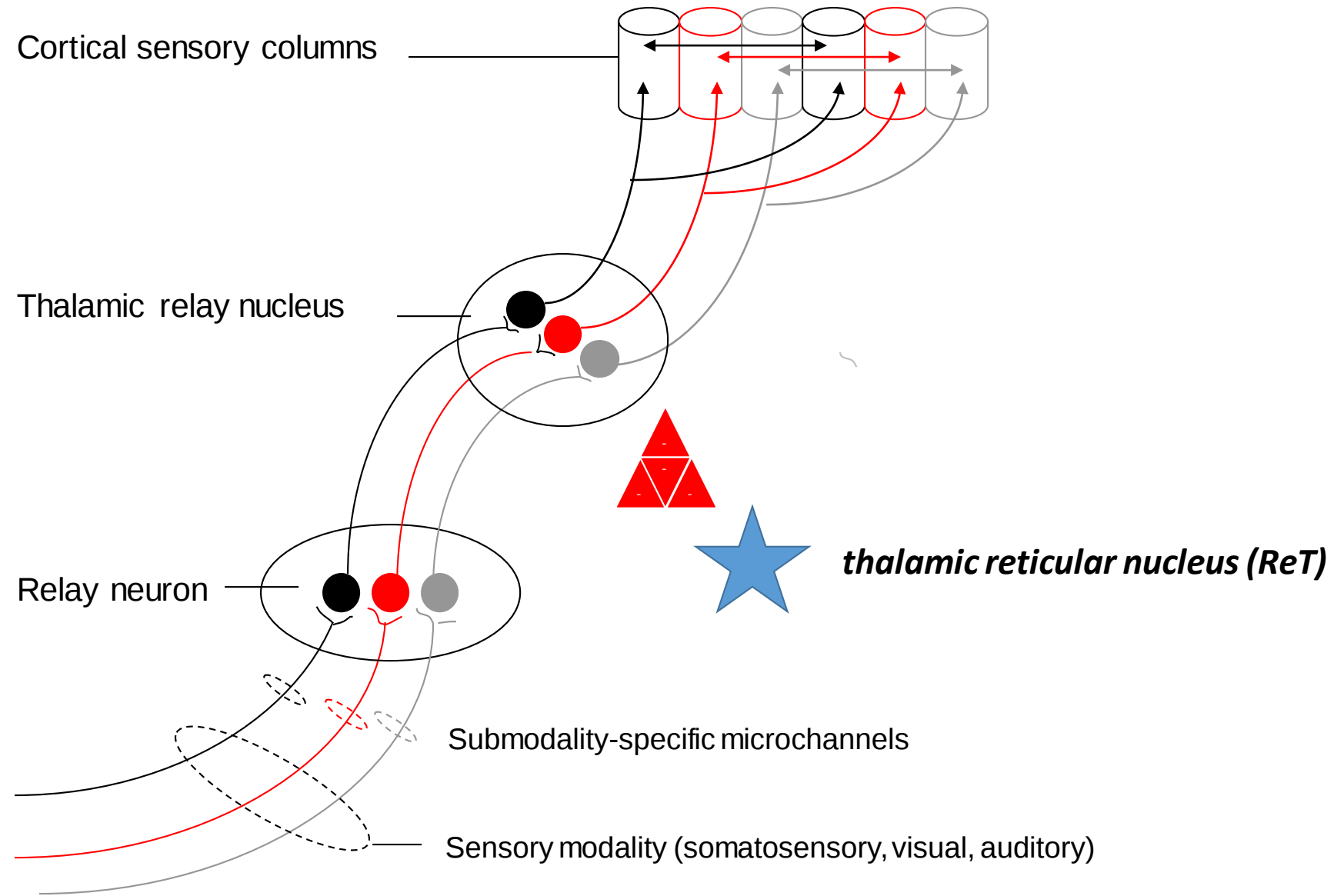


Inhibiția îmbunătățește contrastul









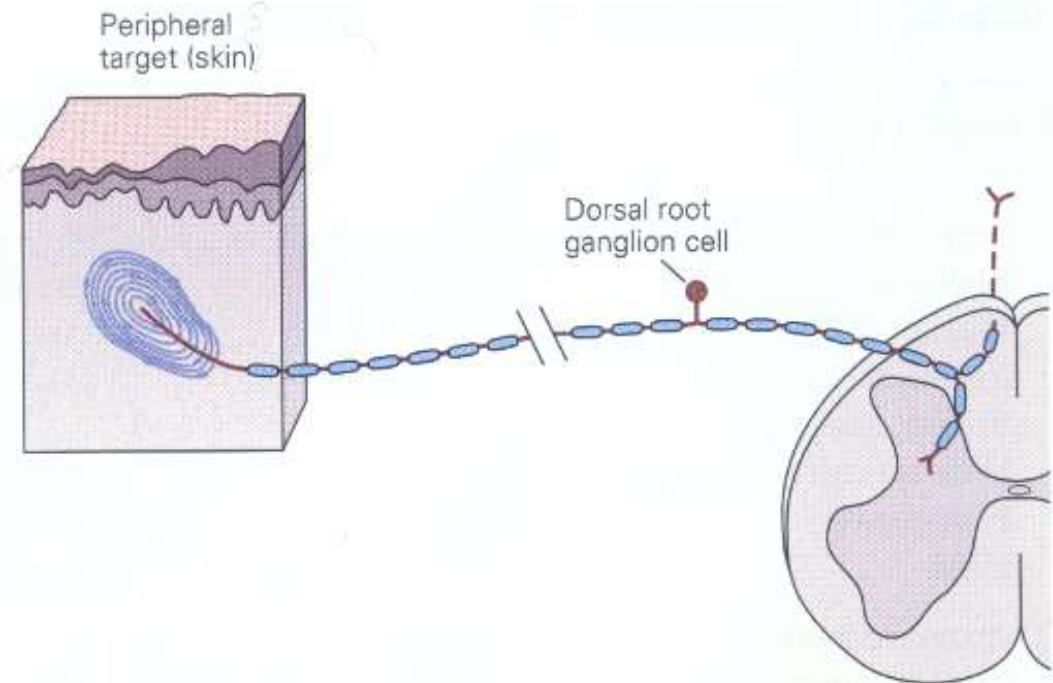
Funcția de Triaj (Gating) a Thalamusului: Firing in modurile Tonic Vs Burst



PERCEȚIA SOMATO-SENZORIALĂ

Ganglionul radacinii dorsale

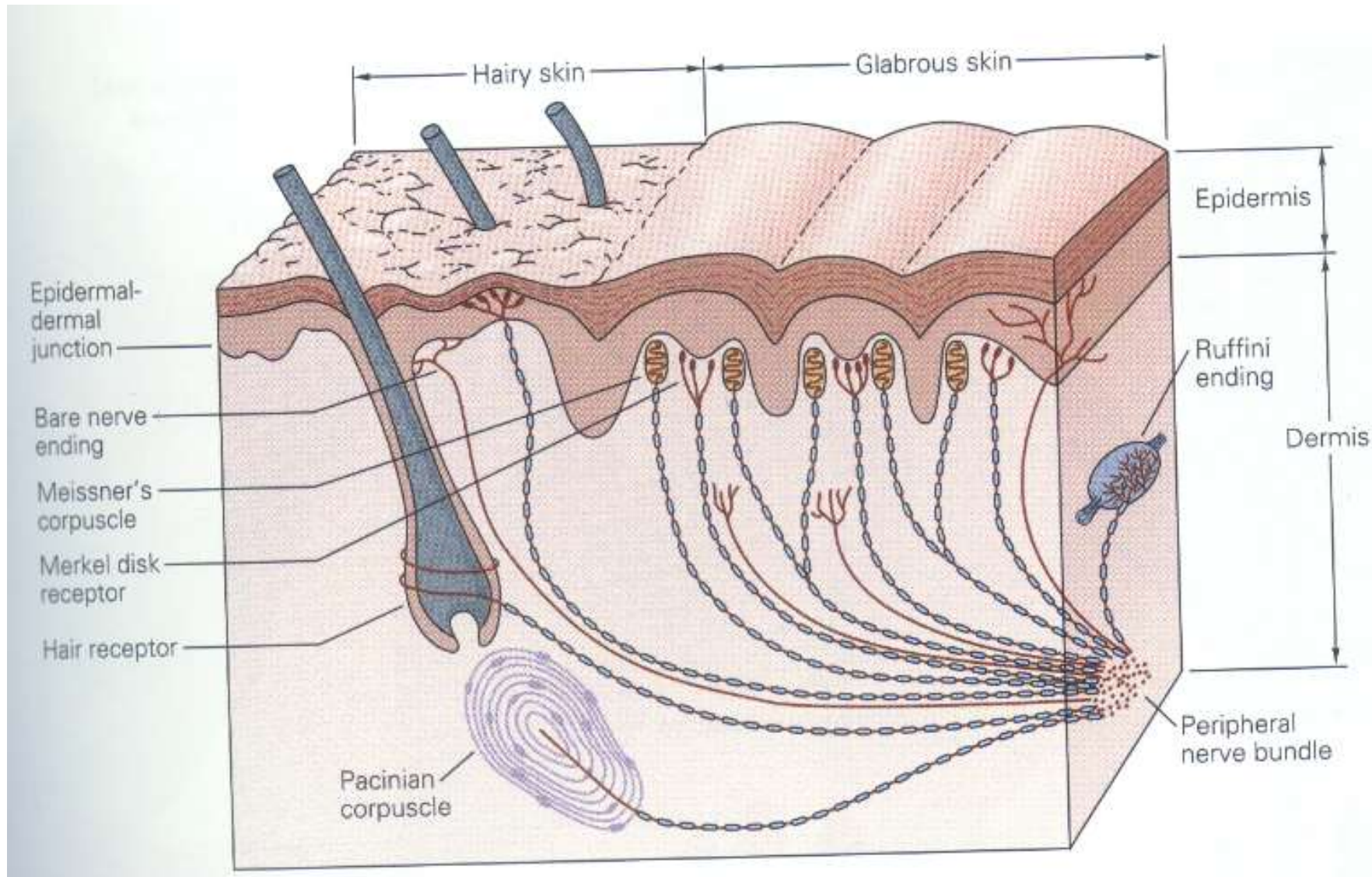
- Informații somatosenzoriale din trunchi și membre
- Transducția stimulului
- Transmiterea informațiilor generate de stimul, codificate

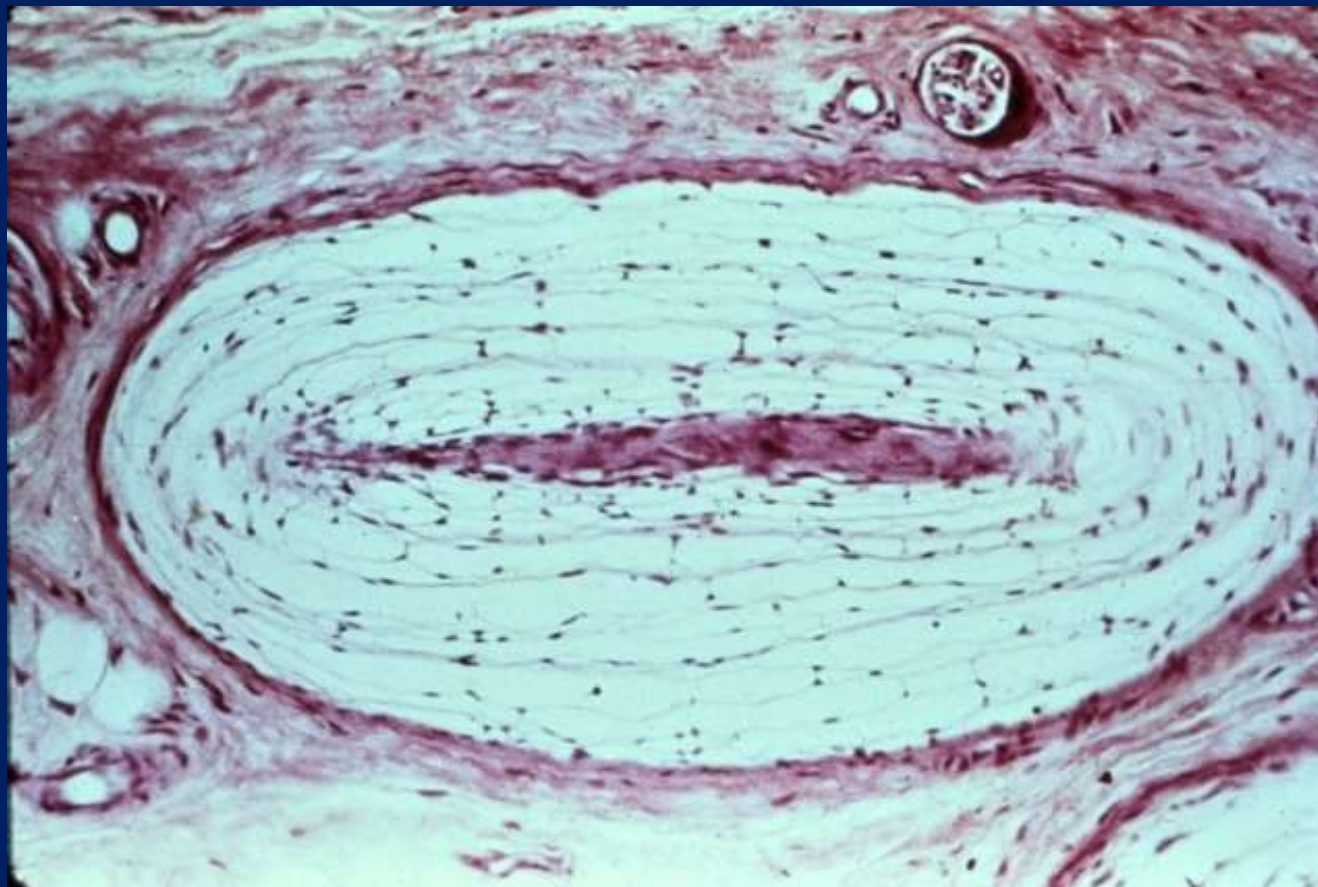


Receptor Types

Receptor type	Fiber group ¹	Fiber name ¹	Modality
Cutaneous and subcutaneous mechanoreceptors			Touch
Meissner's corpuscle	A α , β	RA	Stroking, fluttering
Merkel disk receptor	A α , β	SAI	Pressure, texture
Pacinian corpuscle ²	A α , β	PC	Vibration
Ruffini ending	A α , β	SAII	Skin stretch
Hair-tylotrich, hair-guard	A α , β	G1, G2	Stroking, fluttering
Hair-down	A δ	D	Light stroking
Field	A α , β	F	Skin stretch
Thermal receptors			Temperature
Cool receptors	A δ	III	Skin cooling (25°C)
Warm receptors	C	IV	Skin warming (41°C)
Heat nociceptors	A δ	III	Hot temperatures (>45°C)
Cold nociceptors	C	IV	Cold temperatures (<5°C)
Nociceptors			Pain
Mechanical	A δ	III	Sharp, pricking pain
Thermal-mechanical	A δ	III	Burning pain
Thermal-mechanical	C	IV	Freezing pain
Polymodal	C	IV	Slow, burning pain
Muscle and skeletal mechanoreceptors			Limb proprioception
Muscle spindle primary	A α	Ia	Muscle length and speed
Muscle spindle secondary	A β	II	Muscle stretch
Golgi tendon organ	A α	Ib	Muscle contraction
Joint capsule mechanoreceptors	A β	II	Joint angle
Stretch-sensitive free endings	A δ	III	Excess stretch or force

