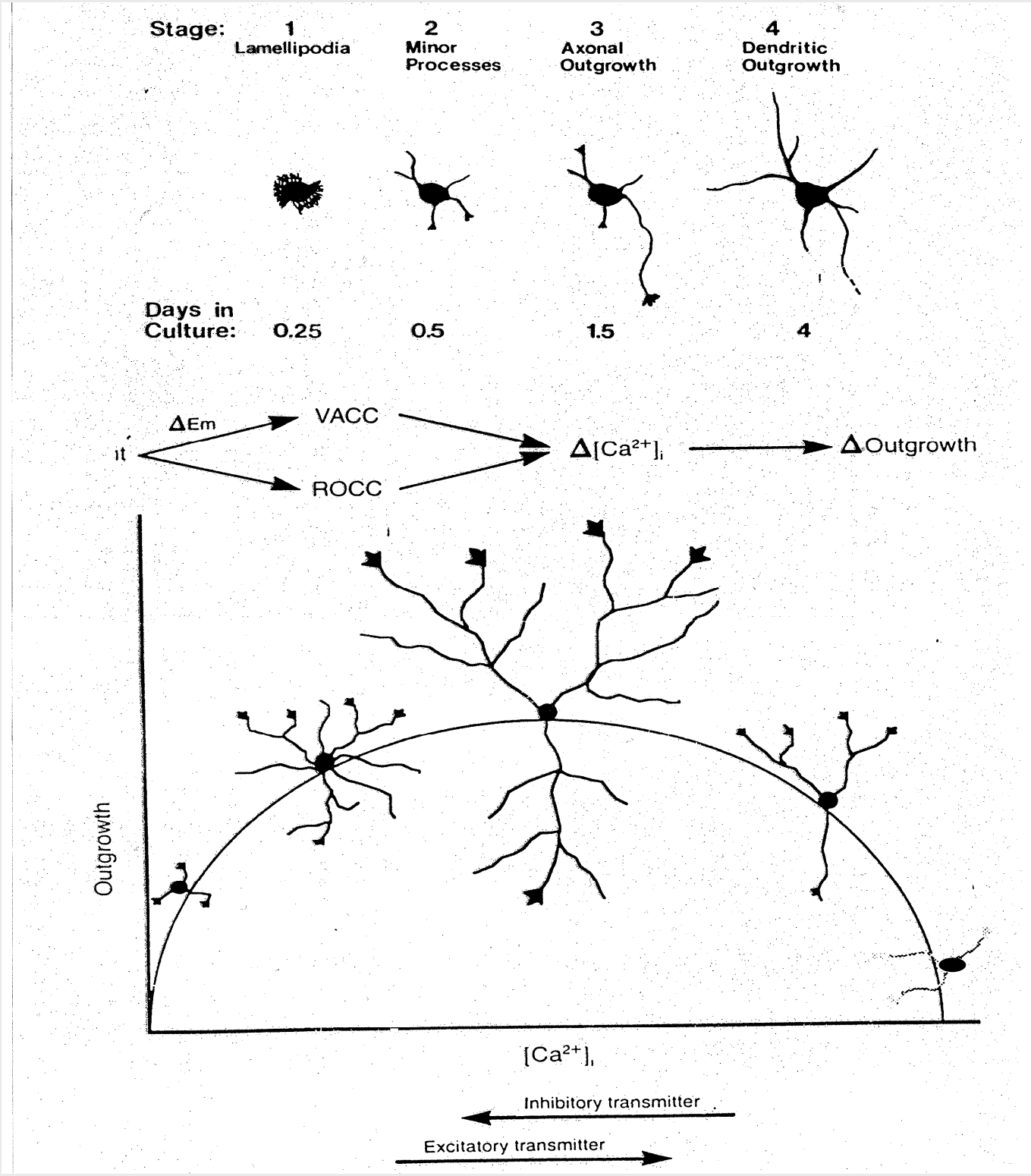
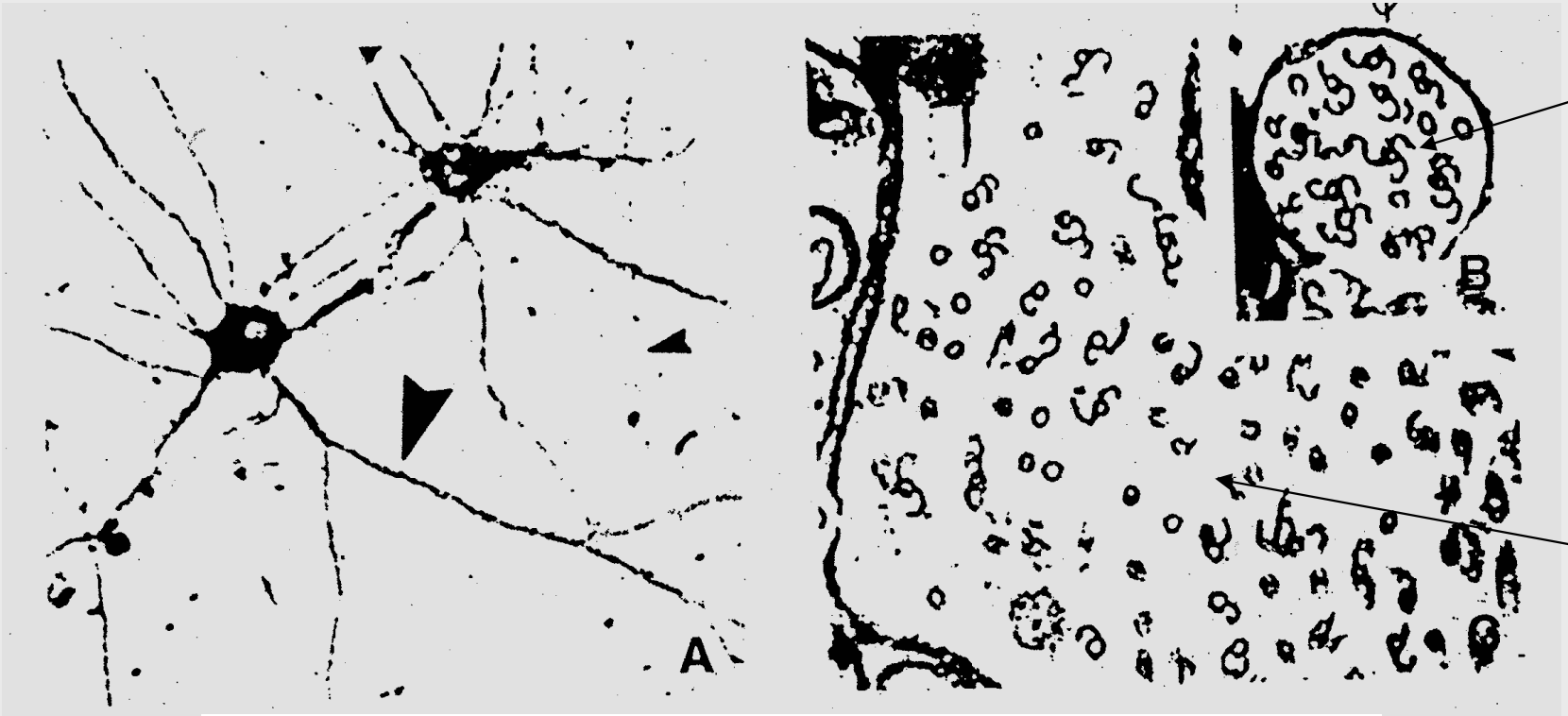
