13004 P

Positive Potentials Recorded from the Superior Colliculus.*

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A needle electrode thrust into an active nerve pathway may so kill nerve fibers in its vicinity that one obtains an effective dead-end lead, with a positive potential. When 2 electrodes are effectively on opposite sides of a region of synapses, the endings of fibers at synapses act similarly. In the superior colliculus of the cat one regularly finds that a probe electrode thrust downward encounters a shallow negative post-synaptic potential, following stimuli to the optic nerve, then a deeper positive potential, usually of considerably higher voltage. Records obtained as the electrode is withdrawn may show, on the other hand, a reversal of the initial upper negativity, giving a positive spike at any level. The potentials encountered in the colliculus may be explained by conventional physiological considerations without the inference of a relative positivity at an active region of a tissue.

From the central region of synapses with optic tract fibers, in the colliculus, pathways radiate out in several directions. In the extreme case, of fibers conducting in all directions from a center, one can consider as an element the cone whose base is a small surface area, subtending a solid angle at the center. Since in the symmetrical case activity in elements adjacent to this will prevent current from flowing across the boundary of such a cone, it may be considered as if insulated in air, and for a small surface area, this element approaches a linearly arranged nerve fiber bundle. The critical feature of the solid figure to be retained is that the shunting material between the fibers will increase, and the resistance decrease, as the square of the distance from the center.

The potential distribution along the surface of such an element will be triphasic, and the positive phase toward the center will be of higher amplitude, because less shunted, than the peripheral positivity. From electrodes placed at the center and at the periphery, therefore, an overall central positivity will be recorded, the more so as the peripheral electrode will usually be at some distance from the ends of active fibers.

The negative spike recorded peripherally will be increasingly

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shunted, and therefore decrease in recorded amplitude, as the electrode is moved away from the central synaptic region, and the transition from negative to positive phases should be correspondingly abrupt at the central ends of the conducting elements.

Plots of spike potential amplitude downward through the colliculus correspond to this scheme, with the qualification that the distribution of fibers required to account for the results is more hemispherical than spherical, and relatively few elements conduct perpendicularly downwards. Due to the "shading" of the central positive region by the peripheral negative hemisphere, any peripheral reference point tends to be relatively negative, and since the reversal point is merely the point isoelectric with the reference electrode, the configuration of the conducting system is a factor in determining the level of reversal and the positive and negative amplitudes. In the periphery of the colliculus only negative spikes are encountered at any depth. On withdrawing the electrode the deep positivity may be little changed, when the surface negativity is reduced or completely reversed due to local injury of fibers along the needle shaft. (Fig. 1.)

The post-synaptic fibers of the cat colliculus are apparently largely non-myelinated, and part of the second phase following the spike potential is presumably an after-potential, reversing with depth for the same reason as the spike reverses. Part is also, however, assignable to successive neurones, so situated in the lower levels of

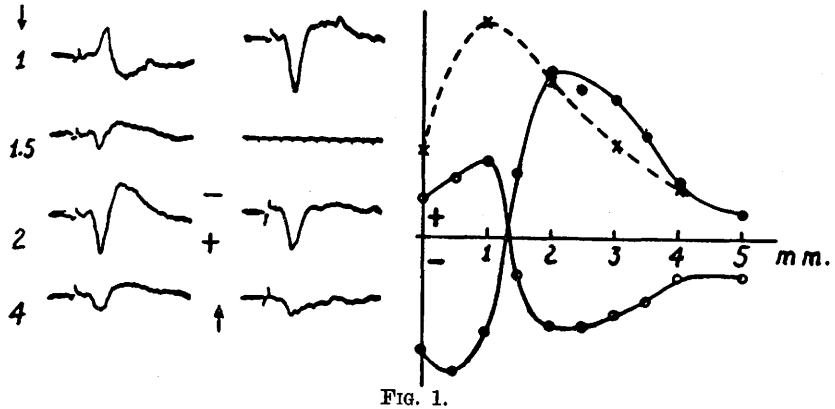

FIG. 1.

Left column, records of colliculus from surface downward to depths indicated, reference electrode in medial geniculate. Right, records from the same depths as needle is withdrawn, all spikes positive. Time 5 msec. intervals. Graph, solid circles, spike amplitude against distance from surface; hollow circles, second phase amplitude; crosses, spike amplitude as needle is withdrawn. Maximal D.C. stimuli to optic nerve in socket. Cat, nembutal 0.25 cc/kg.

the colliculus as to occasion a late negativity there, and a corresponding positivity at upper levels. This will explain certain records of an apparent second-phase potential greater in amplitude than the first phase. Furthermore in the rabbit, where an earlier potential is assignable to larger fibers, at a specific level deep in the colliculus the apparent second phase is replaced by a series of spikes, as occurs in Therman's[1] record from the medulla.

It is obvious that the positive spike may be affected by all activity radiating out from the central region, while the negative spike can be considered to have two components, one the potential assignable to the field in general, like the positive spike, and one assignable to the specific fibers with which the electrode is in contact. If the latter are injured, this component may be reversed in sign, and the record is the algebraic sum of the two components. A corresponding injury in the region of positive potential will, however, affect but a small fraction of the elements responsible for the positivity, with a resulting disparity of positive and negative amplitudes. The reversal may, therefore, occur at any depth, depending on the position of synapses, the degree of injury, and the geometry of the conducting system as a whole.

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Water and Electrolyte Metabolism in Diabetes Insipidus.

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In view of the fragmentary information concerning the salt and water metabolism in diabetes insipidus,[1] the following data on the serum protein, water, sodium, potassium and chloride and the urinary output of these elements on known intake in a case of severe but uncomplicated diabetes insipidus may be of interest. The patient was an unmarried Chinese woman of 20 with a history of the disease for 3 years. Various investigations including X-ray of the skull and blood Wassermann reaction gave no clue as to the etiology of the condition. On a regimen of full hospital diet and fluids as desired, her water intake and urine output amounted to 16 liters

[1] Therman, P. E., *J. Neurophysiol.*, 1941, **4**, 153.

[1] Talbott, J. H., Coombs, F. S., Consolazio, W. V., and Pecora, L. J., *Arch. Int. Med.*, 1940, **66**, 607.