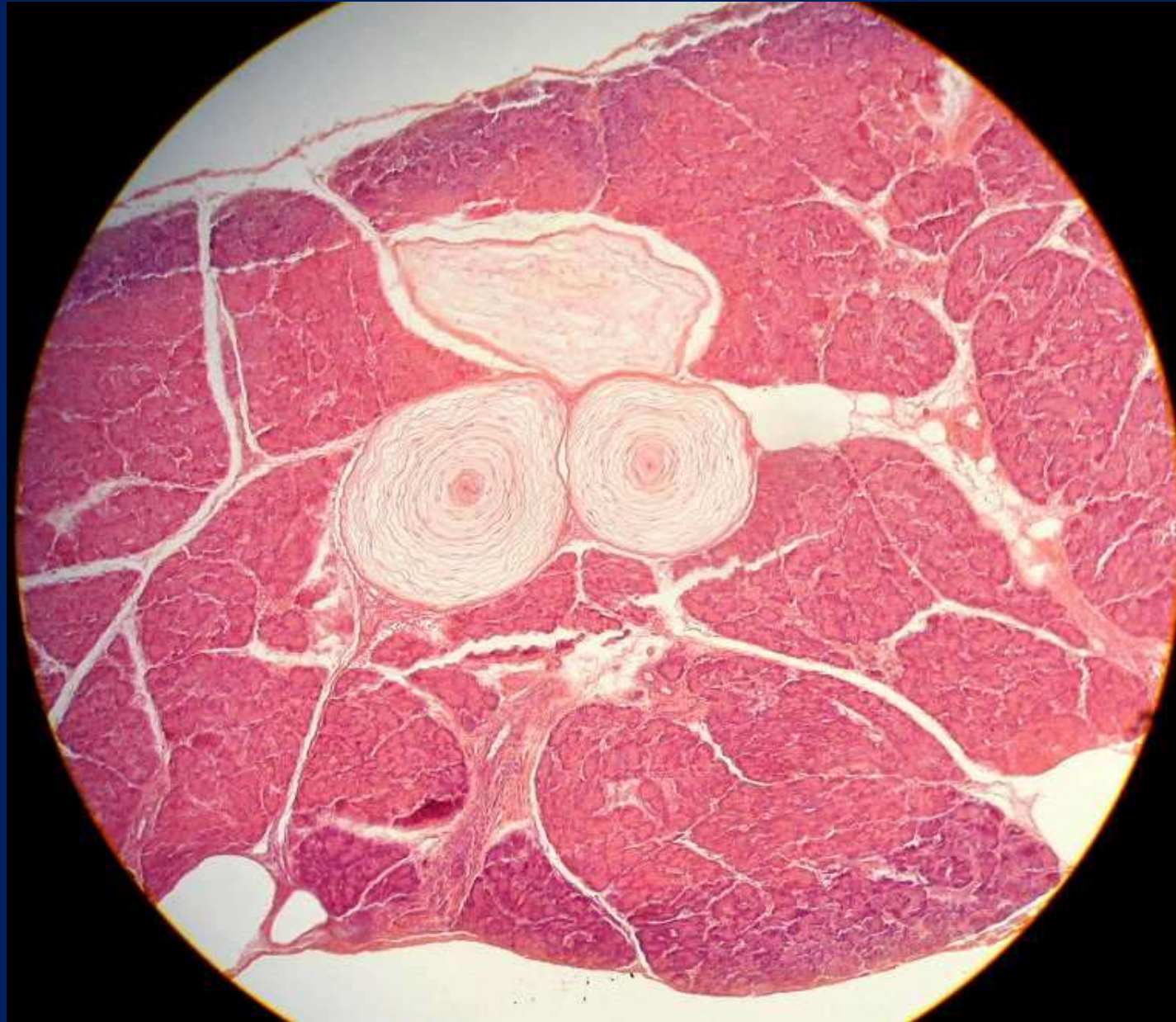
Mecanoreceptori cutanati



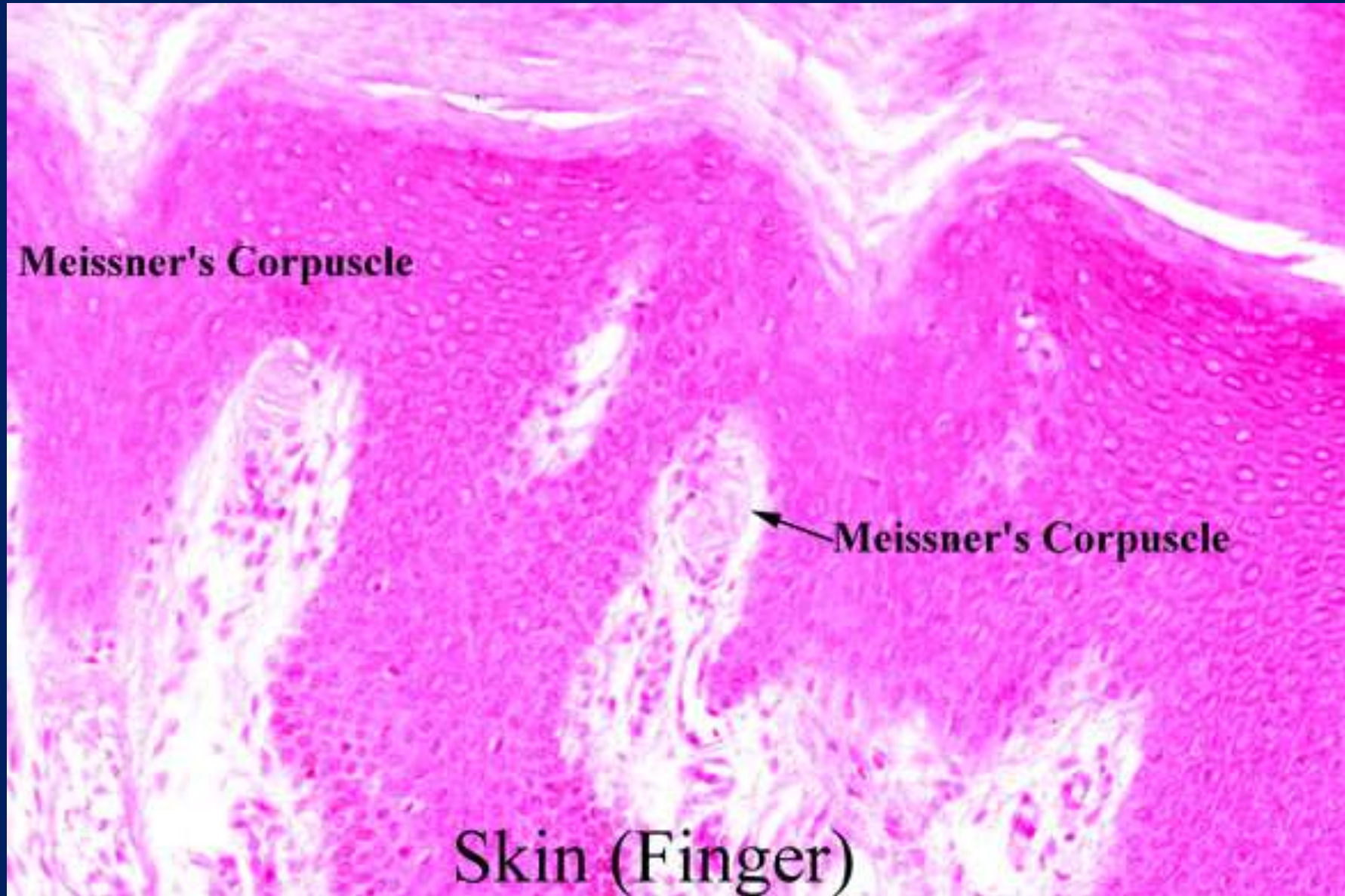


Un corpuscul Pacinian este format din straturi concentrice de celule de țesut conjunctiv plat și fibre de colagen. Straturile sunt separate unele de altele de fluid. O singură terminație nervoasă senzorială trece prin centrul acestei structuri, stimulată de presiunea vibratorie.

Corpusculi Pacini

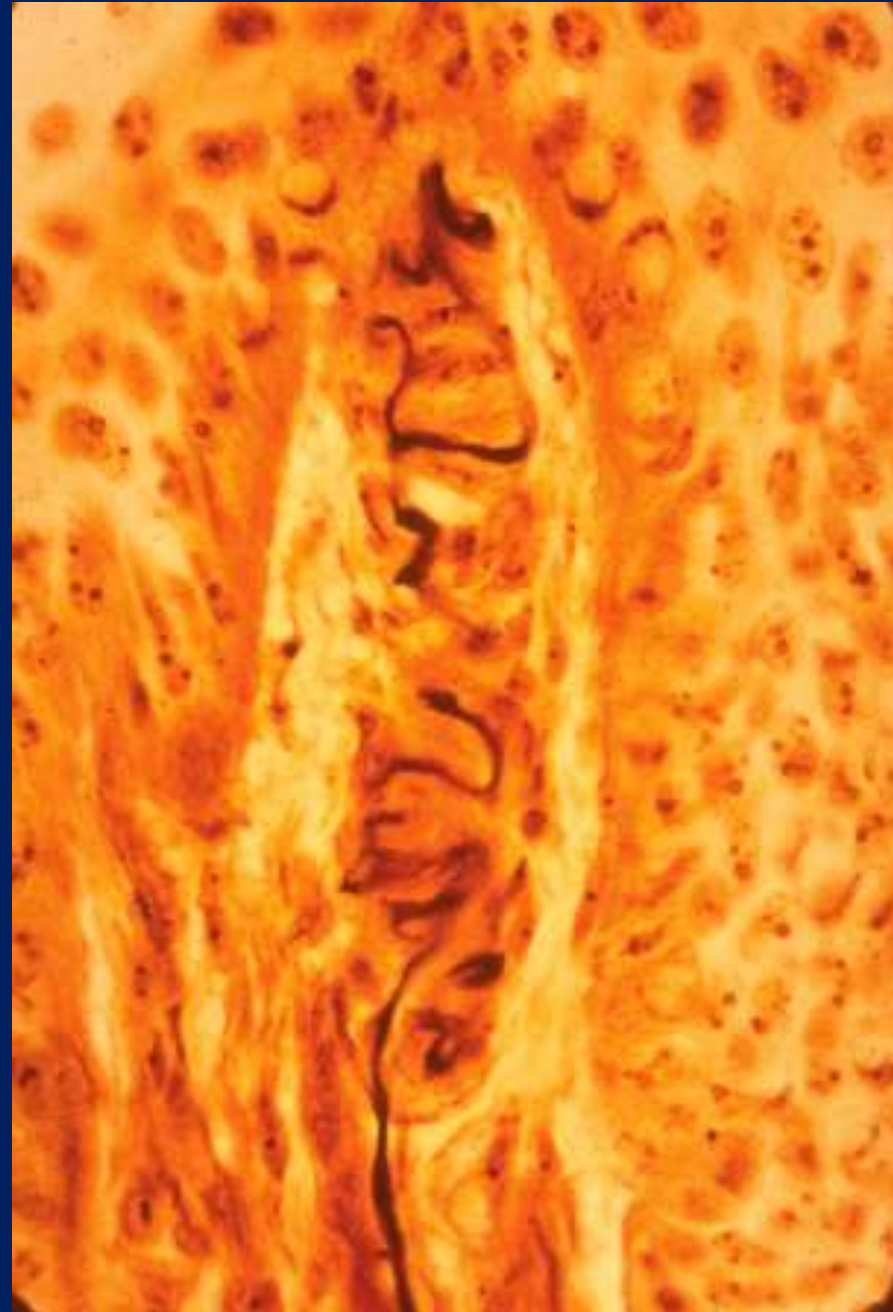


Corpusculi Meissner

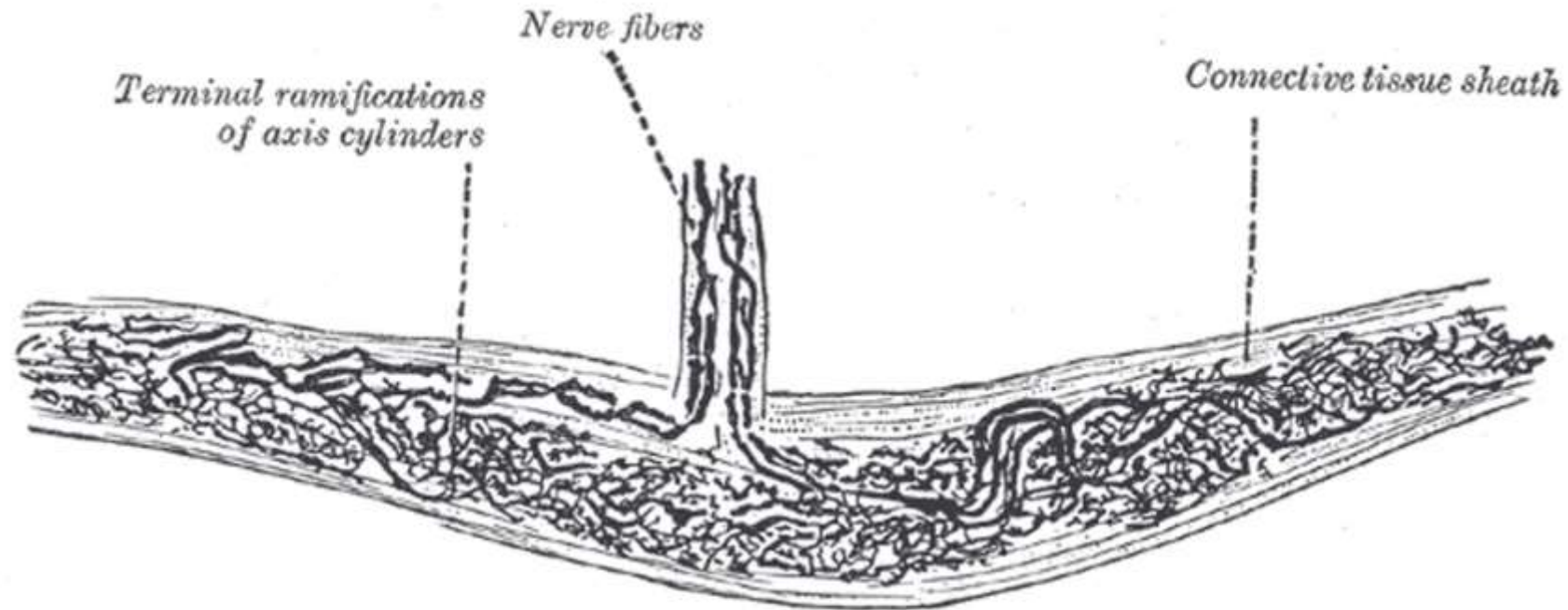


Corpusculi Meissner

Structură globulară
plină de lichid care
cuprinde un teanc de
celule epiteliale
aplatizate. Terminalul
nervos senzorial este
vizibil între straturi.