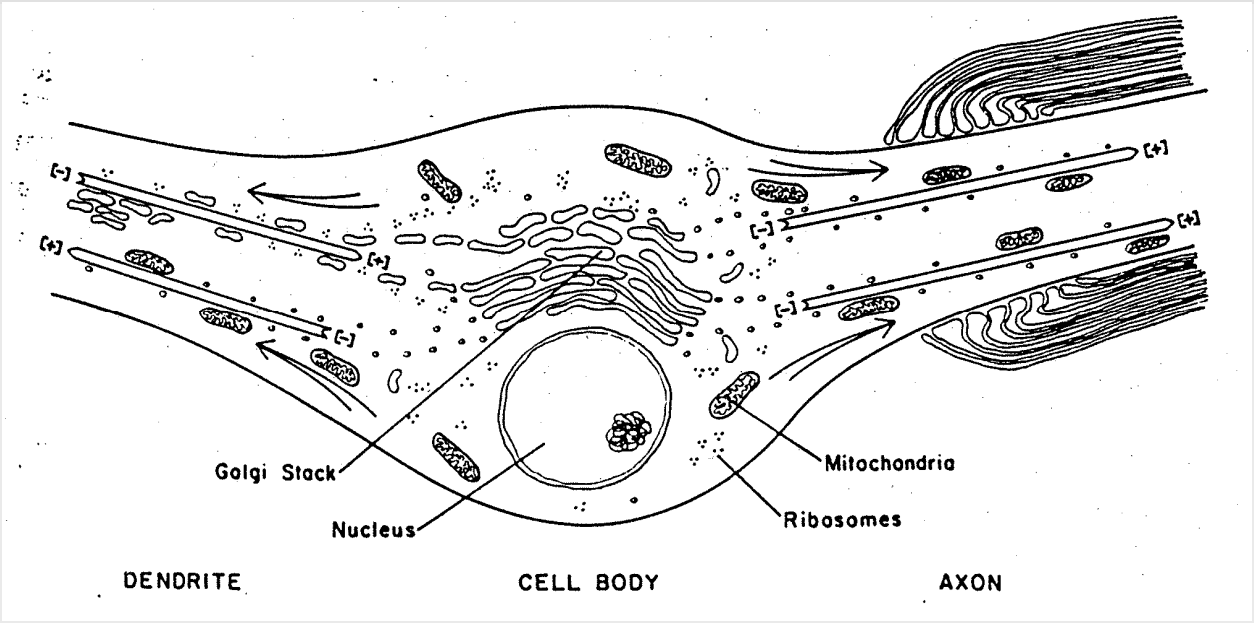
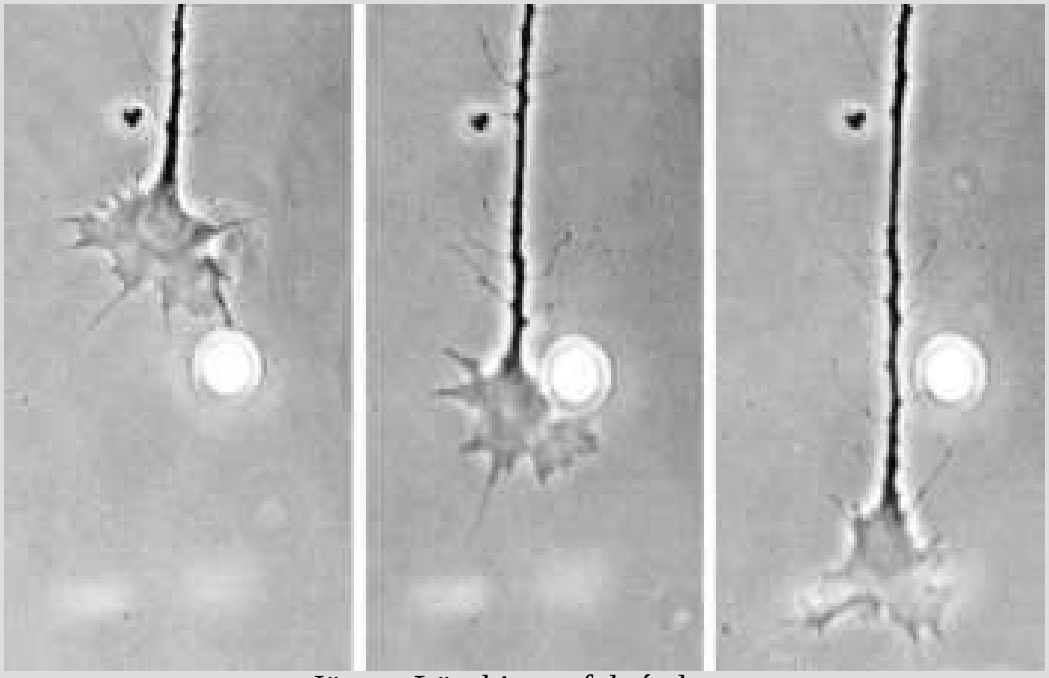
Idegi nyúlványok növekedése

