

This Weeks Citation Classic

Moruzzi G & Magoun H W. Brain stem reticular formation and activation of the EEG. *Electroencephalogr. Clin. Neuro.* 1:455-73, 1949. [Dept. Anatomy, Northwestern University Medical School, Evanston, IL]

Stimulation of the brain stem reticular formation evokes generalized desynchronization of the EEG, simulating the arousal reaction of sensory stimuli. The electrocortical arousal is mediated by an ascending system, which is still active after mid-brain interruption of the classical sensory paths. [The SCI[®] indicates that this paper has been cited over 840 times since 1961.]

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"In 1948, a visiting professorship supported by the Rockefeller Foundation brought one of us (CM.) to Chicago and prompted our collaboration. The scientific background of the original project^{1,3} may be found in works started during World War II: 1) demonstration of an inhibitory reticulospinal system,⁴ involved in the paleocerebellar control of posture and movements;^{1,2} 2) prolonged abolition by paleocerebellar stimulation of the clonic twitches elicited in the chloralosed cat by local strychninization of the motor cortex, an observation suggesting the existence of an ascending inhibitory influence.⁵ We started from the working hypothesis that ascending reticular pathways might explain the paleocerebellar effects on the motor cortex. Our approach was a study on the effects of fastigial and bulboreticular stimulations on the electrical activity of the motor cortex of the chloralosed cat,

before and after local strychnine. Both conceptually and technically we were concerned with a simple problem, and our hope to reach a conclusion within a short time appeared justified. But the results were unexpected¹³ and only at the end of the academic year was our work completed.

"The first experiment was made in December 1948. The EEG of the motor cortex became completely flat during stimulation of the inhibitory bulboreticular formation. By recording from other cortical areas we realized in the same day that the hasty statement written at the beginning of our protocol book ('activity of the motor cortex completely inhibited') gave a distorted picture of the reality. However, a few other experiments on unanesthetized *encéphale isolé* preparations were necessary in order to realize that the well-known phenomenon of the EEG arousal could be reproduced by reticular stimulation. In the next months the physiological significance of the *ascending reticular system* became clear. Our work was mainly concerned with parallel investigations on the phasic aspect of the arousal phenomenon, but it was realized that 'a steady background of less intense activity within this cephalically directed brain stem system' might contribute to the maintenance of the waking state. The first results of reticular lesions were reported by Lindsley, Bowden, and Magoun⁶ in the same issue of the journal.

"The concept of structures responsible for the control of the general *level* of cerebral activities led to new approaches and views in several fields of the neurosciences: *neurophysiology* (mechanisms of EEG arousal and of the orienting reaction; levels of central activity during attentive and relaxed wakefulness, drowsiness, and sleep; and sleep-waking cycle); *neuropharmacology* (barbital narcosis); and *clinical neurology* (coma following midbrain lesions). The predicted ascending reticular pathways were found in neuroanatomical investigations. This convergence of scientific interests and several interdisciplinary symposia on the ascending reticular system may explain why the original paper was highly cited. A more recent review has been prepared by Hobson and Brazier."⁷

1. **Magoun H W.** The role of research institutes in the advancement of neuroscience: Ranson's Institute of Neurology, 1928-1942. (Worden F G, Swazey J P & Adelman G, eds.) *The neurosciences: paths of discovery*. Cambridge, MA: MIT Press, 1975. p. 515-27.
2. **Dell P C.** Creative dialogues: discovery, invention, and understanding in sleep-wakefulness research. (Worden F G, Swazey J P & Adelman G, eds.) *The neurosciences: paths of discovery*. Cambridge, MA: MIT Press, 1975. p. 549-68.
3. **Moruzzi G.** Le développement des connaissances sur l'organisation et les fonctions de la substance réticulaire. *J. Physiol. Paris* 70:681-93. 1975.
4. **Snider R S, McCulloch W S & Magoun H W.** A cerebello-bulbo-reticular pathway for suppression. *J. Neurophysiology* 12:325-34. 1949.
5. **Moruzzi G.** Sui rapporti fra cervelletto e corteccia cerebrale. III. Meccanismi e localizzazione delle azioni inibitrici e denamogene del cervelletto. *Arch. Fisiol.* 41:183-205. 1941.
6. **Lindsley D B, Bowden J & Magoun H W.** Effect upon the EEG of acute injury to the brain stem activating system. *Electroencephalogr. Clin. Neuro.* 1:475-86, 1949.
7. **Hobson I A & Brazier M A B,** eds. *The reticular formation revisited*. New York: Raven Press, 1980. 564 p.