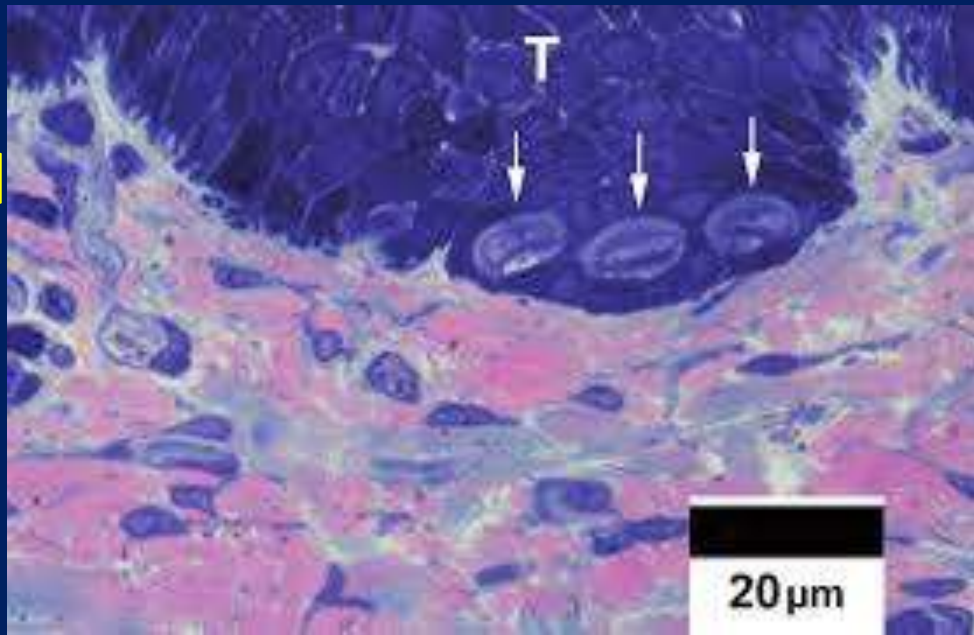


Terminatii Ruffini

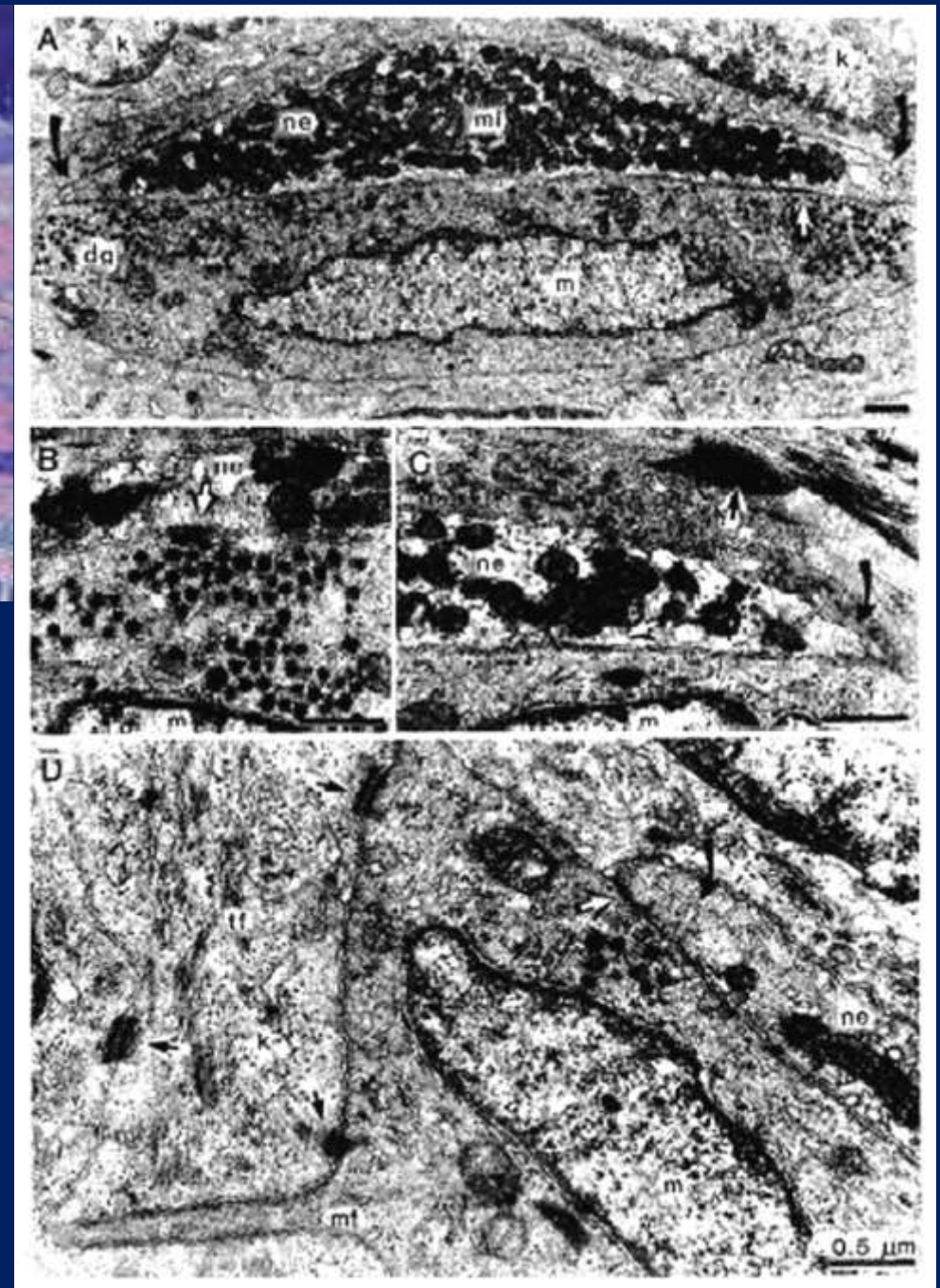


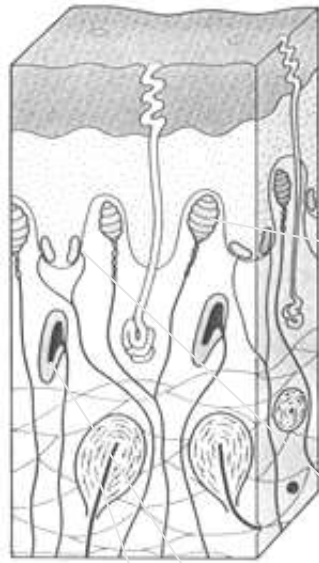
Nerve ending of Ruffini. (After A. Ruffini.)

Discurile Merkel



O mică celulă epitelială care înconjoară terminalul nervos cuprinde o structură rigidă care transmite tensiunea de comprimare de la piele la capătul nervos, evocând un răspuns susținut, care se adaptează lent. Adesea se găsește în grupuri din centrul crestei papilare.





Receptor

Receptive field
size (mm)

Adaptation

Stimulus

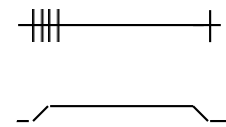
Function



Meissner
corpuscle
(RA-I)

3-5

Moderately rapid



Minimal
skin
motion

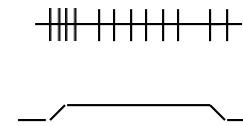
Feedback signal
for grip control



Merkel
disk
(SA-I)

2-3

Slow



Points,
corners,
edges,
curvatures

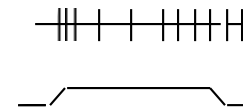
Perception of
form and texture
Contact recognition
of gaps and grids



Ruffini
organs
(SA-II)

15-25

Slow



Skin
stretch

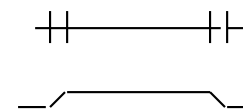
Perception of
hand shape and
finger position



Pacinian
corpuscle
(PC or RA-II)