1. Nyúlvány-kinövés – az idegsejt-polaritás kialakulása
2. Nyúlvány-növekedés (elongáció)
3. Irányválasztás – „aktivitás-független” benövés
    - attraktív, repulzív, permisszív felületek
    - Kötegelődés
4. Aktivitás-függő nyúlvány-szelekció


Stage:
1
Lamellipodia
2
Minor
Processes
3
Axonal
Outgrowth
4
Dendritic
Outgrowth
Days in
Culture:
0.25
0.5
1.5
4
ΔEm
VACC
ROCC
Δ[Ca2+]i
ΔOutgrowth
Outgrowth
[Ca2+]i
Inhibitory transmitter
Excitatory transmitter

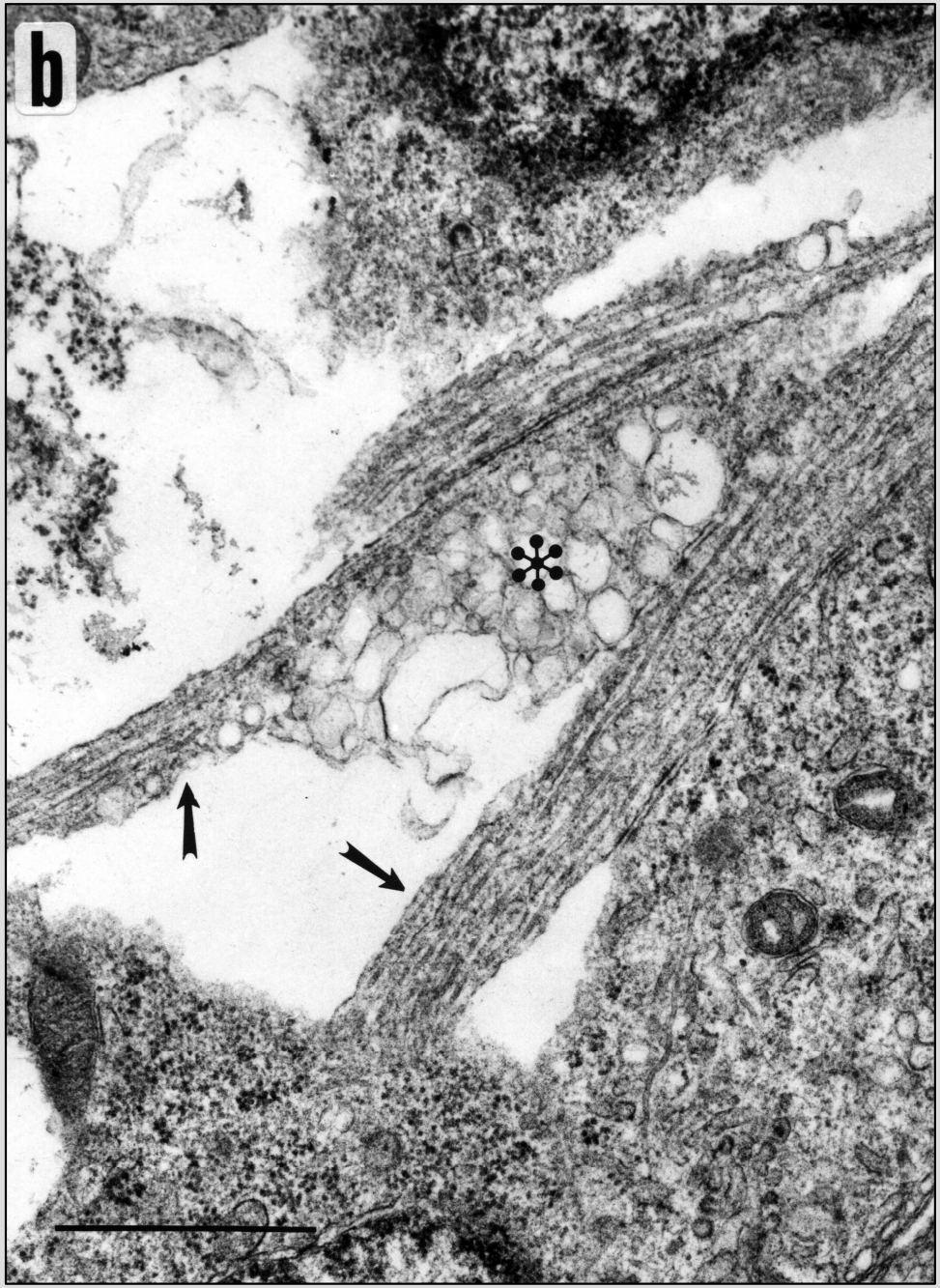

A
B
axon
dendrit


Golgi Stack
Nucleus
Mitochondria
Ribosomes
DENDRITE
CELL BODY
AXON



Jürgen Löschinger felvétele

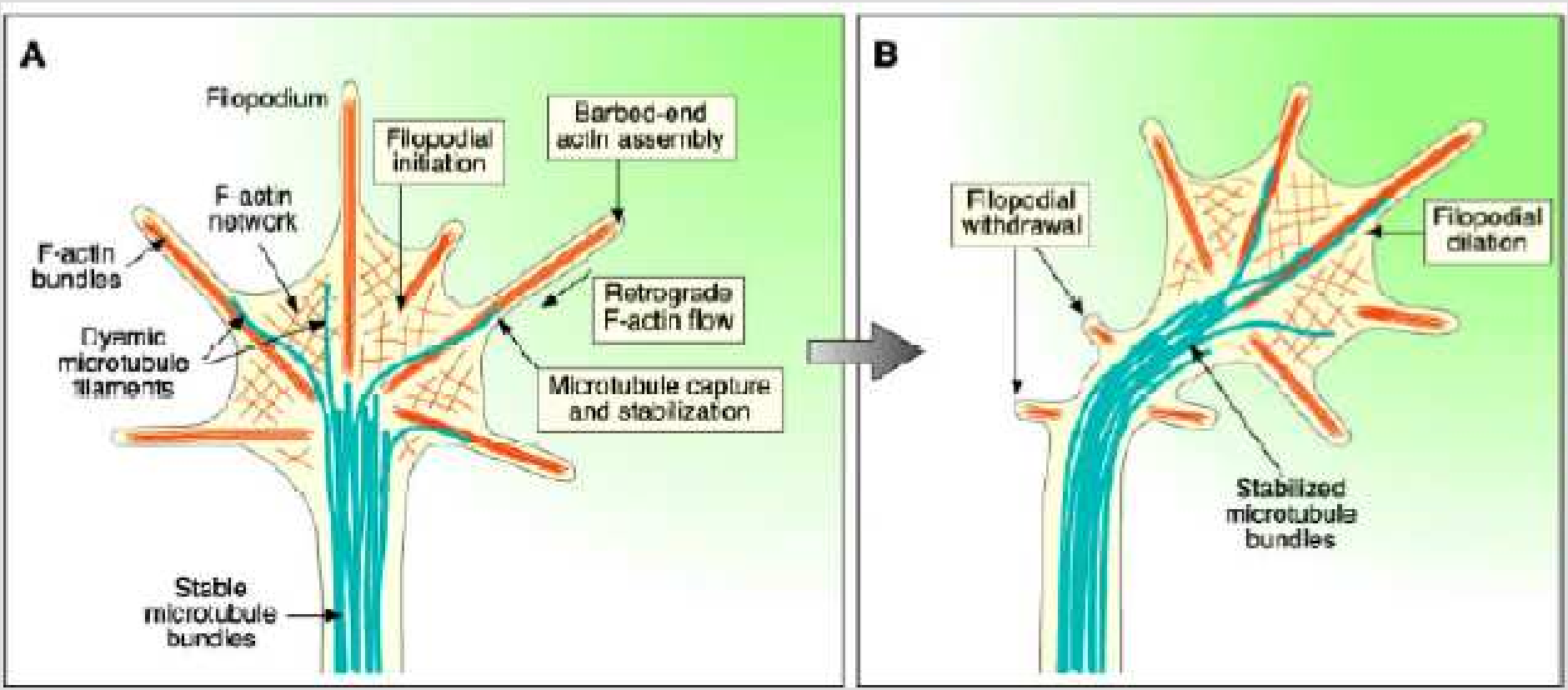
Fázis-kontraszt mikroszkópos video-felvétel

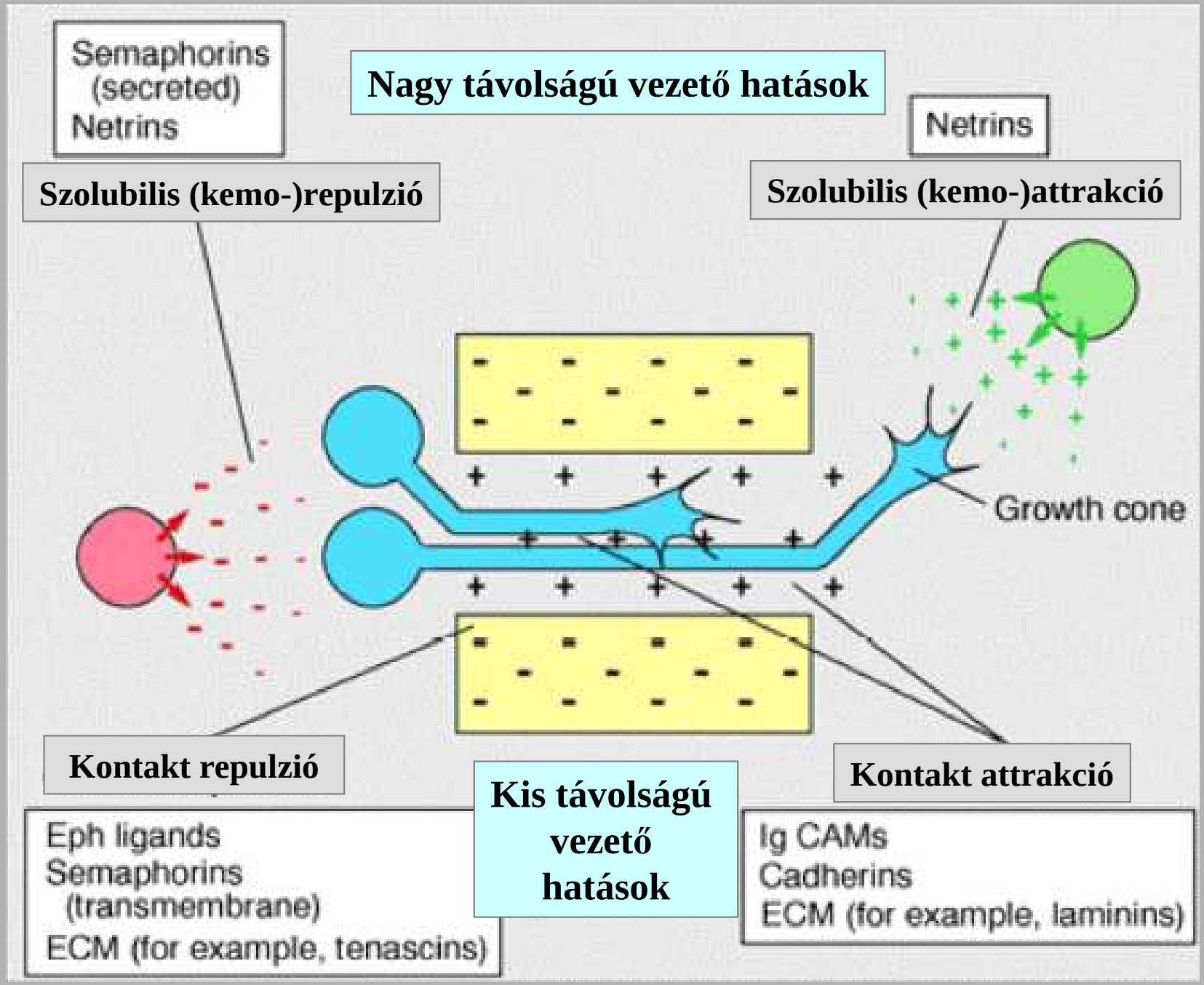


Elektronmiszkrópos felvétel.

