

## XXI. NEUROPHYSIOLOGY\*

W. S. McCulloch  
A. M. Andrew

B. Howland  
J. Y. Lettvin

W. H. Pitts  
P. D. Wall

Since January we have begun using micro-bipolar electrodes. These are two filaments of platinum wire, 0.0004 inch in diameter, drawn out in a coat of glass 0.0004 inch (or less) in thickness, with a 0.0003-inch layer of glass between them. The tip, as usual, is ground to a point of less than 0.00004 inch, one wire forming a cone at the tip, the other coming off eccentrically. At frequencies higher than about 5 kc/sec the resistance of the spinal cord substance is the major component in the impedance between the wires and is substantially constant. Thus it is possible to make an effective constant current stimulator for pulses of 0.2-msec duration to be delivered through these probes.

Stimulation through the microelectrodes proved to be extremely local. Indeed, the resolution was sufficiently good that we were able to separate the intramedullary paths and terminations of different groups of afferents by recording the antidromic volleys in peripheral nerve. This anatomical resolution quite rivals that obtained by silver stains, which take many months to make, as opposed to the few hours required for a stimulation map. The method is applicable to almost any region where afferents and efferents can be distinguished.

Last year we developed the hypothesis that an impulse passing into a constricted region of an axon suffers decrement; into an expanded region suffers none. Supporting evidence was found in the experiment which showed that the interaction block between dorsal root afferents within the cord only acted on orthodromic impulses from root to dorsal column and not on those from column to root. If similar rules applied to the fine collaterals we could use the microelectrodes to determine changes in excitability of different parts of the arbor in response to a conditioning volley along other fibers. So, we recorded out on the roots and peripheral nerve the time course of change in threshold of collaterals from both active and passive fibers after a conditioning volley in one dorsal root. These maps of the time course were made at many points within a transverse plane through the stimulated side of the cord. The results are too complicated for a quarterly report, but we can now specify the place and polarity of some of the events that generate the dorsal root potentials and the orthodromic interaction between afferents.

In addition to these two major sets of experiments, the anatomical maps and the interaction maps, we have made some other studies. One is of great interest to other laboratories which use strychnine to determine direct connections between regions of the brain. We now have fairly good evidence that the strychnine spike is also propagated

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\*This work was supported in part by the Bell Telephone Laboratories, Incorporated; in part by the Teagle Foundation.

antidromically along afferents supplying a strychninized region. We showed this by painting nuclei gracilis and cuneatus with the alkaloid and finding that the local strychnine spike was accompanied by a volley in the dorsal columns and out the dorsal roots. Another piece of work concerns the curious action of a little known alkaloid, gelsemicine; it was carried out in collaboration with Dr. Aldo Truant at Tufts. This drug is a brain-stem analeptic and seems to be a strong analgesic.

Mr. A. M. Andrew, a visiting student from Scotland, has begun work on the caudad connections of the superior colliculus in frogs. He has also completed an EEG phase analyzer to discover relations between movements and the phase of different EEG frequencies. The initial instrument was designed by Mr. R. M. Lerner of this Laboratory. The final apparatus will be used by Dr. M. Bender, Bellevue Hospital, N. Y. Certain weak correlations were found between eye movements and the alpha rhythm of the occipital pole.

We have designed and built a four-channel electronic switch operating at 100 kc/sec and a sampling and integrating device to increase the signal-noise ratio in some of our more delicate experiments.