Large

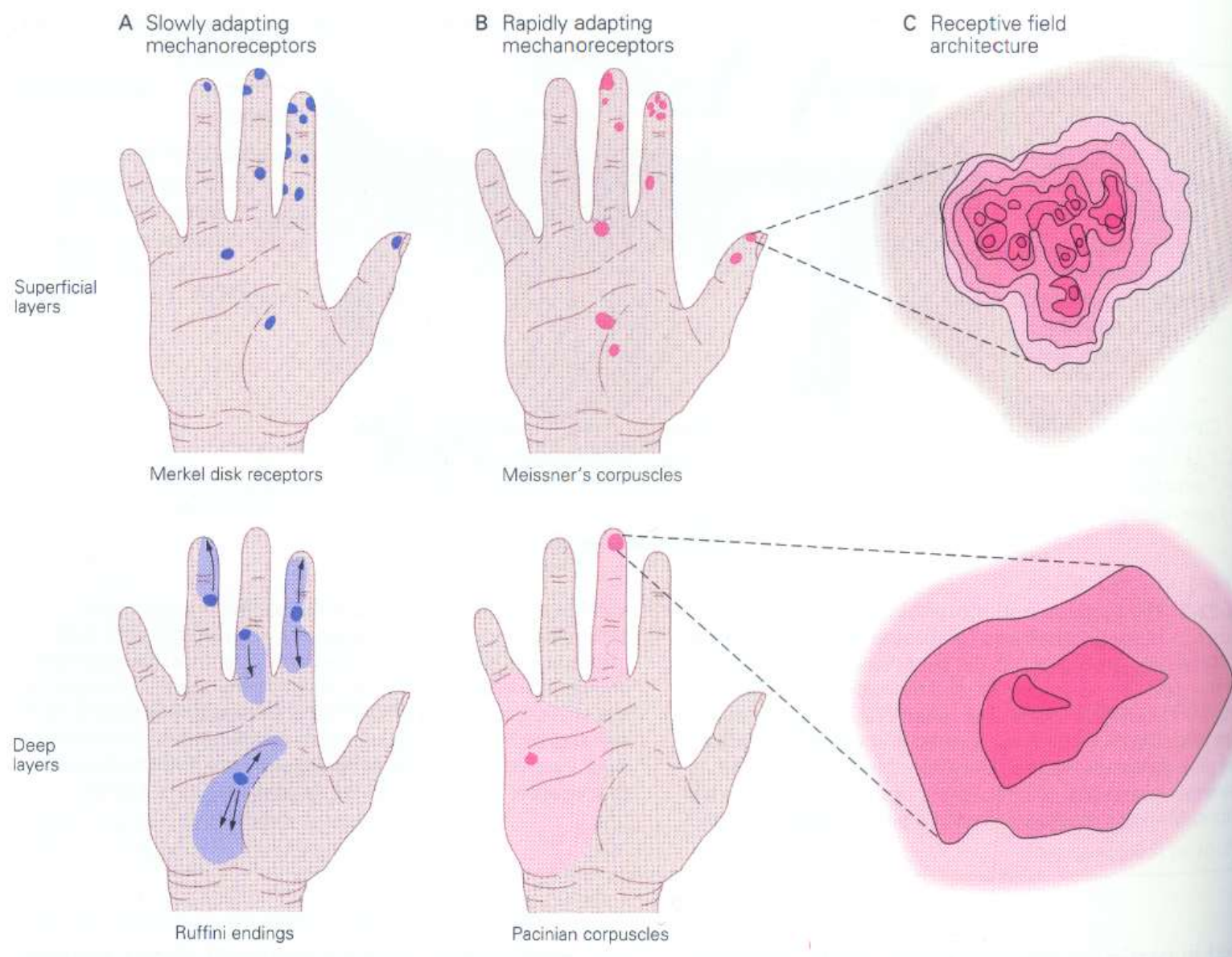
Very rapid



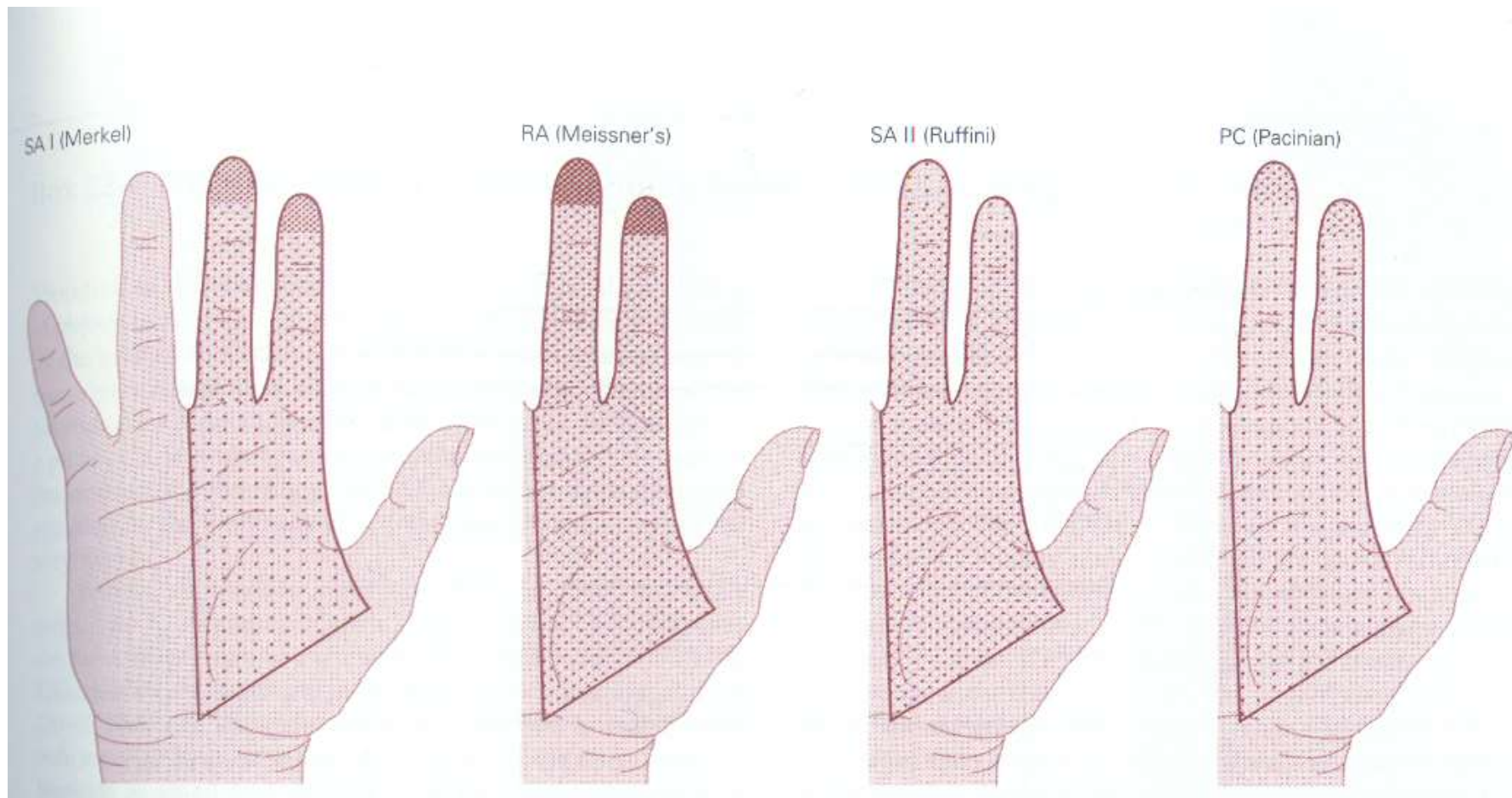
Minimal
skin
motion
Vibratory
stimuli

Transmission
of vibration of
objects held by
the hand

Câmpuri receptive



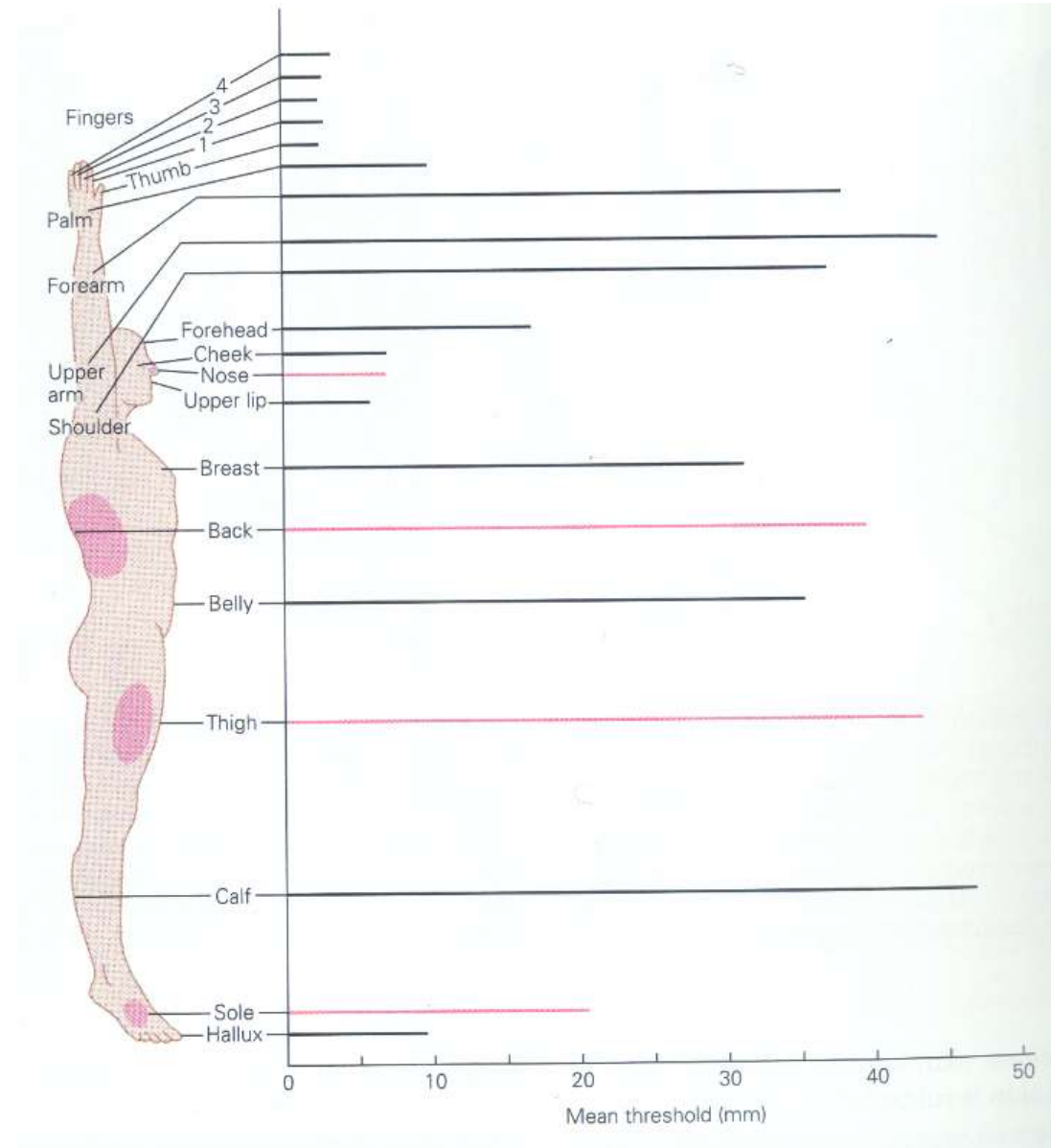
Distribuția mecanoreceptorilor



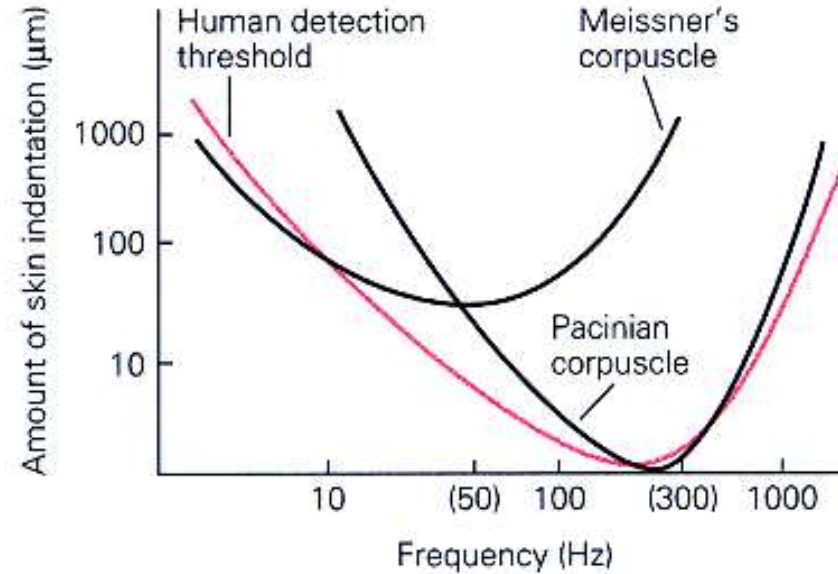
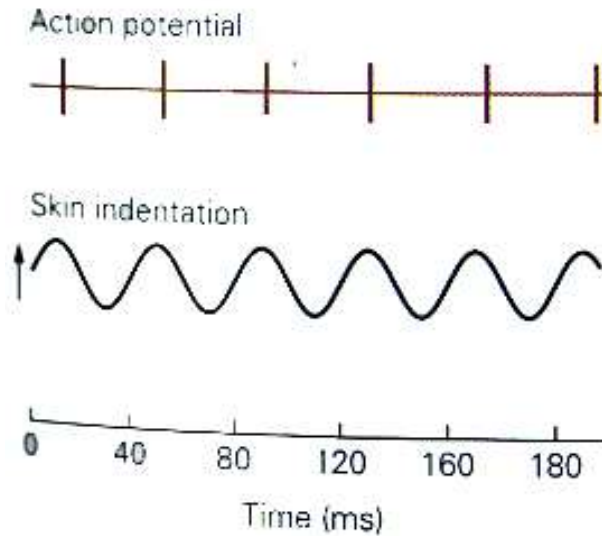
Discriminarea între două puncte

(*Two-Point Discrimination*)

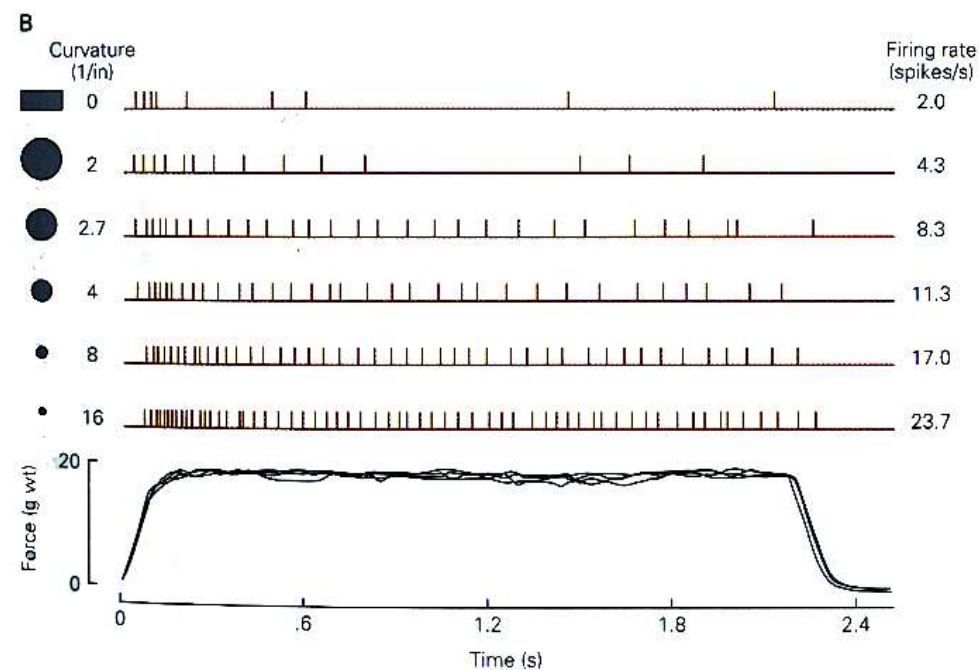
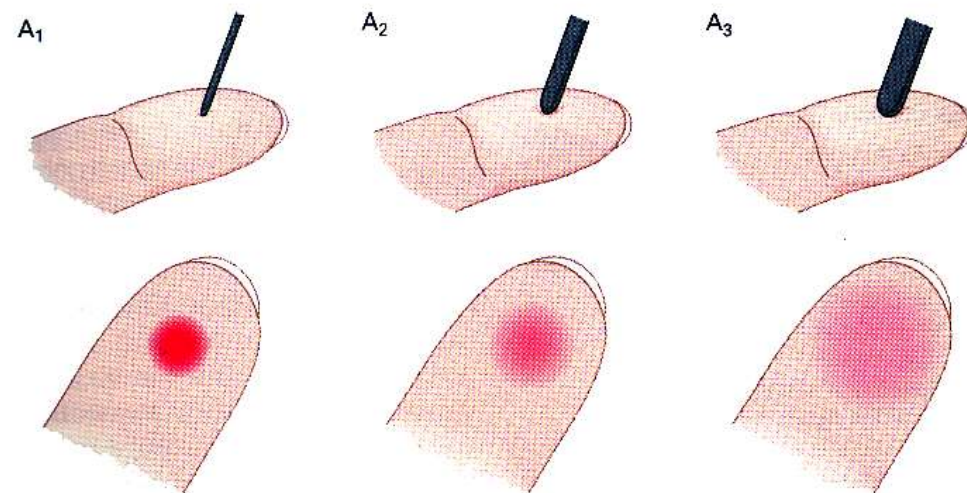
- Distanța minimă la care doi stimuli sunt rezolvați (percepuți) ca distincți.