*: növekedési kúp; ↗: épülő nyúlvány

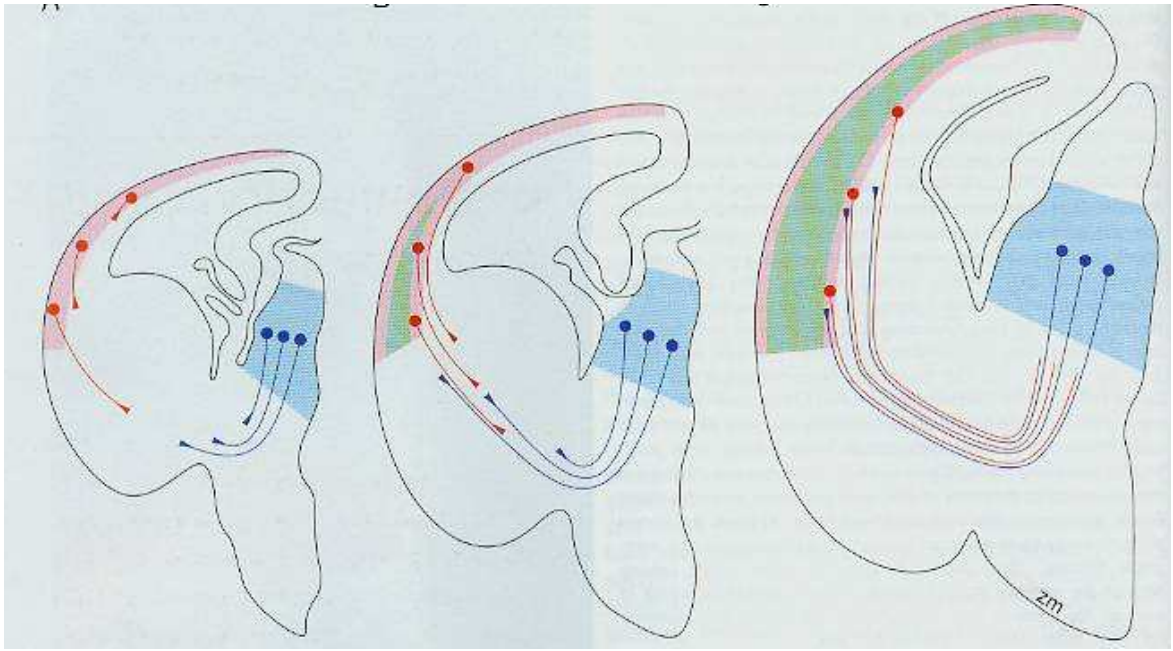
Az axon növekedési kúp letapadása, „előrehaladása” folyamatos membrán-épülést jelent a kúp vezető élén, filopódiumaiban, és anyag-beépülést a rögzülő „axon-rúd” növekedési kúp mögötti részén


A
Filopodium
Filopodial initiation
Barbed-end actin assembly
F-actin network
F-actin bundles
Retrograde F-actin flow
Dynamic microtubule filaments
Microtubule capture and stabilization
Stable microtubule bundles
B
Filopodial withdrawal
Filopodial dilation
Stabilized microtubule bundles

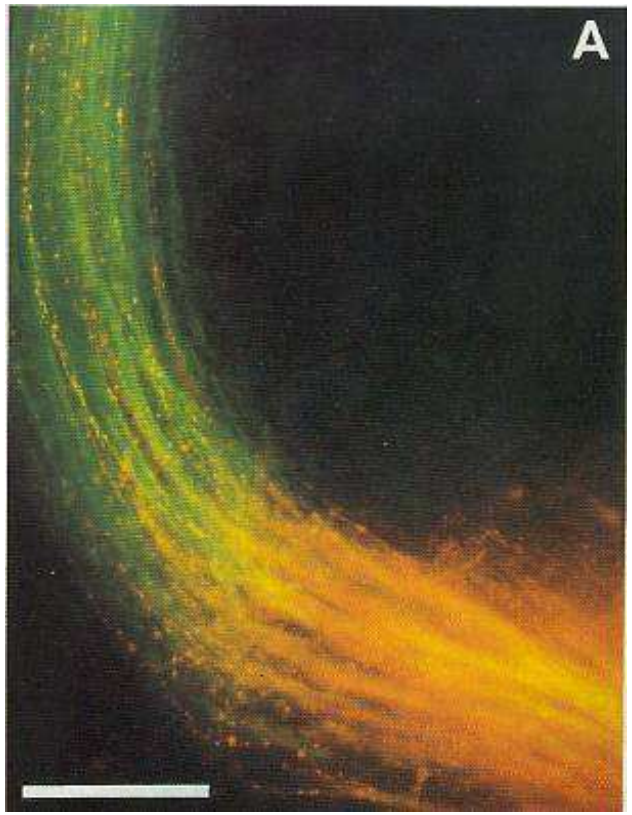


Tessier-Lavigne M and Goodman CS. The molecular biology of axon guidance.Science. 1996 274:1123-33

Növekedési kúp számára a legjobb letapadási felület a szomszéd nyúlvány felszíne:
A nyúlványok kötegeket képeznek

