9.14 classes #27 - 28: Neocortex 4: Association cortex

Readings

Mesulam, M.-Marsel," Chapter 1 ,Patterns in behavioral neuroanatomy: Association areas, the limbic system, and hemispheric specialization" Mesulam, M.-M. (ed.), *Principles of Behavioral Neurology,* Philadelphia, F.A. Davis Company,2001,(pp. 1-121). For the class, study pp. 1-17, 21-54, 71-76.Recommended 76-86

Brodal, Per.," Chapter 20,Cerebral cortex",*The central nervous system: Structure and function,* 2nd edition, New York, Oxford Univ. Press, 1998, pp. 583-620

Polyakov, G.I., "Chapter1, sec.2 Modern data on the structural organization of the cerebral cortex", *Higher cortical functions in man,* New York, Basic Books, pp. 39-69, Luria A. R. The Russian anatomist uses some terms not common in Western neuroscience, but some of the data collected and figures are unique: study fig. 15, 17, 18, 19.

Benowitz, Larry I., "Abstracts of articles", *GAP-43,*(1987, 1988, 1991) (see references below).

Supplementary Readings:

Nolte, John, "chapter 22",*The Human Brain,* 4th edition . [The overlap with Brodal and Mesulam would be helpful to you in learning the structures and concepts.]

Nolte, "chapter 16, The thalamus and internal capsule: Getting to and from the cerebral cortex," pp. 374-396.

Nauta & Feiertag, "chapter. 16, Neocortex ", pp. 289-315.

Benowitz and Routenberg, " GAP-43: an intrinsic determinant of neuronal development and plasticity", *Trends in Neuroscience,*1997, 20*:* 84-91.

Neve, R.L., Perrone-Bizzozero, N.I., Finklestein, S., Zwiers, H., Bird, E., Kurnit, D.M., and Benowitz, L.I. ,"The neuronal growth-associated protein GAP-43 (B-50, F1): neuronal specificity, developmental regulation and regional distribution of the human and rat mRNAs", *Brain Research, 388*: 177-183.

Neve, R.L., Finch, E.A., Bird, E.D. and Benowitz, L.I., " Growth-associated protein GAP-43 is expressed selectively in associative regions of the adult human brain" *Proc. Natl. Acad. Sci. USA,* 1988,85: 3638-3642.

Dani, J.W., Armstrong, D.M. and Benowitz, L.I. ,"Mapping the development of the rat brain by GAP-43 immunocytochemistry", *Neuroscience,*1991, 40: 277-287.

Krubitzer, L. ,"The organization of neocortex in mammals: are species differences really so different?", *Trends Neurosci.,*1995,18: 408-417.

Northcutt, R.G. and Kaas, J.H.,"The emergence and evolution of mammalian neocortex", *Trends. Neurosci.,* 1995,18: 373-379.

Butler, A. B., Reiner, A., Northcutt, R.G. and Kaas, J.H. ," Levels of organization and the evolution of isocortex (Letters to the editor)," *Trends Neurosci.,*1996,19: 89-92.

Questions:

1. Memorize Mesulam's figure 6 (p.8). Define isocortex (iso=same) vs. allocortex (allo=other). What is idiotypic cortex (p.11), which is one type of isocortex? (See also Nauta &: Feiertag, p. 292-3, for definition of isocortex, also of the two types of allocortex).

2. What are the different types of association areas, according to Mesulam? (p.9)

3. What is "mesocortex" (Mesulam's paralimbic cortex), and where is it located? This is not the same as the "mesocortical system" of dopamine-containing axons passing from the ventral tegmental area of the midbrain to the prefrontal cortex, or the "mesolimbic system" of dopamine axons from VTA to limbic structures of the forebrain, including the amygdala, entorhinal cortex, and septal area).(p.49-54)

4. According to Mesulam, what are the two essential transformations that are likely to occur in higher-order association areas? (p. 39-41)

5. Contrast the modality specific disconnection syndrome of pure alexia with "central" alexia, in terms of the type of association area that must be damaged. (p. 39-41)

6. What are the two "heteromodal fields" in the primate brain? Which is larger? (p.9-11)

7. What thalamic nuclei connect with the two neocortical fields in question 6?(M p.73-75) See also, Brodal fig. 20.7.

8. Note the three types of cortex in Polyakov's (Luria's) fig. 15. Polyakov's primary fields of the nuclear zones are equivalent to Mesulam's idiotypic cortex. P's secondary fields are equivalent to M's unimodal association areas. P's tertiary fields are equivalent to M's heteromodal association areas. What evolutionary trend is suggested by the species comparisons? (We will discuss and criticize the suggestions in class.)

9. What general feature of neocortical organization is suggested by Polyakov's fig. 17? Try to relate this to his fig. 18 (the Vogt's myelogenesis map, similar to one done by Flechzig) and to Mesulam's subdivisions. How do these pictures relate to Benowitz' GAP-43 findings?

10. Describe the neocortical territories (areas projected to) of the basic thalamic cell groups:
    -- the geniculate bodies ("external geniculates") (LGBd, MGB)
    -- the ventral thalamus: ventral posterior nuclei (ventrobasal) (VPL, VPM)
    ventral anterior and ventral lateral (VA-VL)
    -- the lateral thalamus, including the pulvinar nucleus (LD, L, LP, Pulvinar, Po)
    -- the medio-dorsal thalamic nucleus (MD)
    -- the anterior nuclei (AD, AV, AM)
    -- the intralaminar and midline nuclei

    Try to extract as much as you can from the readings. Basic points will be reviewed in class. See Brodal fig 20.7 (better than the Mesulam diagram of thalamus). In class, probably in the final session on neocortex, we will contrast rodent and primate, looking at frontal sections of thalamus as well as surface views of the hemisphere. (cf. Nolte, ch. 16).

11. One of the major meanings of the term "association cortex" is that these are the areas with long transcortical interconnections. What basic patterns of connections can you see in the Brodal figures? Relate these to Nauta's figure 115, showing association fiber groups which are so large in the human brain that they can easily be seen in dissections.