Mesial Cerebral Incision*

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Clinical observations relate lesions of the brain stem to alterations in awareness. When the lesion extends into the third ventricle, it may be associated with amnestic confusion and confabulation, or a peculiar state called akinetic mutism. Pontine hemorrhages and hemorrhages in the posterior fossa have been clearly correlated with profound (but sometimes reversible) alterations in awareness. From such clinical observations, Jefferson summarized the areas of the human brain in which lesions may produce stupor. As shown in Fig. 1, these areas are mesial or paramesial and related to the brain stem as defined by Herrick. According to Jefferson's interpretation, the relevant clinical phenomena depend on different degrees of de-afferentation at different levels. This is essentially the same view as Magoun presented in discussion of Cairns' celebrated case of akinetic mutism. He surmised that the epidermoid cyst interfered with reticular influences directed cephalically as well as caudally.

Both interpretations are, of course, based on the extensive and expanding body of experimental data which associates arousal with the ascending reticular activating system. Originally, Moruzzi and Magoun reported that the process of arousal depended on an excitation of the central brain stem and then elaborated the responsible mechanisms. Lindsley et al. demonstrated that a cat whose classical sensory afferents were sectioned bilaterally, in mesencephalic tegmentum, was wakeful and had a normal electrogram. Whereas bilateral section (at the same level) which spared the classical sensory afferents but destroyed the reticular pathways caused somnolence and corresponding changes in the electrogram. Dempsey and Morison first reported a rostral counterpart of the ascending reticular activating system which was called the diffuse thalamic projection system. Jasper and Droogleever-Fortuyn enlarged its description and correlated pathological activity (in this system) with the profound alterations in awareness which characterize petit mal epilepsy. In another experimental-clinical correlation, Peterson et al. produced a syndrome in cats similar to akinetic mutism by making lesions in the caudal hypothalamus, midbrain tegmentum, and peri-aqueductal gray substance.

All of the physiological reports imply that the arousal systems are bilateral as well as diffuse in action. Ramón y Cajal and Scheibel and Scheibel described axons of the systems that cross the midline, thus providing some anatomical evidence for bilateral function.

The central integrating capability and the bilateral action of these systems has been emphasized by Penfield. From a thorough correlation of experimental data with wide

![Fig. 69. A and B are the posterior and anterior "critical points" for production of stupor.](image)

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obvious.

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"Hegemony of the hemispheres." The disparate hemispheres seem capable of a considerable autonomy in learning and presumably in independent regulation of sensory input. These findings can be reconciled with the centrencephalic concept because of previous clinical information on effects of callosal section and the exclusion of essential mesial structures from the experimental section. Sperry has excluded the floor of third ventricle, most of the mesencephalon, and all of the pons and medulla from incision. Moreover, some clinical observations indicate that callosal section does not interfere with awareness, while others show a clear relationship between stupor and lesions of the third ventricle or pontine structures. Presumably, the central integrating system can still exercise its bilateral prerogatives from the safety of the remaining brain stem despite severance of other hemispheral connections.

However, Adametz has shown that staged destruction of the rostral reticular formation, in some cases involving the peri-aqueductal gray, is compatible with the survival of conscious and seemingly normal cats. The akinetic mutism so often described with lesions in this area was seen only when equivalent lesions were made acutely in one stage. Mutism was noted when the lesions involved peri-aqueductal gray, but this was not associated with akinesis if reticular formation had been destroyed in several stages. Although Adametz was concerned primarily with a comparison of the effects of an acute lesion with a staged lesion at one transverse level of the rostral brain stem, his work suggests also that disturbances of consciousness are not an inevitable consequence of lesions in this area.

Perhaps median incision in the floor of the third ventricle, pons, and medulla would interfere with awareness. Such incision might divide the arousal systems and (with full

![Fig. 1. Reproduced from Penfield (1973, p. 7).](image1)

Clinical observation, he derived the term centrencephalic system. This denominates the neurone circuits which must unite the two hemispheres within the higher brain stem (Fig. 2). Of this term, he said: 18 "Those parts and circuits within the brain stem which may be shown to serve the purposes of inter-relationship of the cortical grey matter of the two hemispheres may be defined as the centrencephalic system and only those." Moreover, he also said that, "associative connections confined to each hemisphere could not alone serve the requirements of sensory organization."

At first sight, Sperry's "split-brain preparations" seem almost paradoxical or even contradictory to the concept of a centrencephalic system. In these mesial cerebral (and cerebellar) incisions, he separated major hemispheral connections in monkeys (Fig. 3). Afterwards, these animals did not suffer any obvious impairment of awareness, although subtle testing indicated what Sperry called a "hegemony of the hemispheres." The disparate hemispheres seem capable of a considerable autonomy in learning and presumably in independent regulation of sensory input. These findings can be reconciled with the centrencephalic concept because of previous clinical information on effects of callosal section and the exclusion of essential mesial structures from the experimental section. Sperry has excluded the floor of third ventricle, most of the mesencephalon, and all of the pons and medulla from incision. Moreover, some clinical observations indicate that callosal section does not interfere with awareness, while others show a clear relationship between stupor and lesions of the third ventricle or pontine structures. Presumably, the central integrating system can still exercise its bilateral prerogatives from the safety of the remaining brain stem despite severance of other hemispheral connections.

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