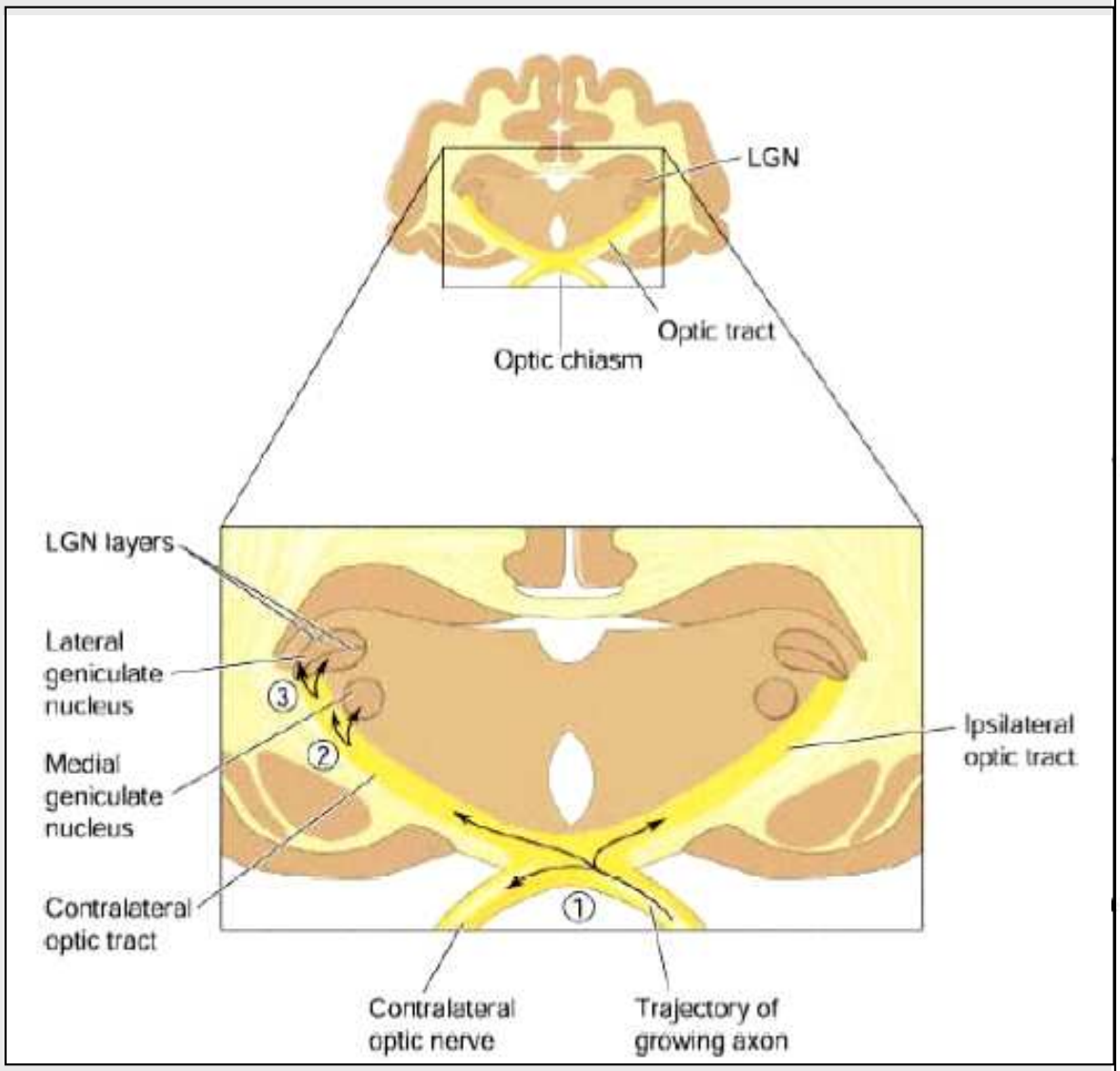


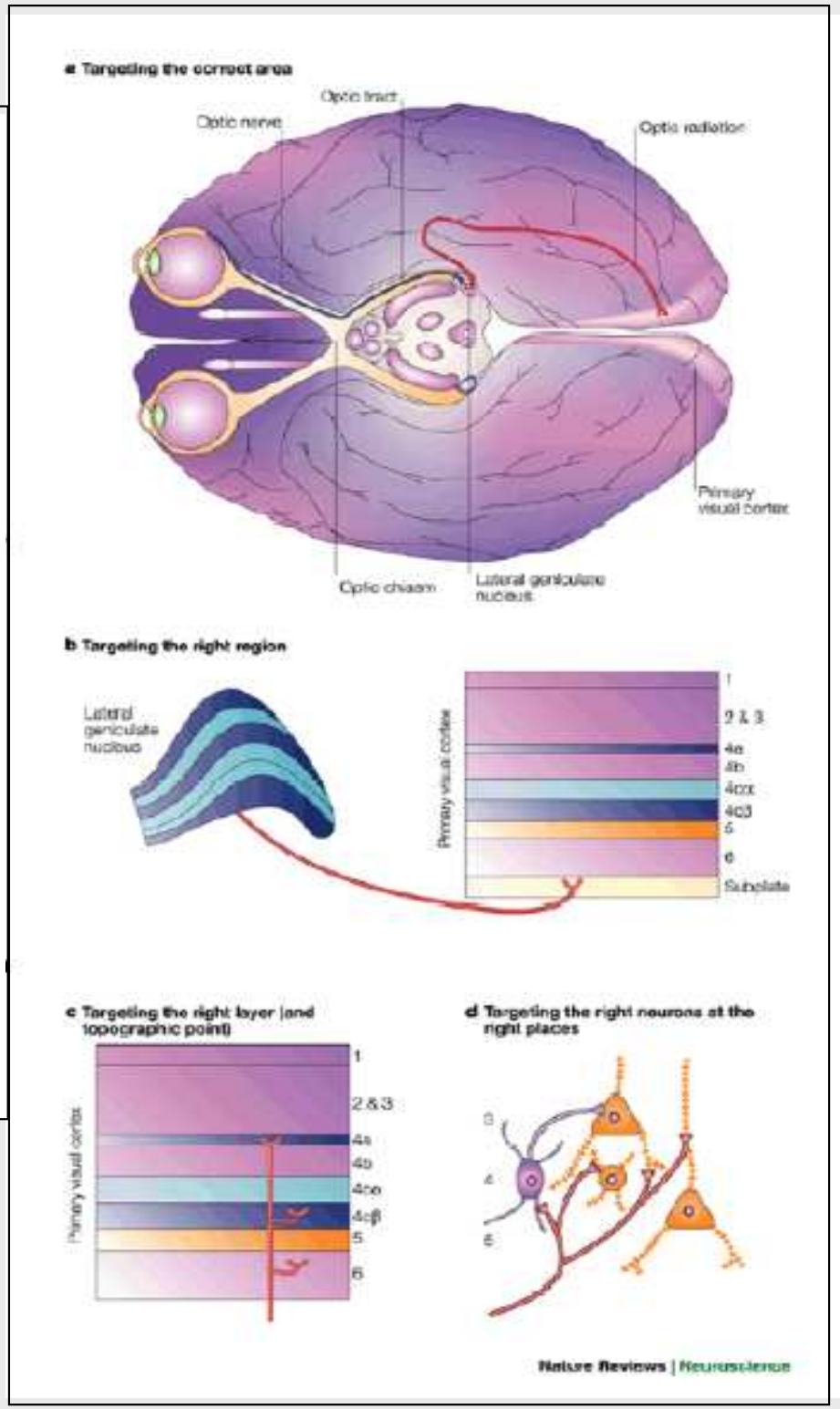
Az kérgi sejtek nyúlványai „bevezetik" a thalamus sejtek nyúlványait a jövendő kéreg felé



Molnár Zoltán felvétele

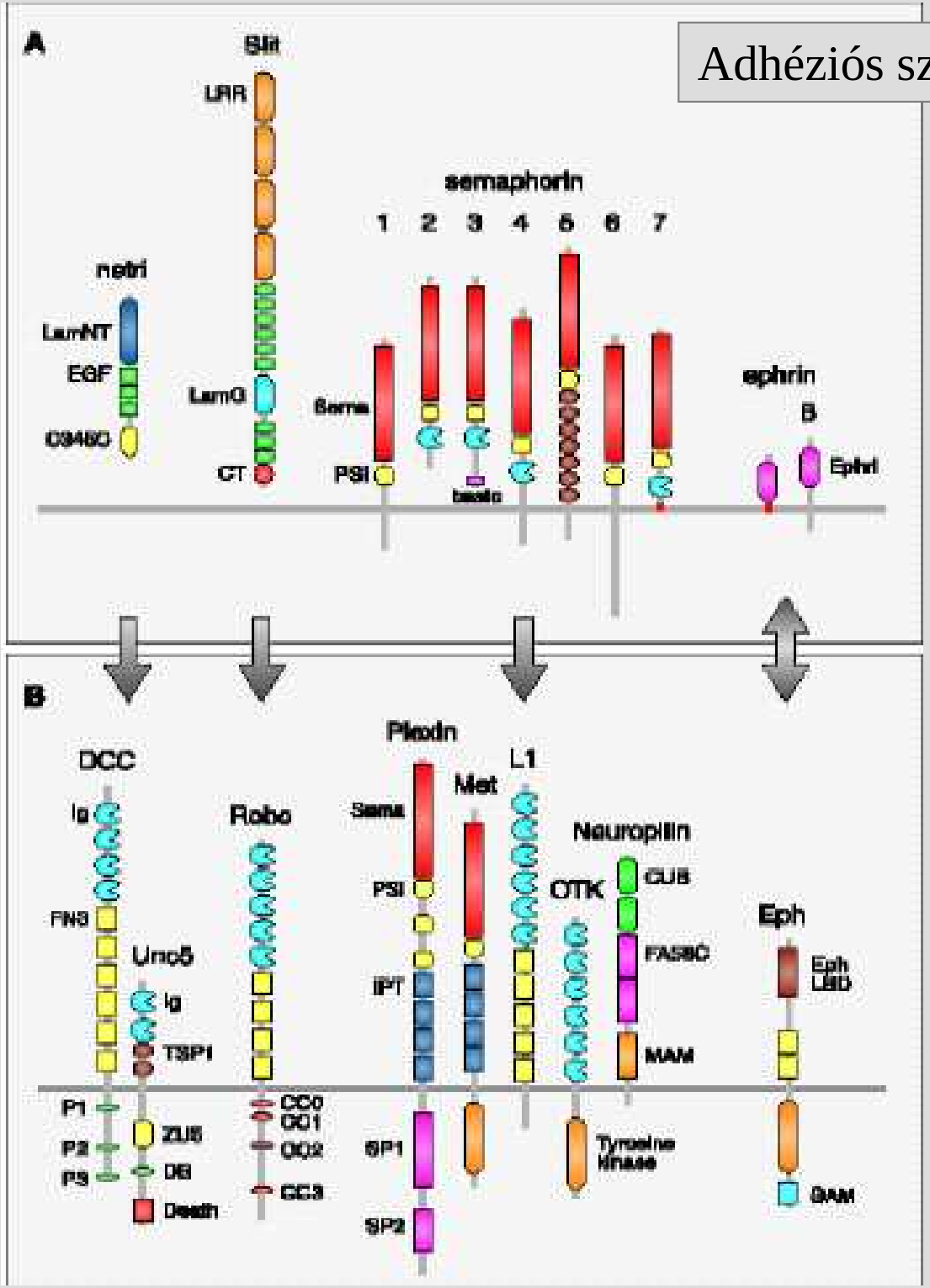
A kötegelt axonok irányított növekedése:





- **Látórostok teljes / részleges átkereszteződése**
- **Piramis-rostok átkereszteződése**
- **Felszálló érző kötegek átkereszteződése**

Adhéziós szignál (guidance) molekulák



Receptor	Ligand	Letapadási jel
DCC/Unc5	Netrin	repulzív/attraktív Wadsworth, Hedgecock 1996
Robo	Slit	repulzív Wong et al., 2002
Neuropilin	Semaphorin	repulzív/attraktív Chen et al., 1998
Eph (Trk receptors)	Ephrin	repulzív/attraktív Himanen, Nikolov 2003
NogoR	MAG,Omgp , Nogo66	repulzív McGee, Strittmatter, 2003