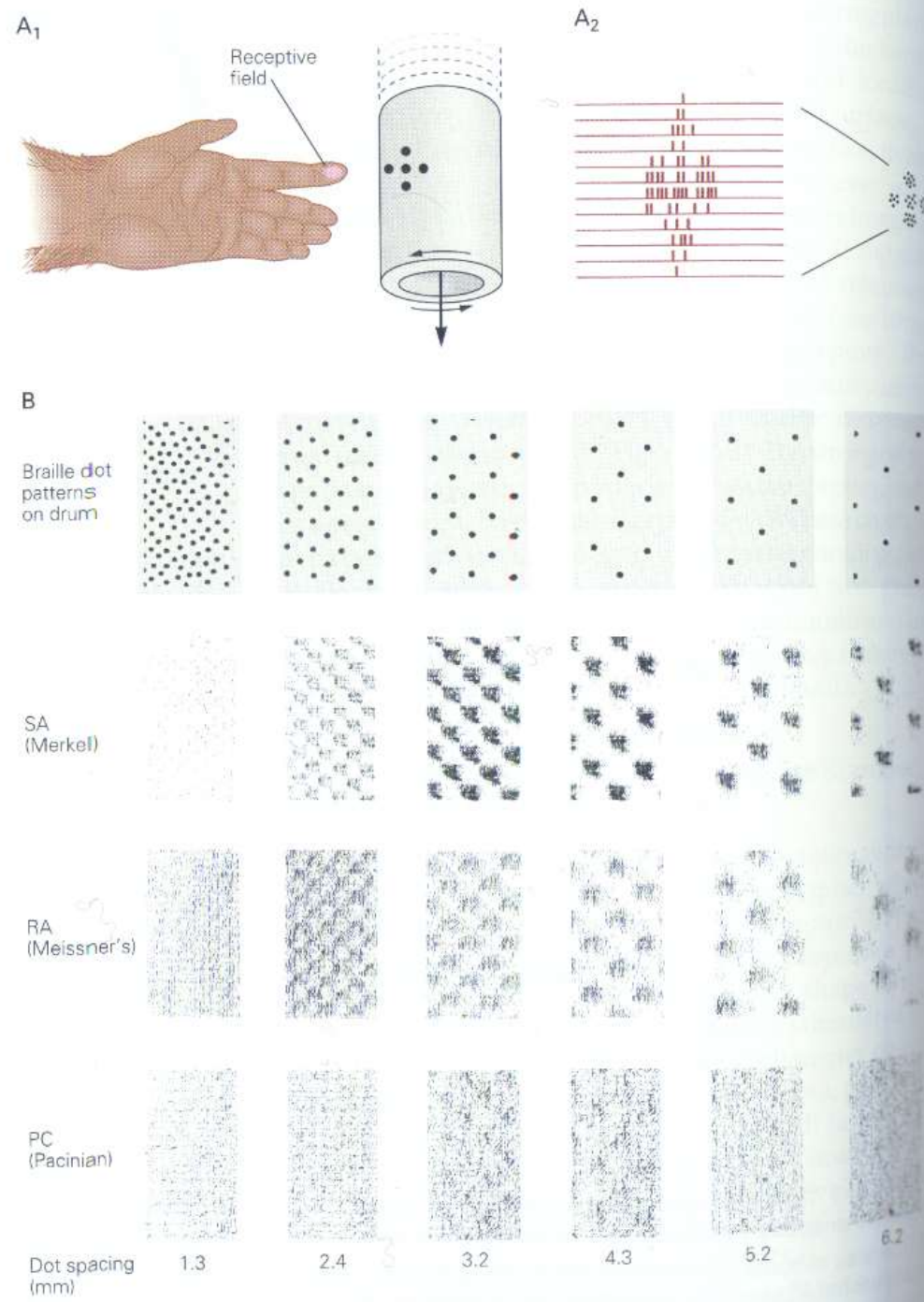
Percepția vibrațiilor



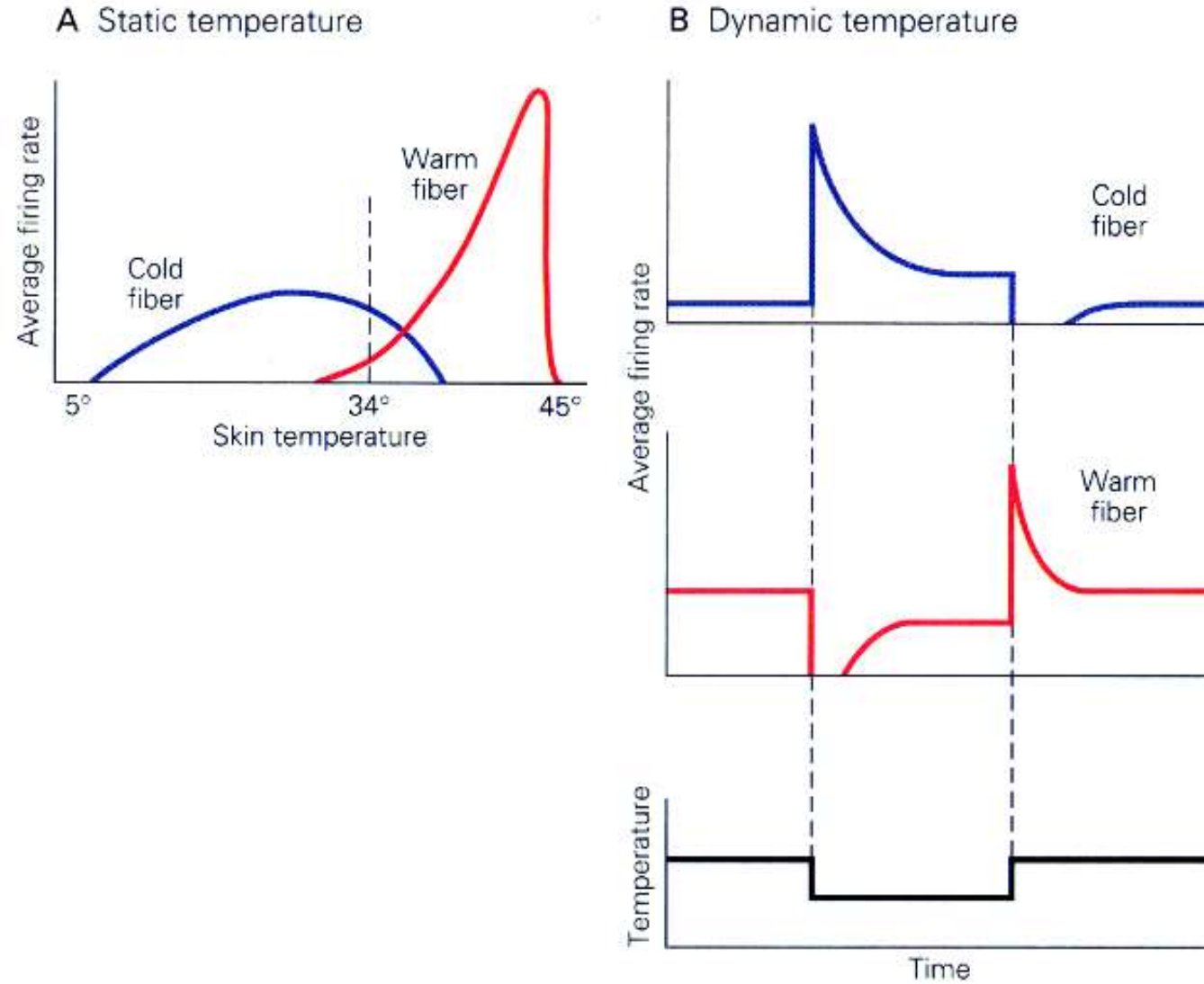
Forma și dimensiunea obiectelor



Textura



Receptori termici



CLASSIFICATION OF THE CUTANEOUS MECHANICAL, INNOCUOUS THERMAL, AND NOCICEPTIVE RECEPTORS USING SMALL-DIAMETER FIBERS AND OF THEIR ADEQUATE STIMULI

RECEPTOR

ADEQUATE STIMULUS

Cutaneous mechanoreceptors

Group A-delta high-threshold mechanoreceptors

Group C high-threshold mechanoreceptors

Nondiscriminative tactile stimuli

Rub, tap, stretch, squeeze, pinch

Rub, tap, stretch, squeeze, pinch

Cutaneous thermoreceptors

Cold thermoreceptors

Warm thermoreceptors

Innocuous warm and cold thermal stimuli

Transient reduction in temperature

Transient increase in temperature

Cutaneous nociceptors

Mechanonociceptors

Group A-delta mechanonociceptors

Group C mechanonociceptors

Thermonociceptors

A-delta heat thermonociceptors

A-delta, C cold thermonociceptors

Chemonociceptors (C)

Polymodal nociceptors (C)

Mechanical, thermal, and/or chemical stimuli

Mechanical tissue damage

Mechanical tissue damage

Noxious heat and tissue damage

Noxious cold and tissue damage

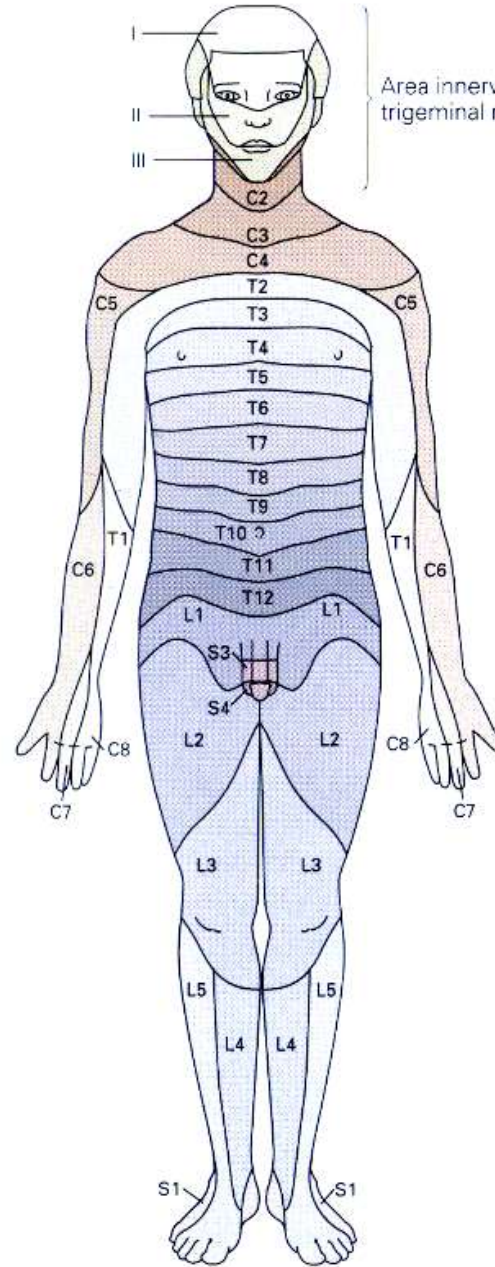
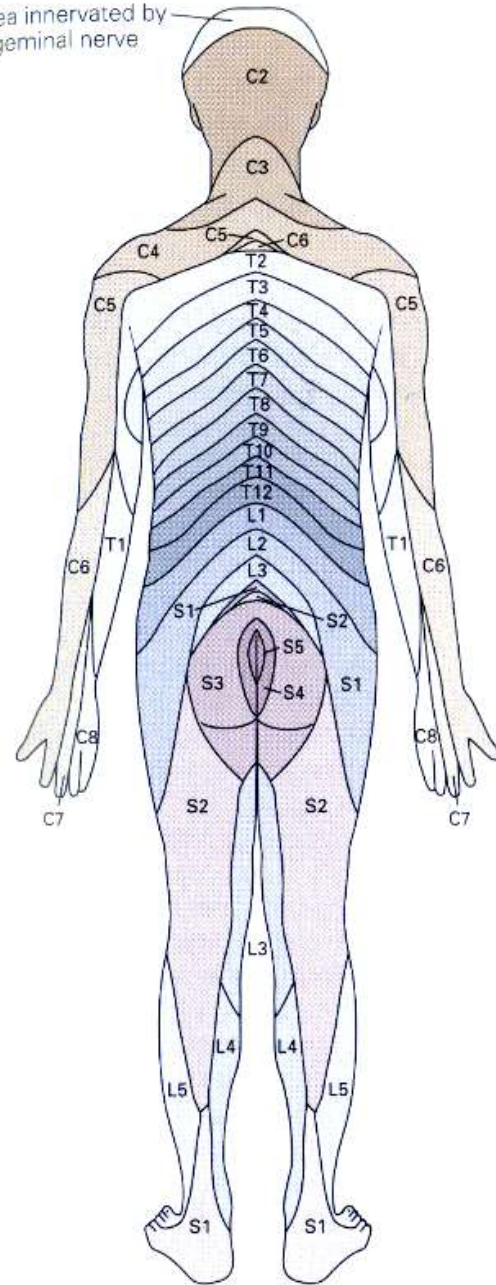
Insect venom, bradykinin, histamine

Noxious heat/cold, tissue damage, algescic chemicals

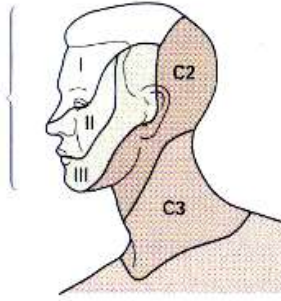
CONDUCTION VELOCITY GROUPS

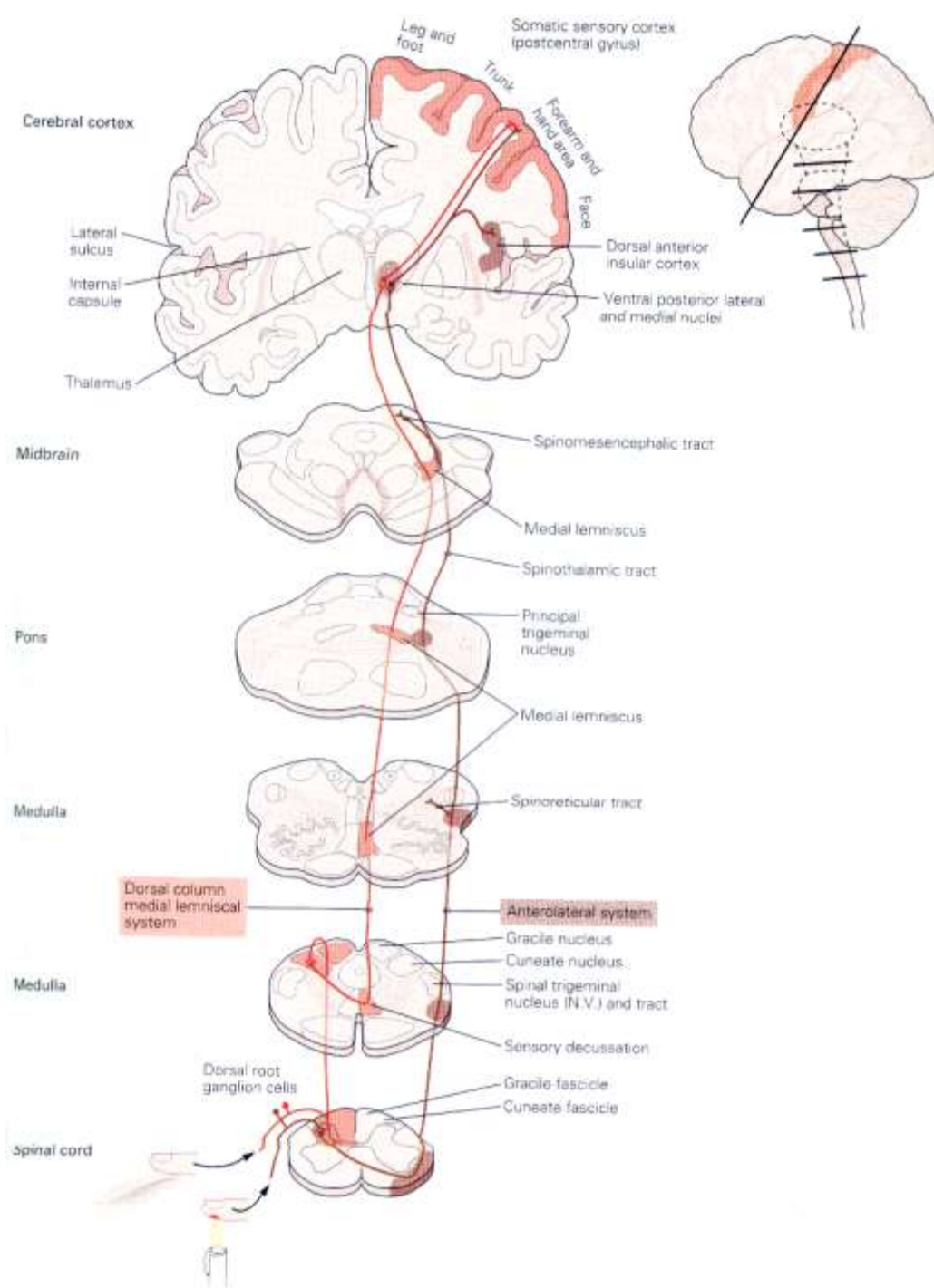
TYPE	GROUP	DIAMETER (mm)	VELOCITY (m/s)	FUNCTION
SENSORY AXONS				
Ia & Ib	A α	12–22	72–132	motor afferent: annulospiral, Golgi tendon organ
II	A β	5–12	30–72	motor afferent: flower spray sensory afferent: touch, pressure, hair, joint, vibratory receptors
III	A δ	2–5	12–30	sensory afferent: hair, free nerve endings (fast pain, temperature)
	B	1–3	3–15	sympathetic
IV	C	0.3–1.3	0.6–2.3	sympathetic, sensory afferent: slow pain, temperature, mechanoreceptors
MOTOR AXONS				
	α	3.5–8.5	50–100	α -motor neurons
	γ	2.5–6.5	10–40	γ -motor neurons

