Talairach & Braak Define a New View of Cingulate Functionality

During the 1960s and 1970s the Papez-MacLean model of limbic circuitry was the dominant view of how the limbic system works. This simple circuitry assumed a reverberating system and general views of emotion with no specific input and output systems for sensorimotor processing. In 1973 Talairach et al. and in 1976 Braak fundamentally changed the face of limbic research by demonstrating cingulate motor functions and a cingulate motor area (primitive gigantopyramidal field), respectively. While previous investigators such as Kaada (1951) showed autonomic and skeletomotor responses to cingulate electrical stimulation, this never led to a fundamental revision of how limbic systems function. Talairach et al. evoked lip puckering, finger kneading, and bilateral limb movements with electrical stimulation; movements associated with kissing, scratching, or pushing. These movements differ significantly from those evoked by motor cortex stimulation in that they are associated with behaviors that are valenced and context dependent. For the first time, it was possible to view cingulate cortex as something more than a vague part of the limbic system; instead it has a direct and specific role in skeletomotor control. Thus began a new era in cingulate research.

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Research Reports

A PRIMITIVE GIGANTOPYRAMIDAL FIELD BURIED IN THE DEPTH OF THE CINGULATE SULCUS OF THE HUMAN BRAIN*

HEIKO BRAAK

Anatomisches Institut der Universität, 23 Kiel (G.F.R.)

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SUMMARY

By stereomicroscopical examination of a complete series of pigment preparations up to 1000 μm thick, a gigantopyramidal area in the brain of man is described, which lies in front of the primary motor field on the medial surface of the hemisphere and is almost totally buried in the depth of the cingulate sulcus extending in both length and width over about 15 mm. Serial sections cut in the transverse plane display the field approximately within the limits of the commissura anterior on the one hand and the corpora mamillaria on the other, where it occupies large parts of the dorsal wall of the gyrus cinguli (lower bank of sulcus cinguli) and a small area of the adjacent superior frontal gyrus. The sharply outlined field does not fuse with the primary motor area and is evidently more primitively organized than the precentral motor field. Structural details betray an intimate relationship between this gigantopyramidal field and the archipallial proisocortex. We could clearly trace a gradation, that is, a stepwise change of architectonic features in constant orientation from the limbic proisocortex over a small paralimbic transition zone to the gigantopyramidal field, accounting for the numerous limbic traits recognizable within it, such as, for instance, an accentuated external granular layer, a dense and broad lamina pyramidalis, and a band-like appearance of Va.

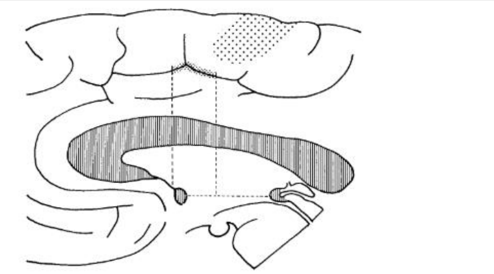


Fig. 1. A view of the medial surface of a human brain, illustrating the approximative position of the primitive gigantopyramidal area (densely dotted) and the primary motor field (sparsely dotted).