SEMA I, II, VIII: gerinctelen; receptor: plexinek
SEMA III-VII : gerinces; receptor: neuropilin 1 és 2

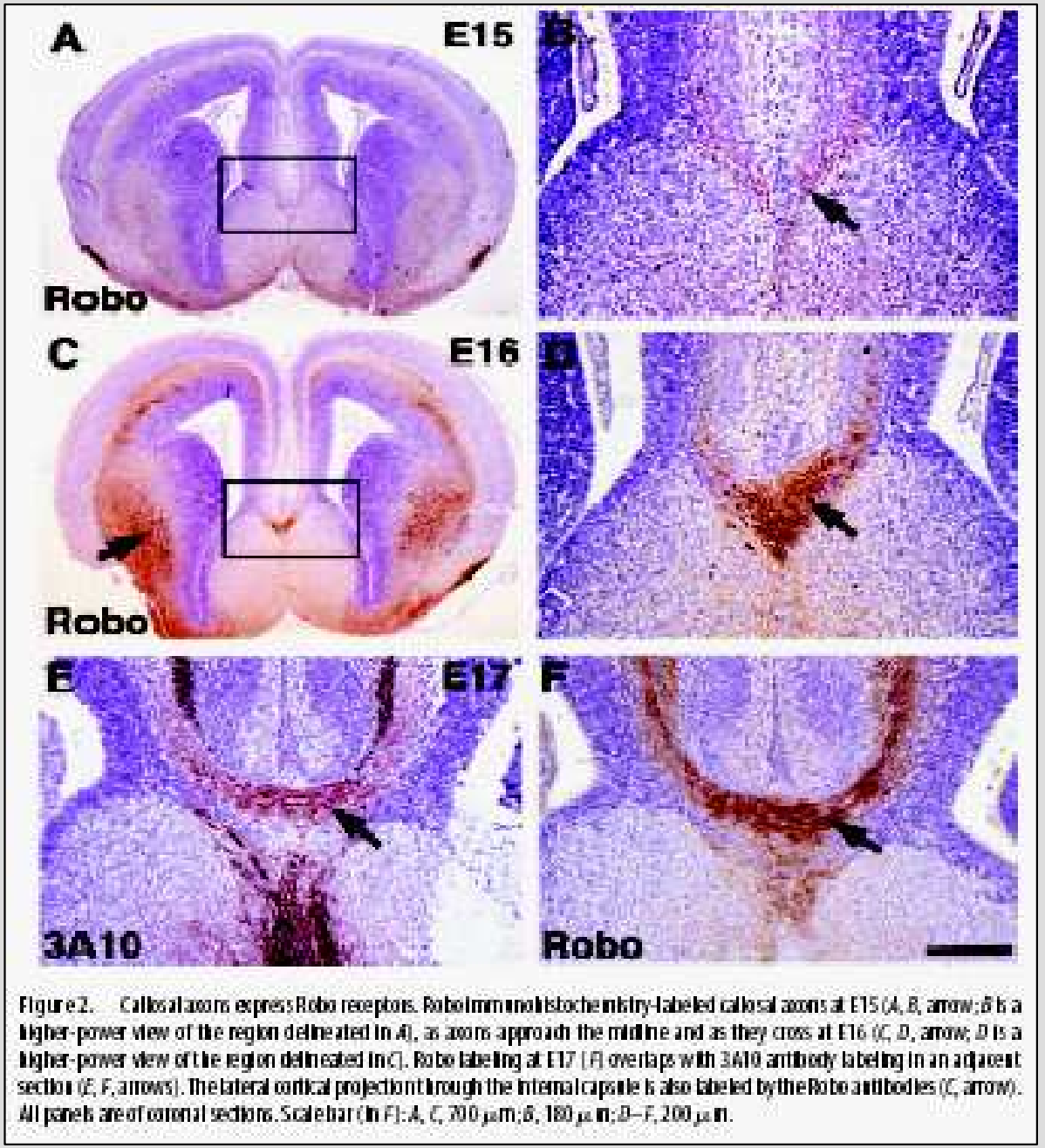
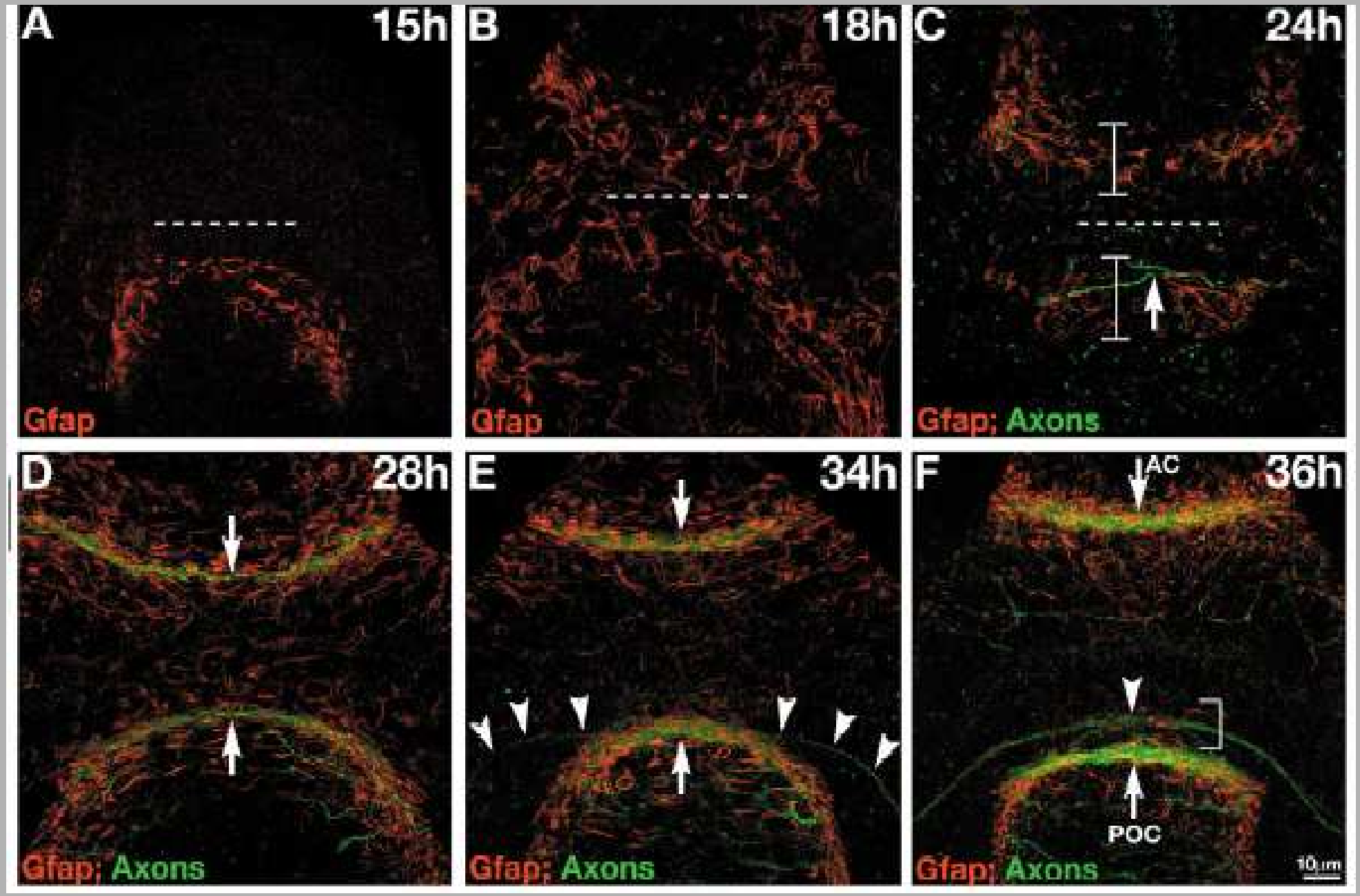
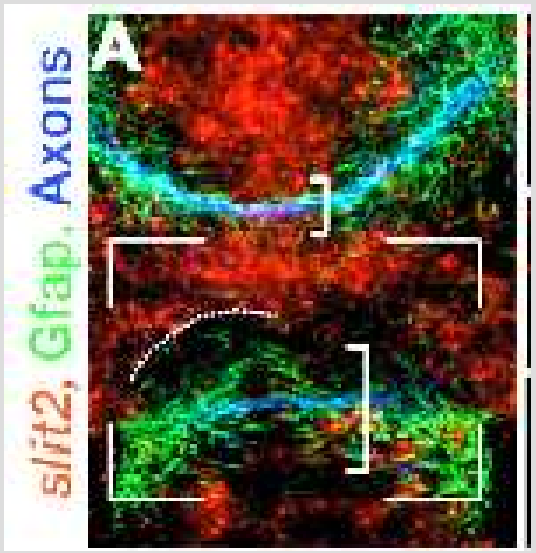