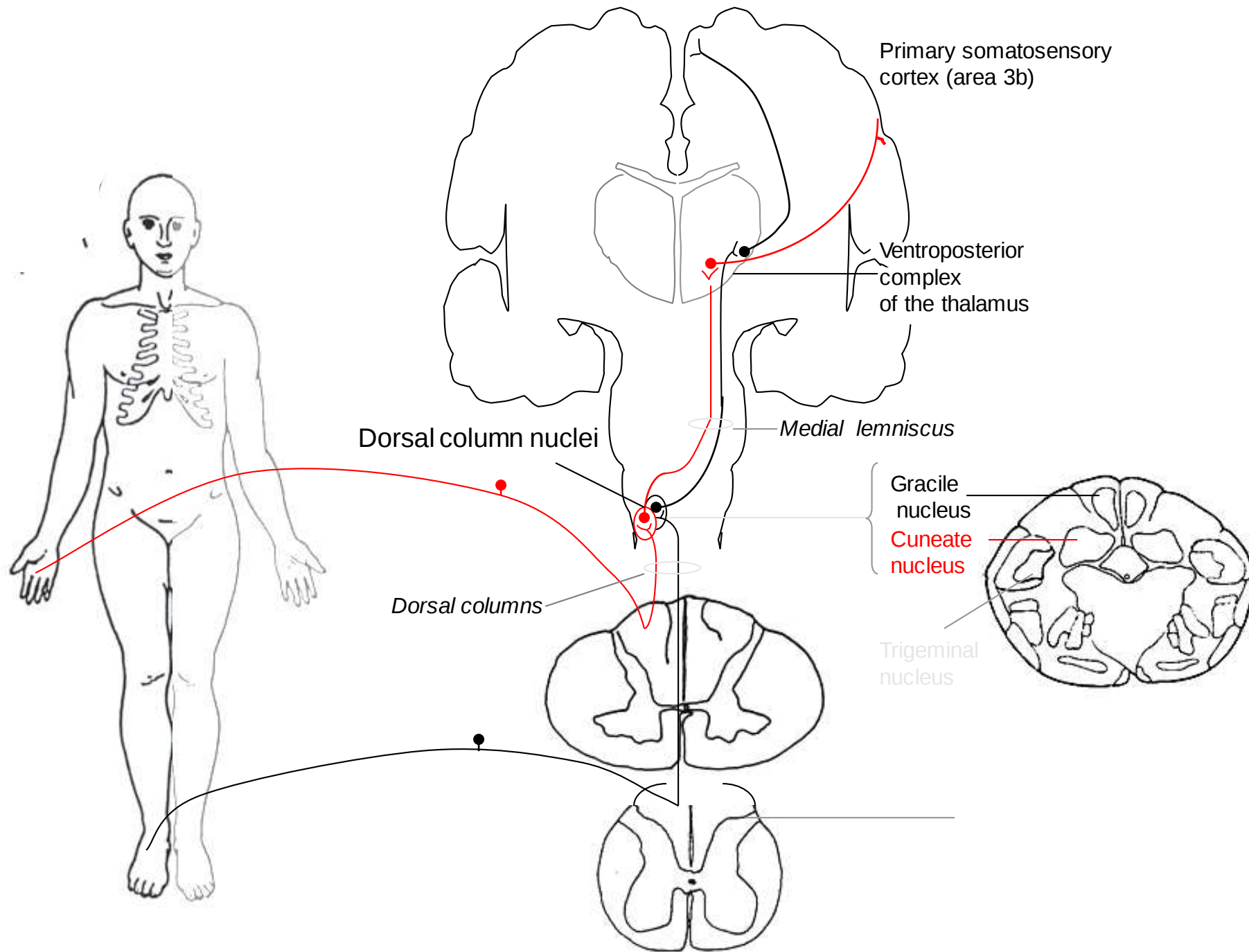
Area innervated by
trigeminal nerve

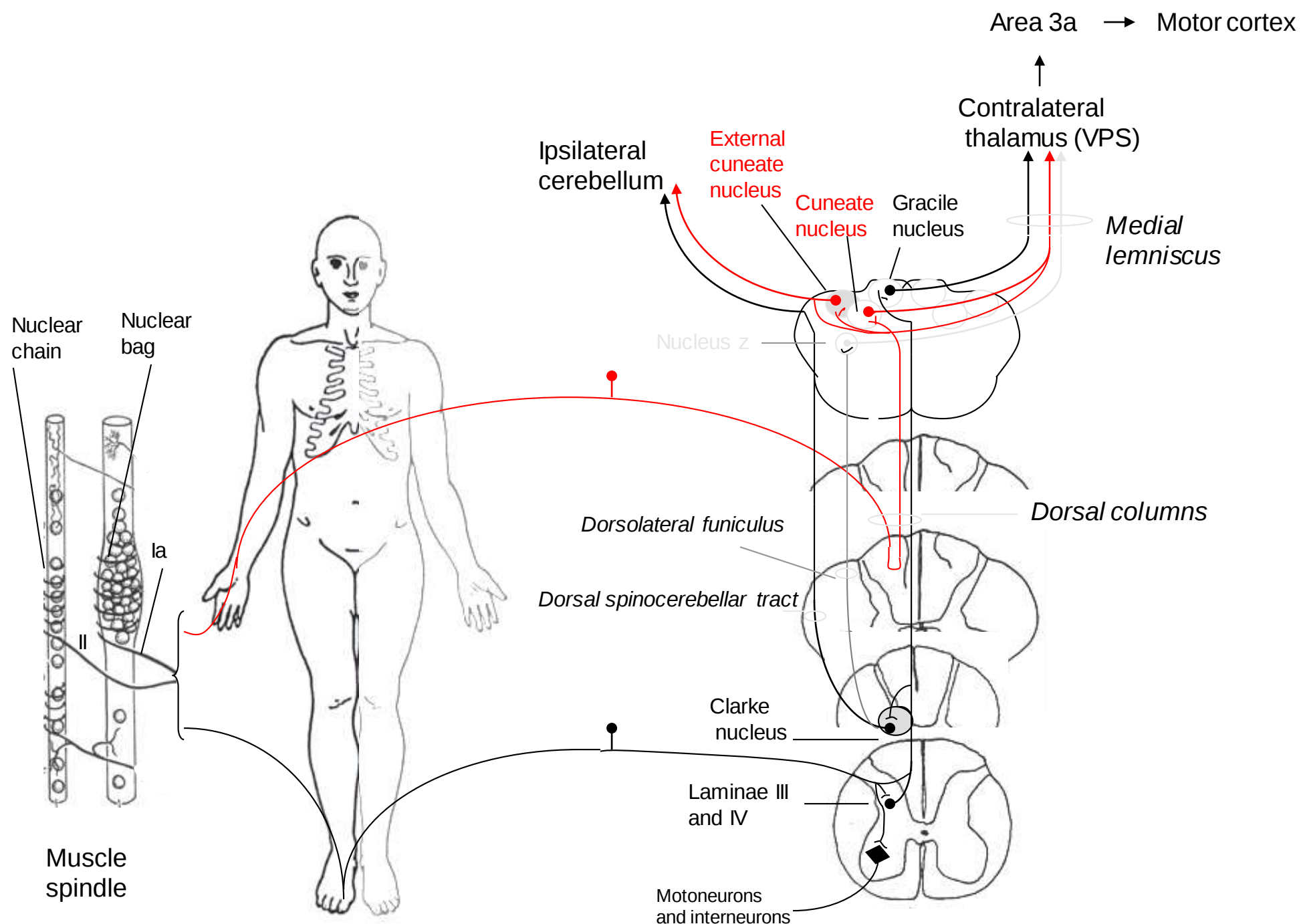


Area innervated by
trigeminal nerve



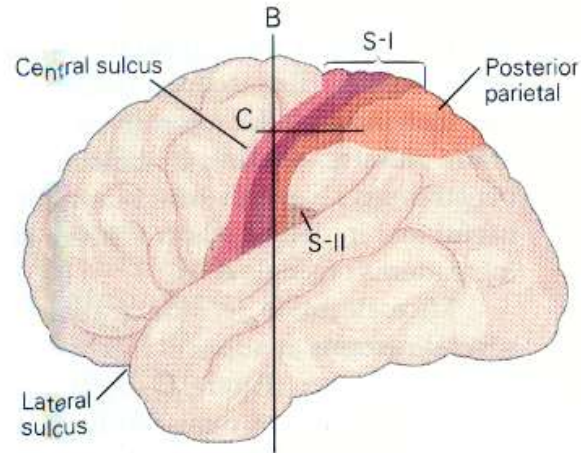




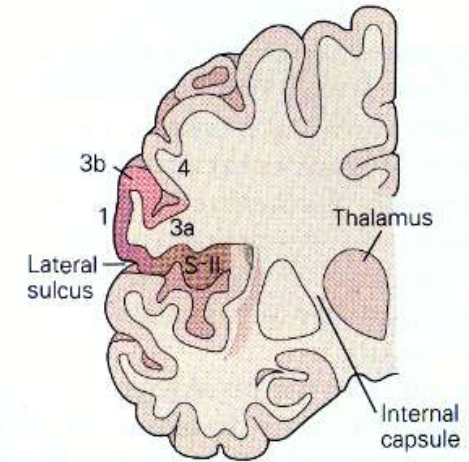


Cortexul somatosenzorial

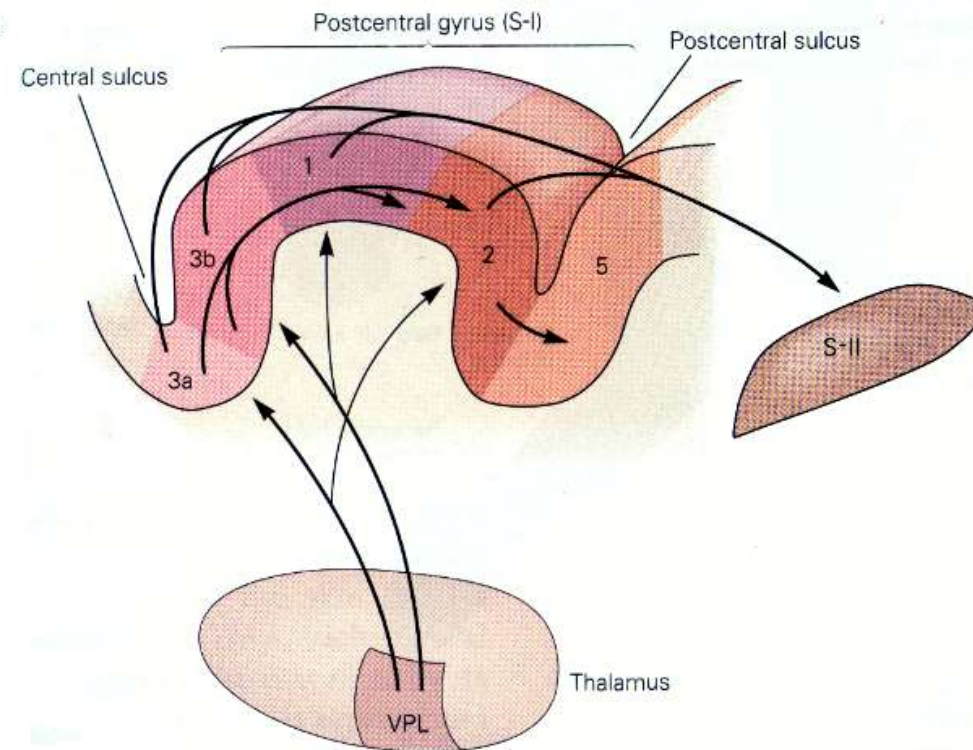
A The somatosensory cortex

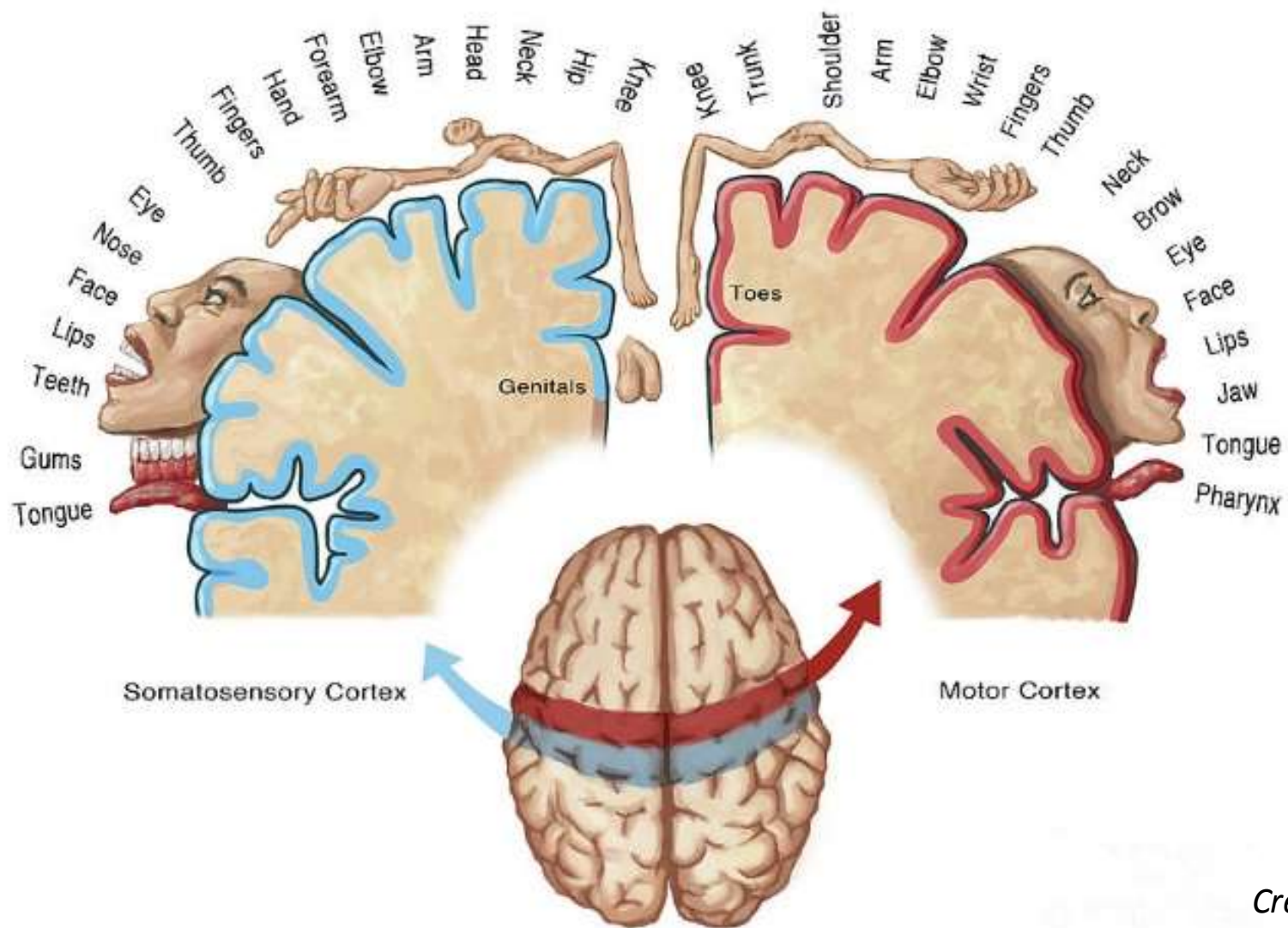


B Coronal section



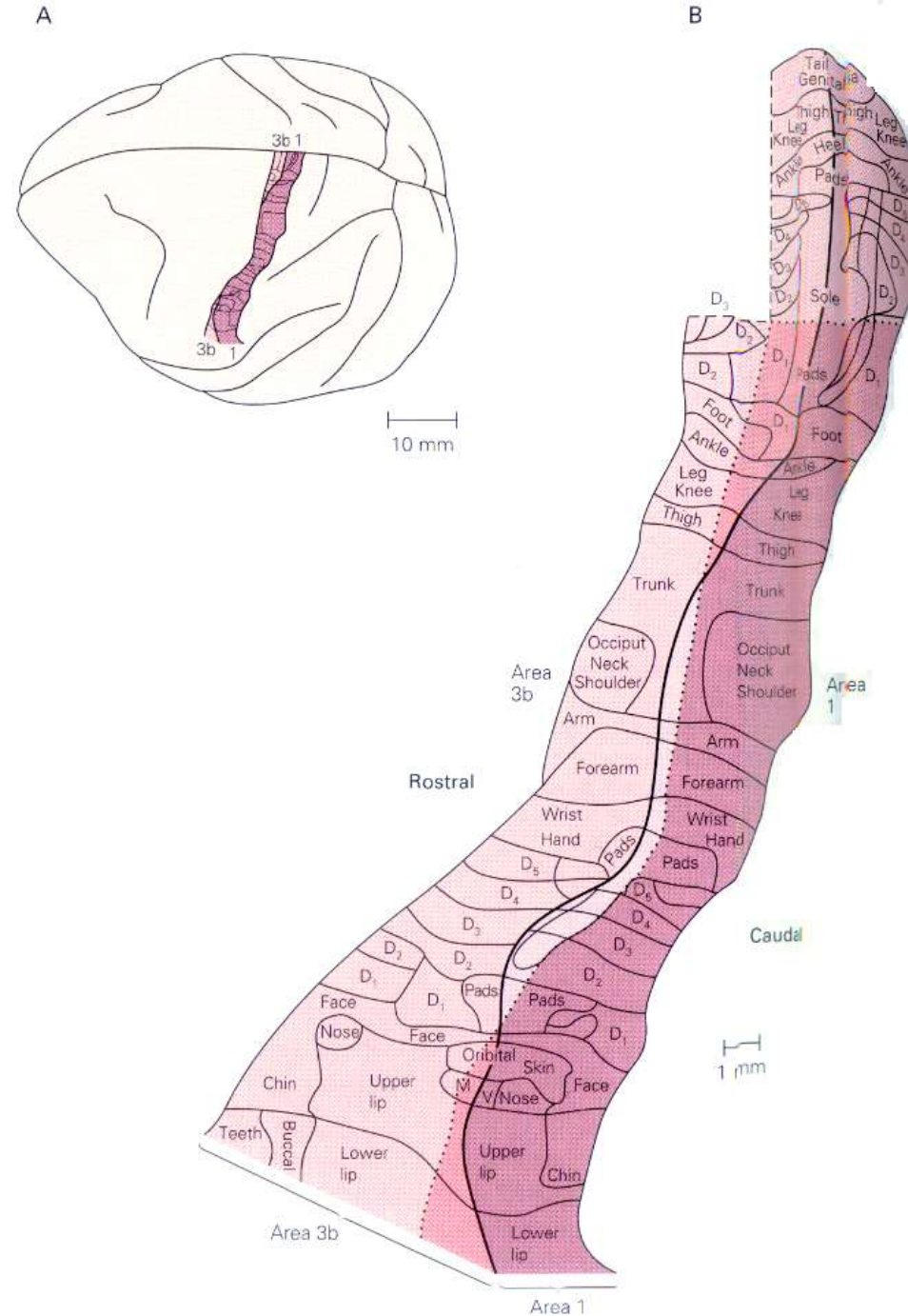
C



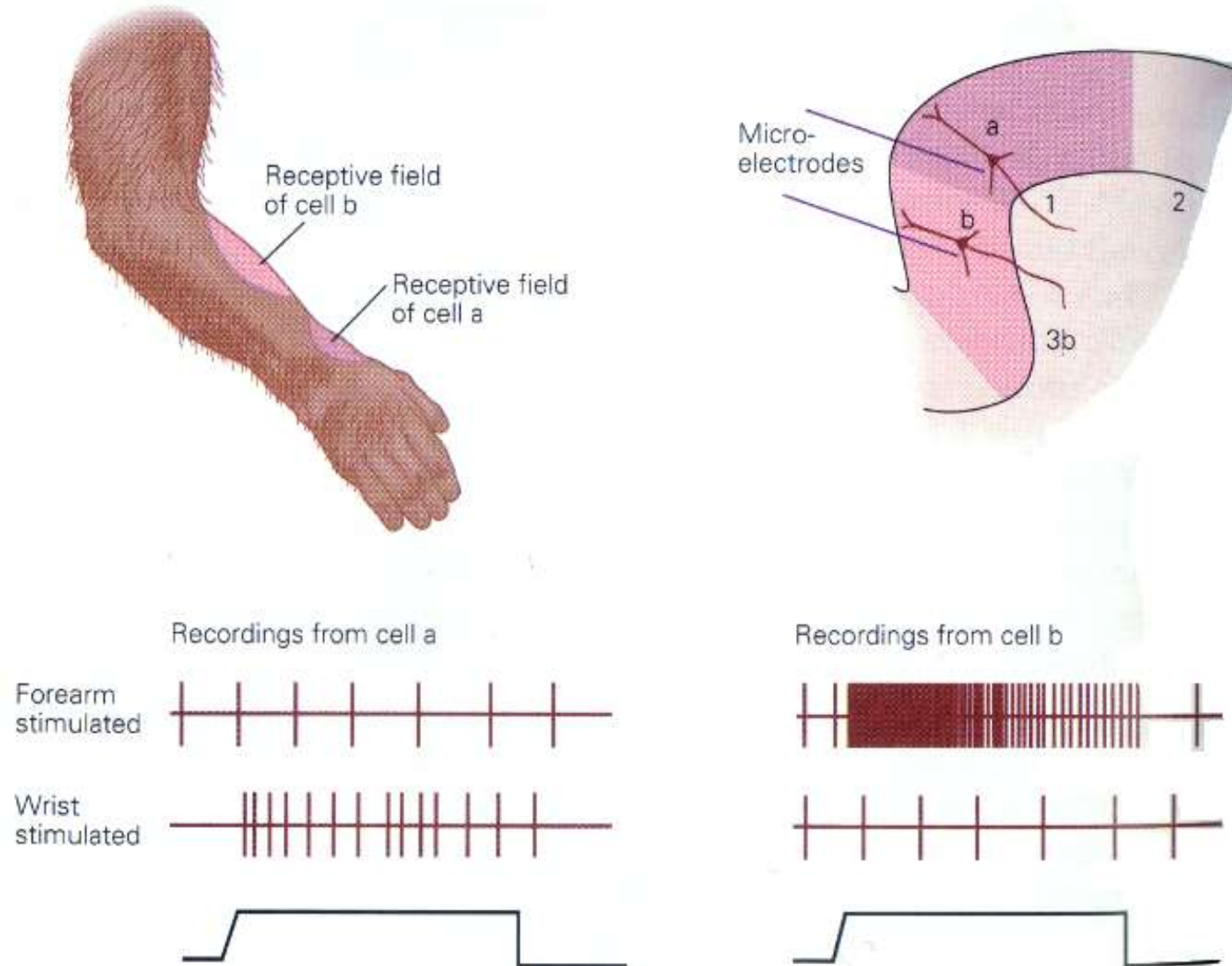


Credits: Spencer Sutton; "The Original Homunculus Co."