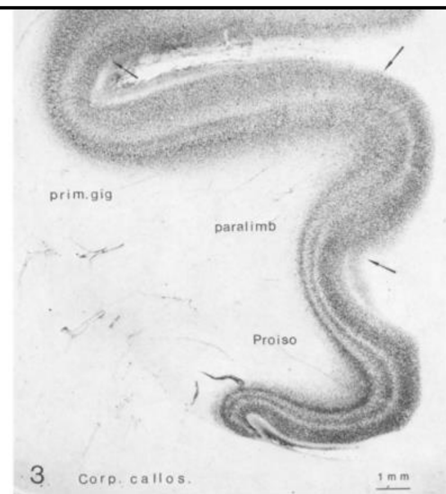
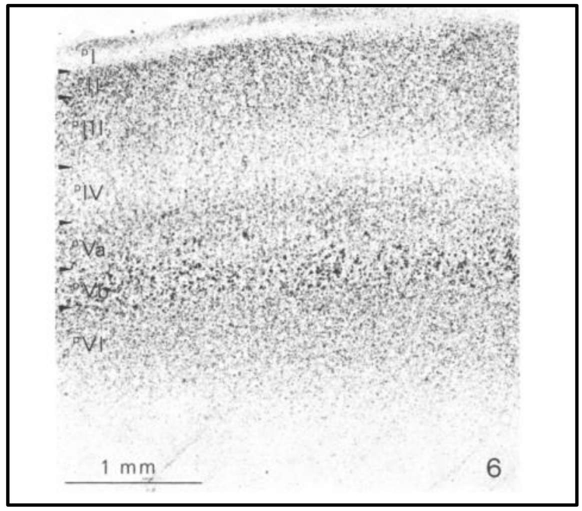


Fig. 3. Transverse section through the gyrus cinguli and adjacent parts of the superior frontal gyrus of man. The steps from the bitaeniate proisocortex over a paralimbic transition zone to the propeunitaeniate gigantopyramidal area are clearly recognizable. The boundaries of the fields are marked by arrows. prim.gig, primordial gigantopyramidal area; paralimb, paralimbic transition area; Proiso, cingulate proisocortex; Corp. callos., corpus callosum. Pigment preparation, 1000 μm, aldehyde-fuchsin.

Cingulate sulcal cortex was subsequently shown to have projections to the spinal cord in the monkey (Biber et al., 1978) where a similar field exists (Luppino et al., 1991) and a role in signal-triggered, target acquisition movements (Shima et al., 1991).

Braak's work was performed with 1 mm thick pigment (lipofuscin) preparations that have unique laminar patterns of staining. These can now be converted to current laminar profiles based on immunohistochemical reactions as shown below. The gigantopyramidal field is now termed area 24d (Matelli et al., 1991; see also cingulate cortex review in The Human Nervous System, 3rd ed.).



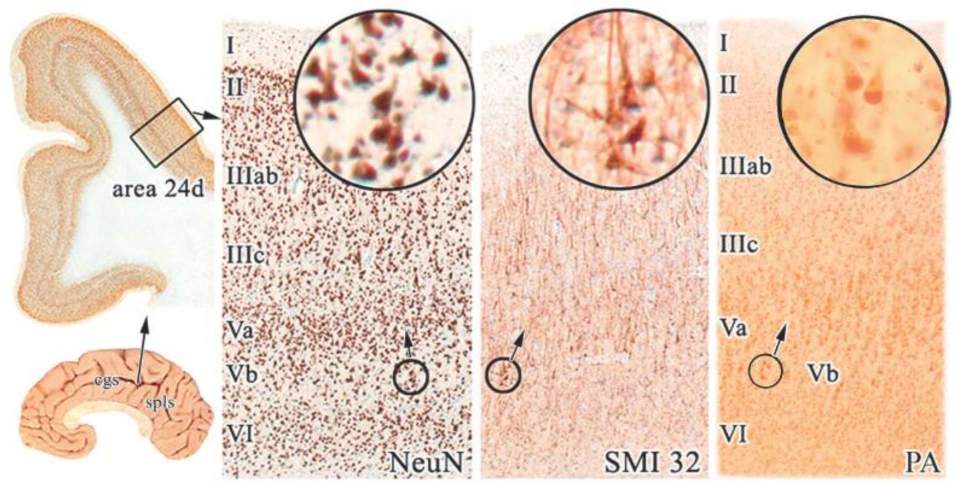


FIGURE 25.13 Overview of area 24d that contains part of the caudal cingulate premotor area in three preparations including pigment architecture (PA; kindly provided by Heiko Braak at Ulm University, Ulm, Germany). Betz neurons in layer Vb clusters magnified ×5.5.

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