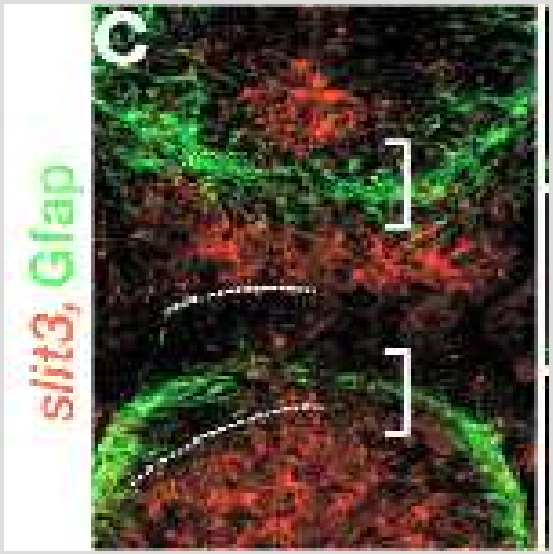
Figure 2. Callosal axons express Robo receptors. Robo immunohistochemistry-labeled callosal axons at E15 (*A*, *B*, arrow; *B* is a higher-power view of the region delineated in *A*), as axons approach the midline and as they cross at E16 (*C*, *D*, arrow; *D* is a higher-power view of the region delineated in *C*). Robo labeling at E17 (*F*) overlaps with 3A10 antibody labeling in an adjacent section (*E*, *F*, arrows). The lateral cortical projection through the internal capsule is also labeled by the Robo antibodies (*C*, arrow). All panels are of coronal sections. Scale bar (in *F*): *A*, *C*, 700 μm; *B*, 180 μm; *D*–*F*, 200 μm.

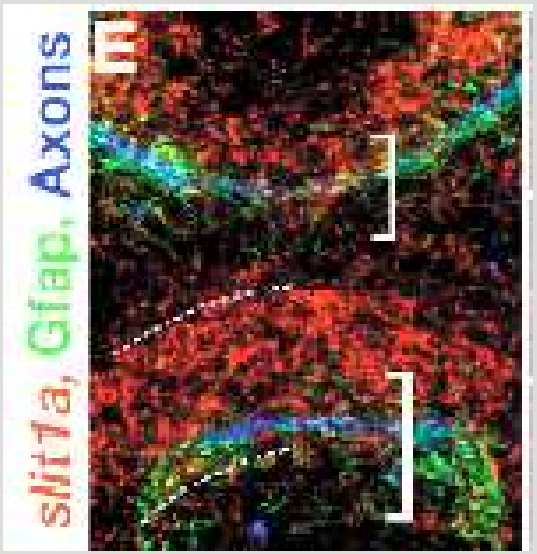


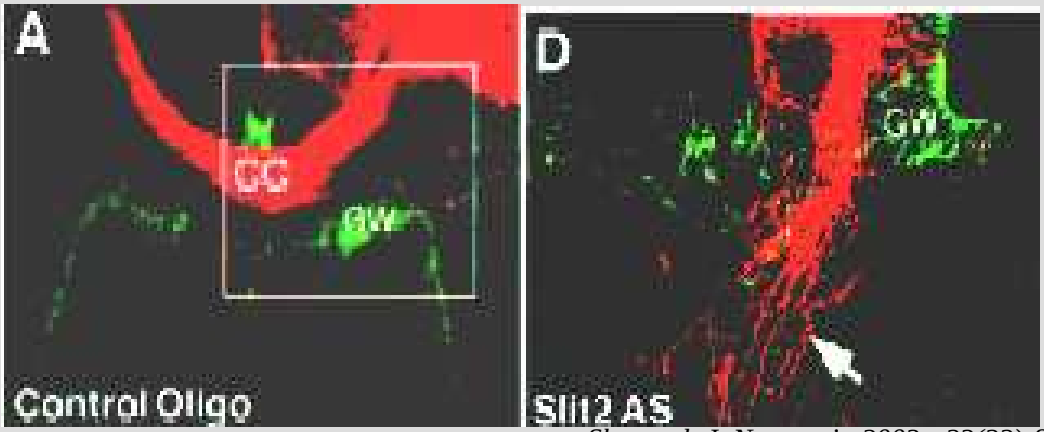
Baresi et al., Development, 2005. 132, 3643-3656

„Glia-hidak” kialakulnak a középvonalat átlépő axonok megjelenése előtt.
Zebrahal embrió
AC: commissura anterior; POC : commissura post optica;