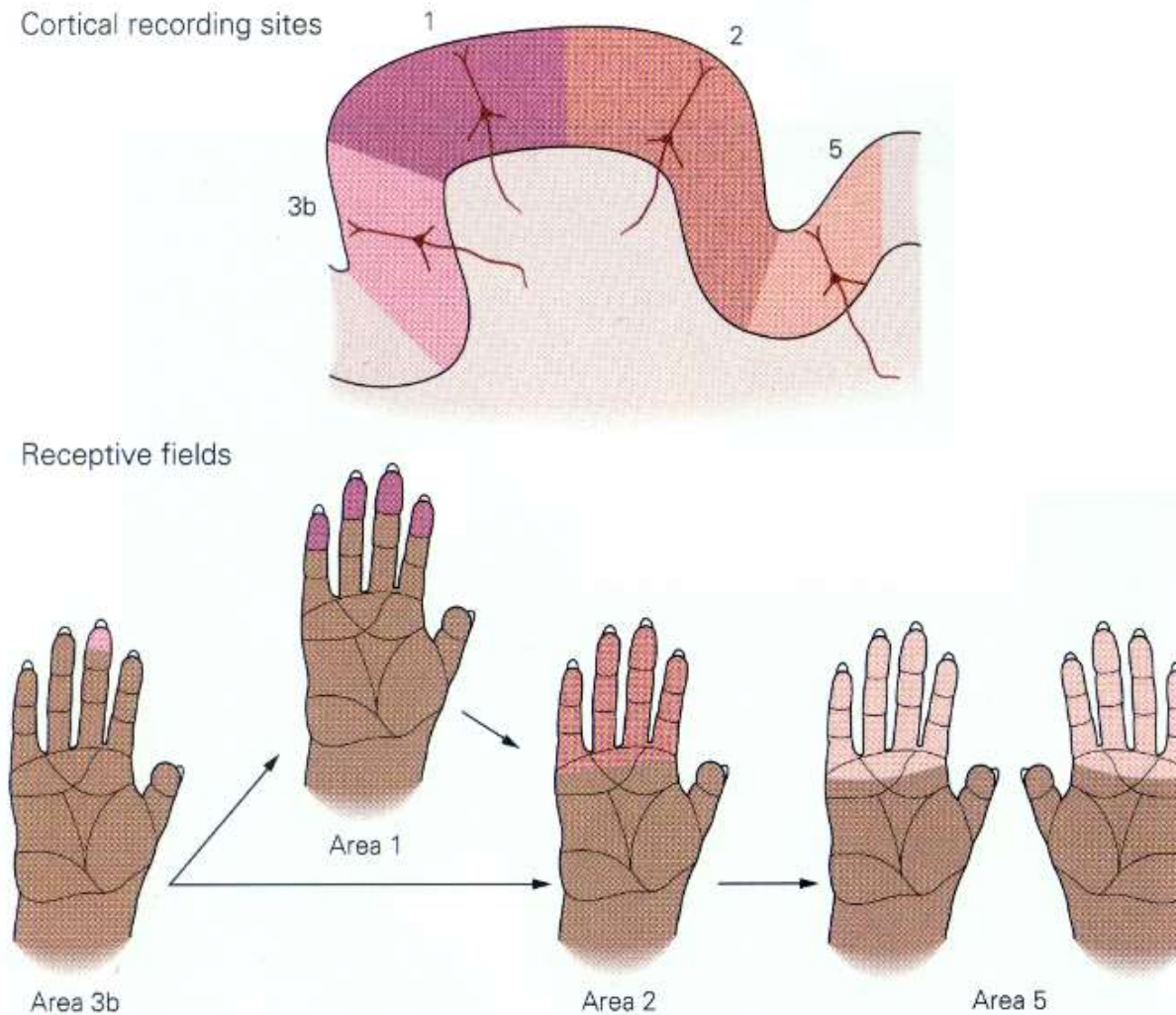
Harta corticală a suprafeței corpului



Înregistrările neurofiziologice clarifică harta somatotopică

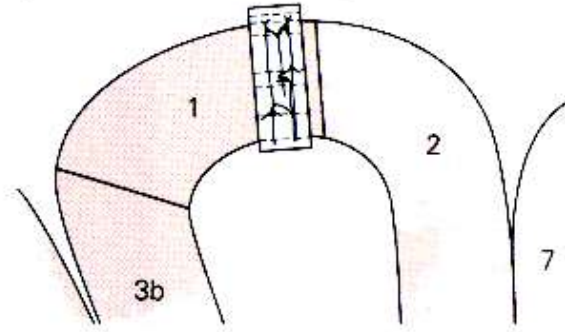


Câmpuri receptive în Cortexul somatosenzorial primar

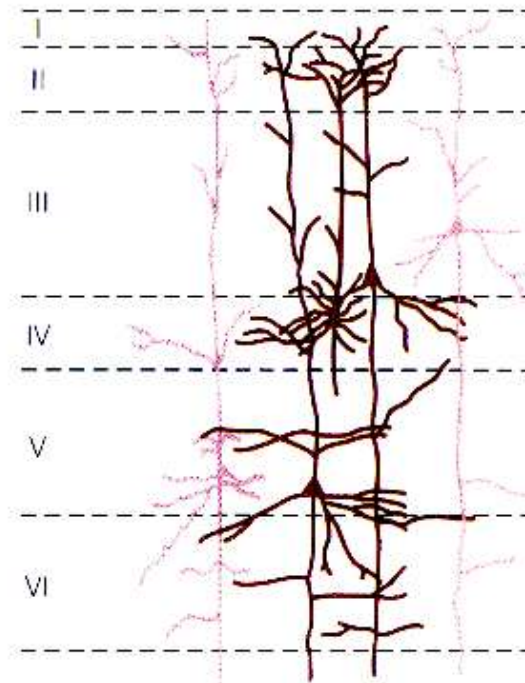


Organizarea columnară a cortexului somatosenzorial primar

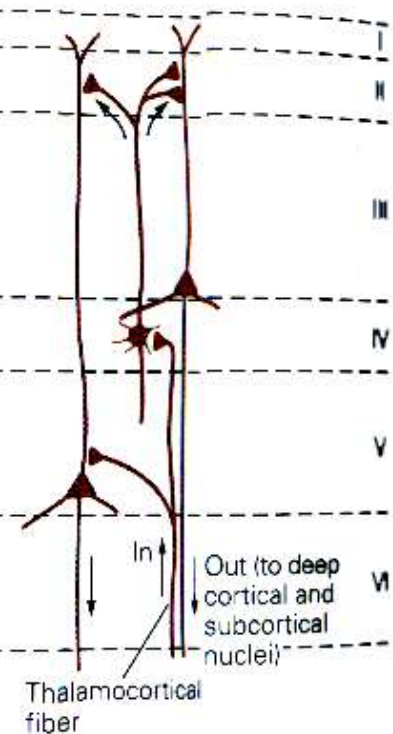
A Sagittal section of monkey S-I cortex



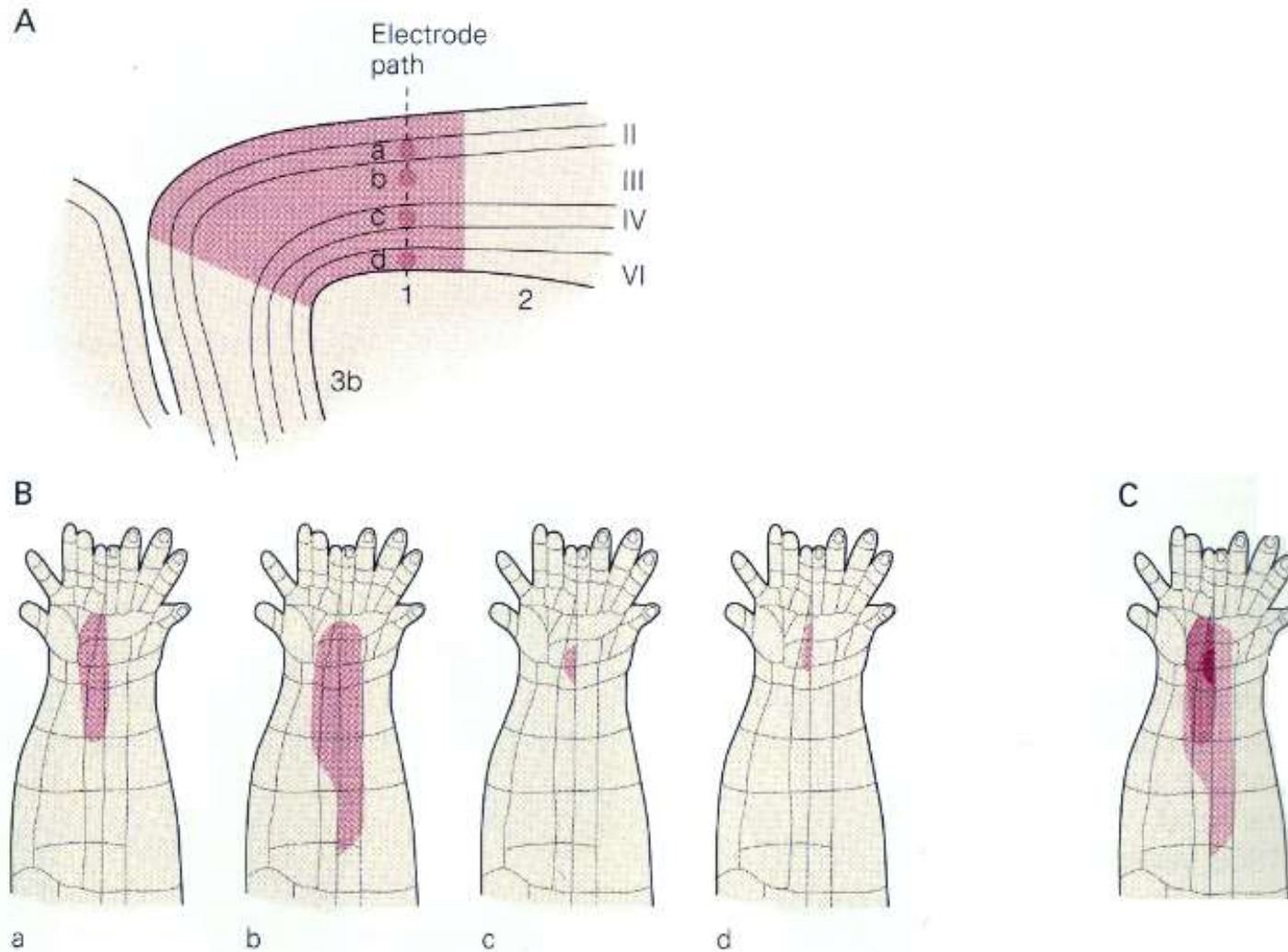
B Expanded view of cortical histology

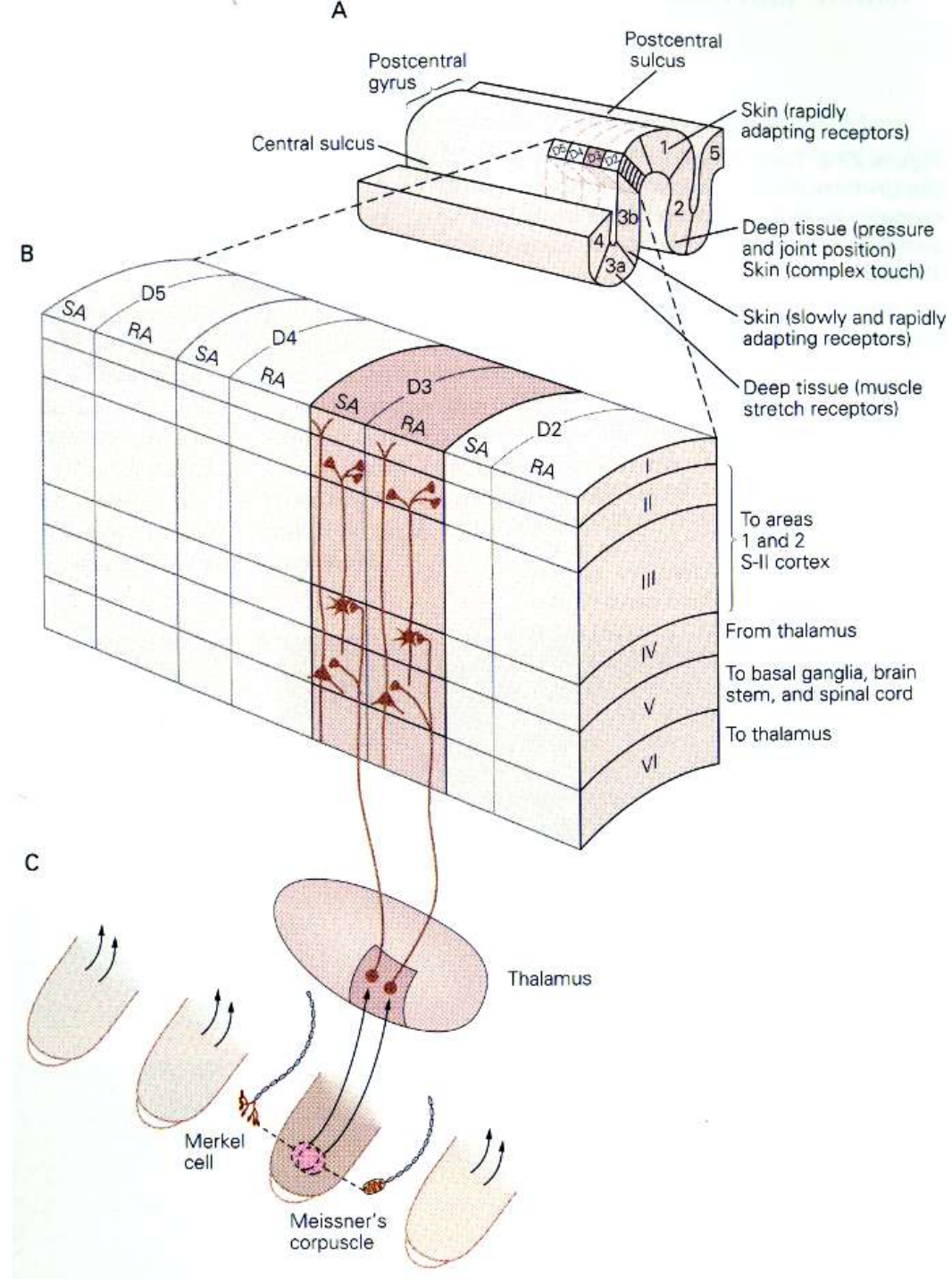


C Schematic cortical circuits



Câmpuri receptive corticale



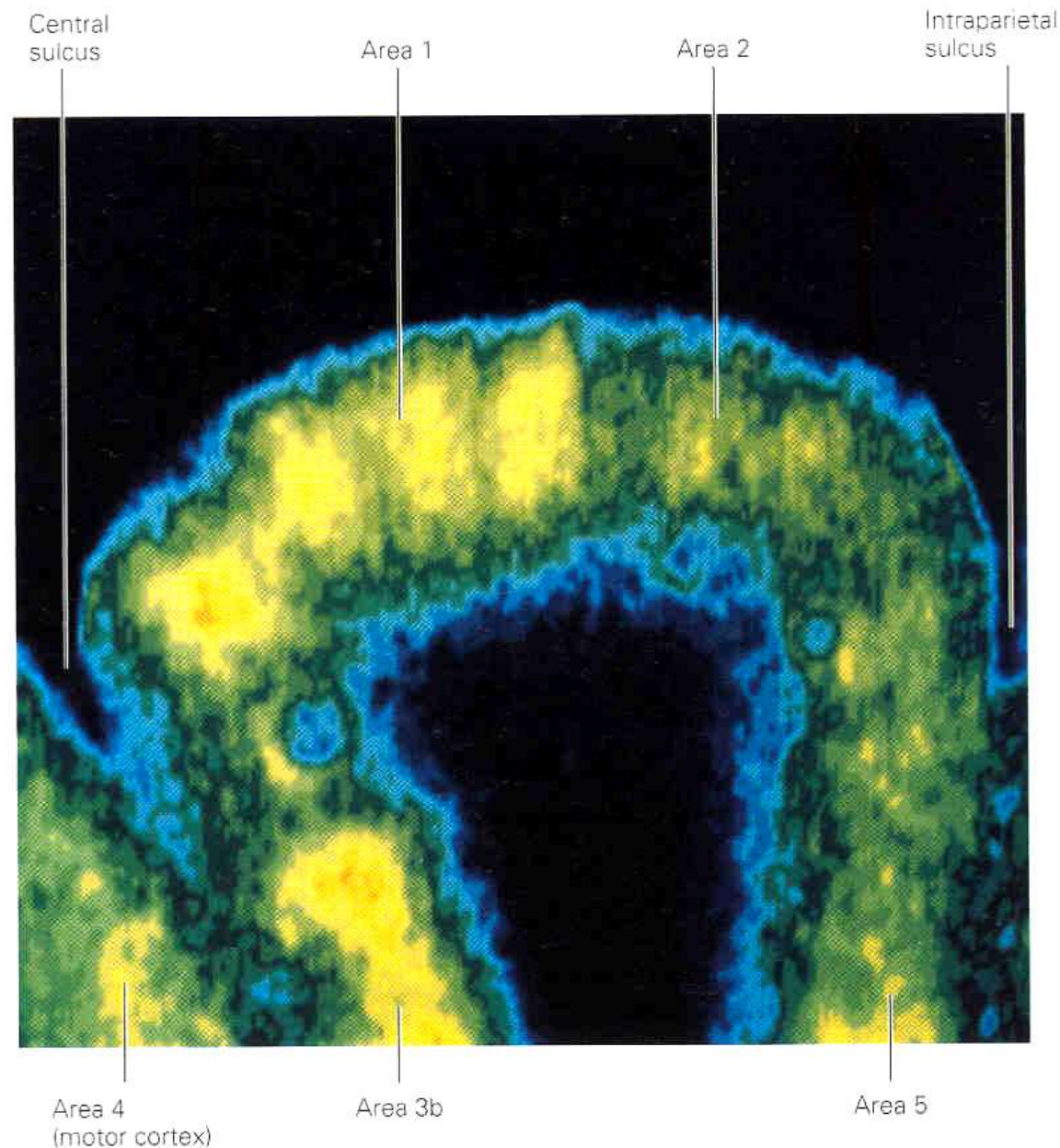


Modulele funcționale elementare ale cortexului: Coloanele Neuronale