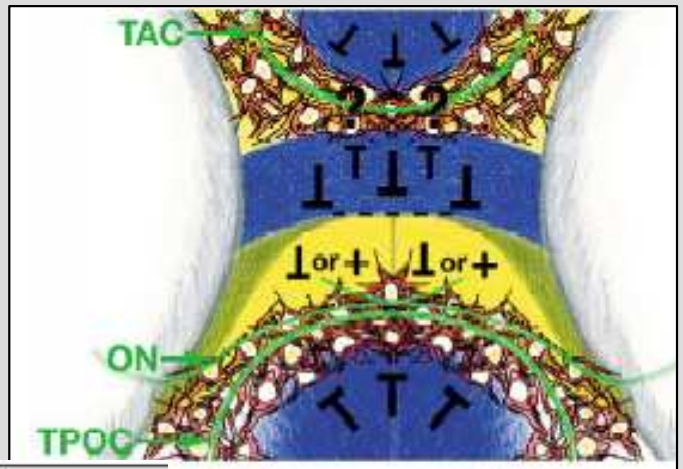


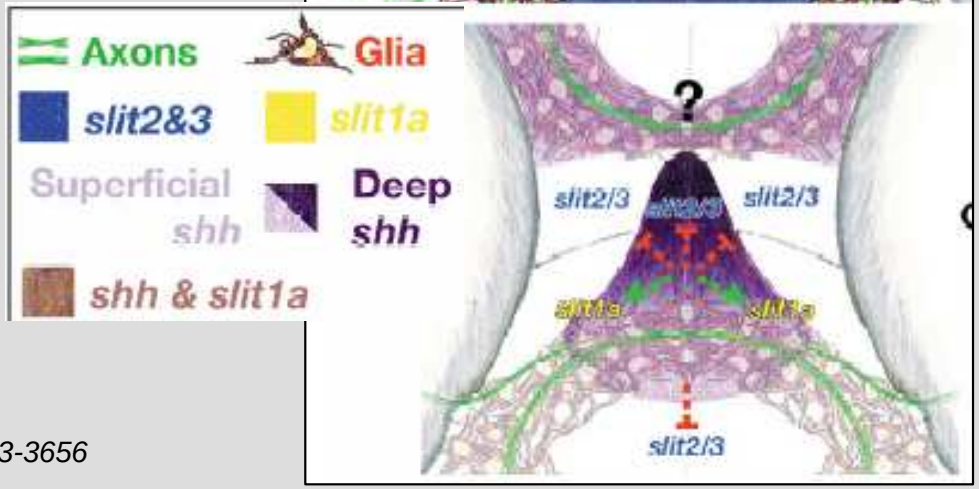


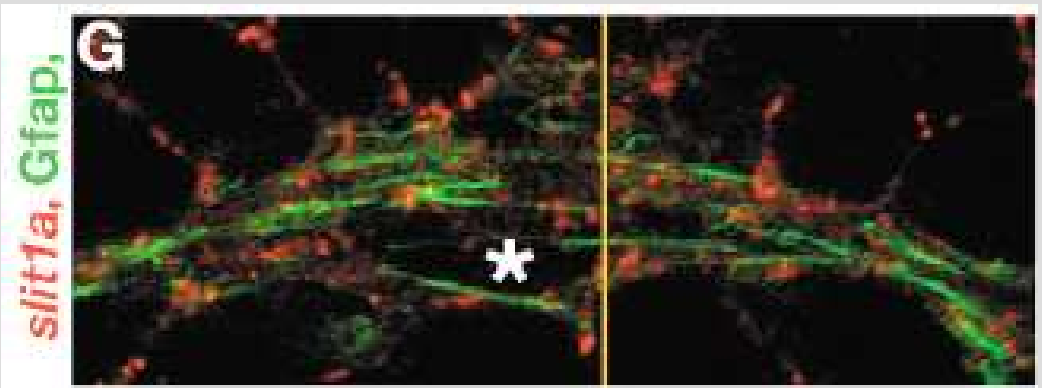




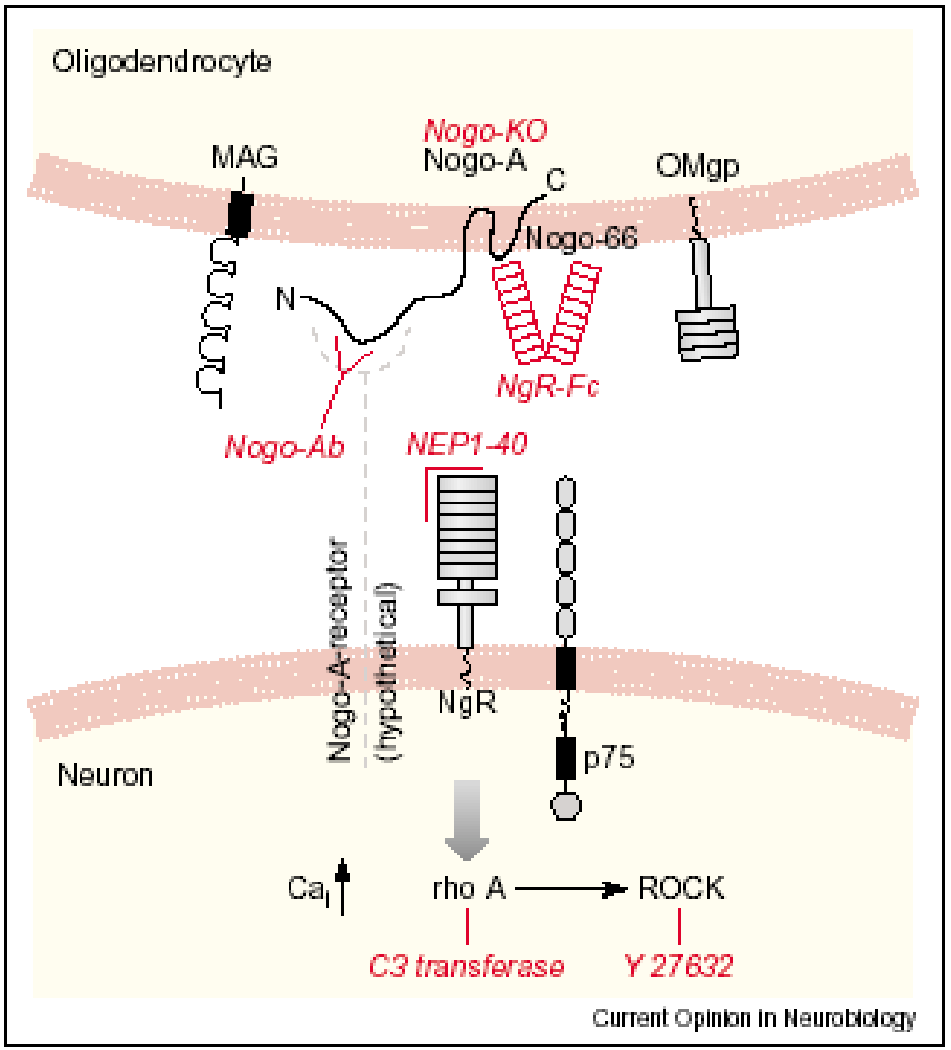
Shu et al. J. Neurosci., 2003 • 23(22):8176–8184



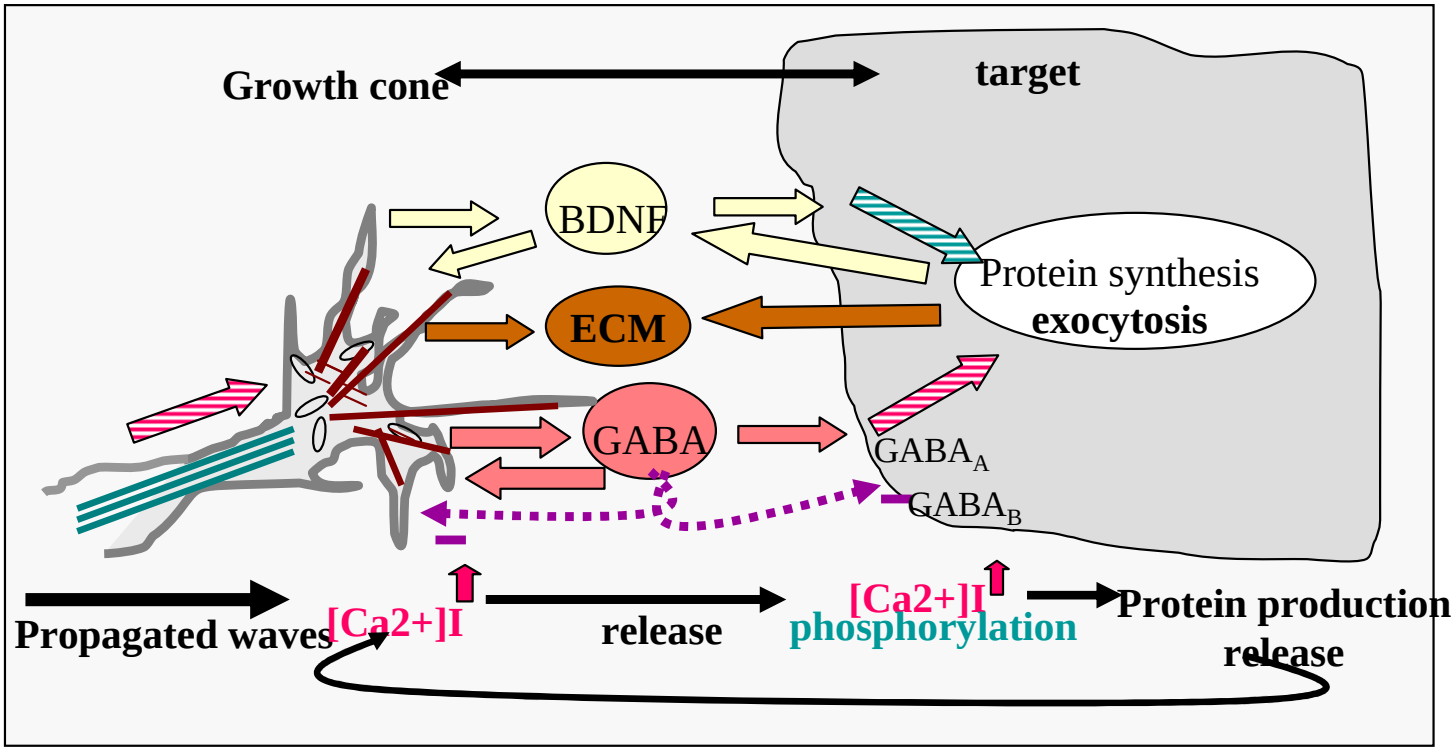




Baresi et al., Development, 2005. 132, 3643-3656



Nogo-A, MAG and OMgp, the principal inhibitors of neurite growth in CNS myelin, interact with a receptor complex comprising NgR, p75 and additional components. Methods of blocking Nogo and its actions are shown in red. As well as gene deletions (Nogo-KO), Nogo-A, which is shown with its two main active sites facing the extracellular space, can be neutralized by specific antibodies or by a soluble Nogo-66-binding fusion protein comprising domains of the receptor subunit NgR. The NgR subunit itself can be blocked by the NEP1–40 peptide derived from the first 40 amino acids of the Nogo-66 region of Nogo-A. As MAG and OMgp also bind to NgR, NEP1–40 may be a particularly potent reagent. Nogo-A and Nogo-66 activate Rho-A and its downstream target ROCK, the activity of which can be blocked by C3 transferase and the inhibitor Y27632, respectively.



Jelitai, Madarasz; Int.Rev.Neurobiol. 2006