Labelling cu ^{14}C 2-
deoxiglucoză

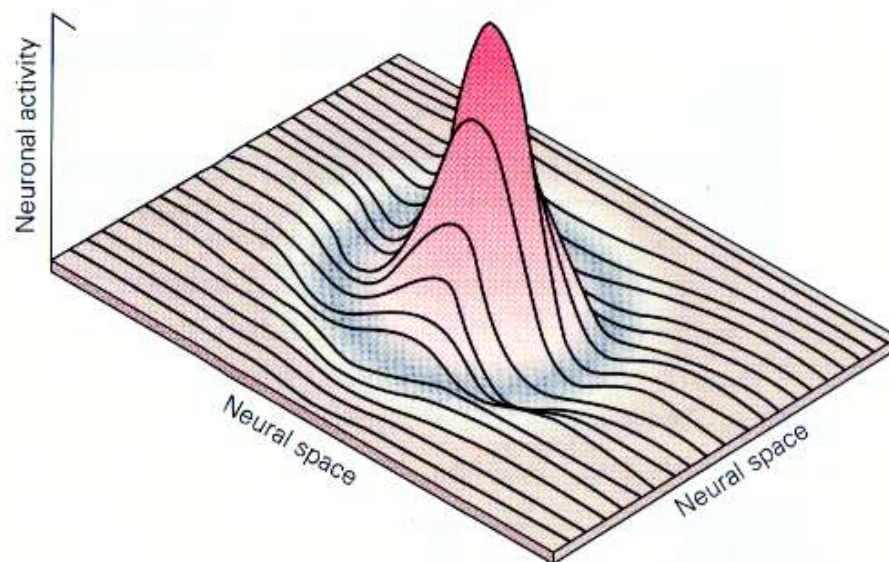
Coloanele verticale sunt
etichetate de la Stratul II la
Stratul V.

(în special stratul IV)

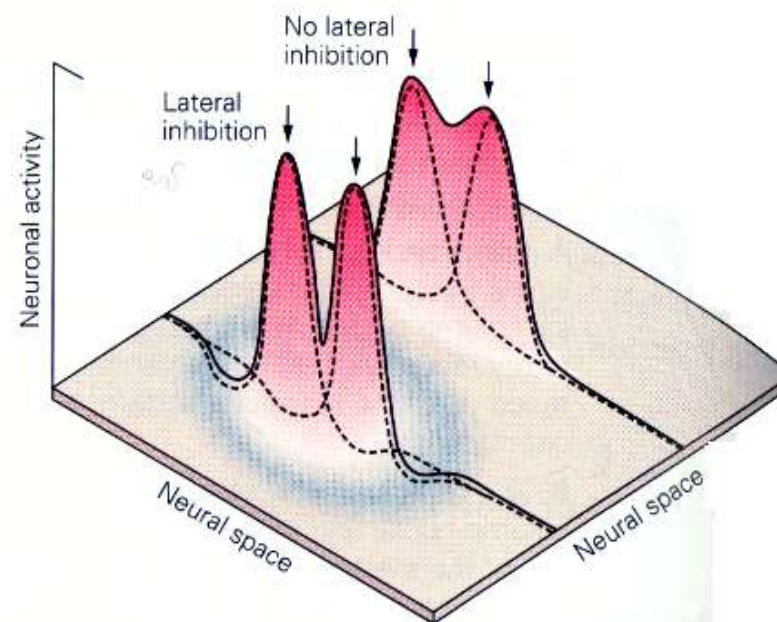


Discriminarea între două puncte

A One-point stimulus

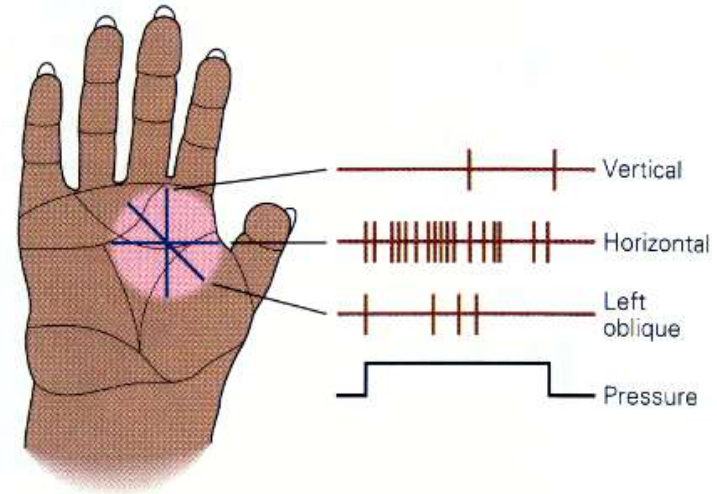


B Two-point stimulus

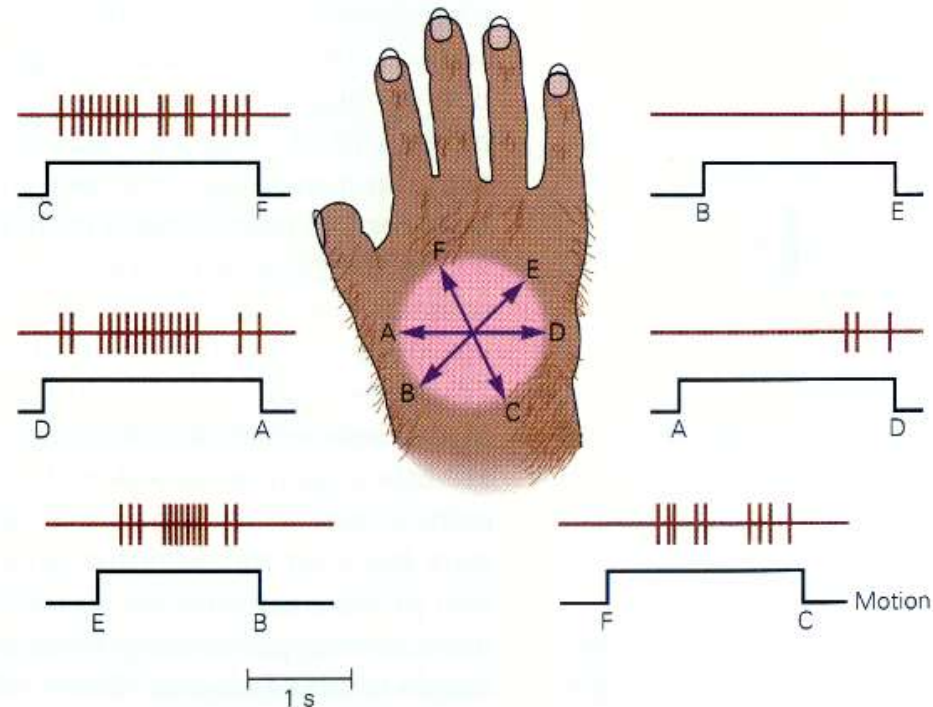


Neuronii din zonele corticale superioare au proprietăți complexe de detectare a caracteristicilor

A Orientation-sensitive neuron



B Direction-sensitive neuron



O singura experiență - integrarea
mai multor modalități senzoriale în
același timp



*"The touch" by Abraham Bosse; Credit: Lauros / Giraudon
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