

5. This report is adapted from a thesis submitted in partial fulfillment of the requirements for an M.S. degree in physiology. This work was supported by a U.S. Public Health Service post-sophomore medical school fellowship (PX-117-3) and by grants to R. W. Doty from the Foundation Fund for Research in Psychiatry and from the National Institute of Neurological Diseases and Blindness (B-1068).

8 September 1959

## Inhibition of Central Auditory Response

**Abstract.** Suitable electrical stimulation of the region of the decussation of the olivocochlear bundles, which supply efferent innervation to the organ of Corti, was found to abolish the response of the auditory cortex to a click, without changing the responses ( $N_1$  and  $N_2$ ) of the eighth nerve in cats. At higher stimulation values the eighth nerve responses also were abolished, and at intermediate stimulus values responses at the medial geniculate and inferior colliculus were suppressed.

Inhibitory pathways of the nervous system have been much studied in recent years. In the auditory field, Rasmussen (1) found efferent fibers (the olivocochlear bundle) to the peripheral organ, and Galambos (2) reported that under certain conditions stimulation of these efferent fibers markedly reduces the  $N_1$  and  $N_2$  components of the changes in electrical potential that occur at the round window membrane when the ear is exposed to sound. Desmedt (3) located, in the posterior lateral part of the diencephalon, an area the stimulation of which decreased the potentials evoked in the cochlear nuclei. The experiments that are reported here demonstrate a further effect of stimulating the region of the olivocochlear bundle.

Thirty-four adult cats were anes-

thetized with Nembutal (25 mg/kg) and maintained at a light level of sedation. One animal, in addition to Nembutal, after the insertion of an endotracheal tube, was given a constant infusion of a neuromuscular blocking agent, Flaxidle, and maintained on artificial respiration. The level of the Flaxidle was such that no movement could be elicited by any means of stimulation. Potentials were recorded from the auditory cortex with a monopolar silver ball electrode, from the medial geniculate and inferior colliculus with bipolar stainless steel electrodes, and from the round window with a silver foil electrode. A stainless steel bipolar electrode with an outside diameter of not more than 2 mm was used to stimulate the region of the olivocochlear bundle. A pair of Tektronix type 122 preamplifiers and cathode ray oscilloscope were used to amplify the responses. Auditory stimuli consisted of a 0.075-msec click delivered by a crystal microphone connected to a hollow ear bar. Electrical shocks to the region of the olivocochlear bundle were generated by a Grass stimulator through a stimulus isolation unit. They were of 1 msec duration, at a repetition rate of 100/sec, and were on for a total duration of 320 msec. In all of the experiments there was a 5-msec delay between the end of the electrical stimulation and the onset of the click. At the end of each experiment the animal was sacrificed with all of the electrodes in place, and perfused with normal saline and then with 10-percent neutral formalin. All of the brains were saved for histologic examination.

A small region, 10 mm rostral from the obex on the floor of the fourth ventricle, was found which, upon stimu-

lation, would inhibit the eighth nerve response, the  $N_1$  and  $N_2$  of the round window response. This confirmed the previous work of Galambos (2). When stimuli to the region of the olivocochlear bundle which were not strong enough to inhibit the  $N_1$  and  $N_2$  were used, the cortical-evoked potential to a click was markedly suppressed or abolished (Fig. 1). Cortical suppression was accompanied in some animals by a slight reduction in the eighth nerve response and in others by no change at all in the eighth nerve response. These observations have been repeated in 34 animals. The response at the medial geniculate to a click was suppressed by shocks to the region of the olivocochlear bundle. These shocks were also accompanied by some reduction but not total suppression of the eighth nerve response. The same relationship was found for the inferior colliculus, in that it could be suppressed, but only after the  $N_1$  and  $N_2$  were somewhat diminished. The inferior colliculus in some animals was never totally suppressed until the eighth nerve response was abolished.

In all of the experiments the region which gave the maximal central inhibition was identical with that which gave the maximal suppression of the eighth nerve response. Stimulation of the olivocochlear region did not suppress a response in the somatic cortex to single shock of a cutaneous nerve. The neuromuscular blocking agent was found to have no effect upon the suppression.

The question arises as to whether or not some structure other than the olivocochlear bundle is also being stimulated. If the central suppression is due to the olivocochlear bundle, the possibilities are that it may have other central connections, that there may be an antidromic effect, or that there may be certain key fibers in the eighth nerve essential for a cortical-evoked potential which are being selectively inhibited (4).

ROBERT J. RUBEN  
JAN SEKULA\*

Department of Otolaryngology,  
Johns Hopkins University School of  
Medicine, Baltimore, Maryland

### References and Notes

1. G. L. Rasmussen, *J. Comp. Neurol.* **84**, 141 (1946).
2. R. Galambos, *J. Neurophysiol.* **19**, 424 (1956).
3. J. E. Desmedt and K. Mechelse, *Proc. Soc. Exptl. Biol. Med.* **90**, 772 (1959).
4. This work has been supported by grants from the Alfred P. Sloan Foundation and the National Institute of Neurological Diseases and Blindness.

\* Fellow of the Rockefeller Foundation. Permanent address: Medical Academy, Cracow, Poland.

8 August 1959

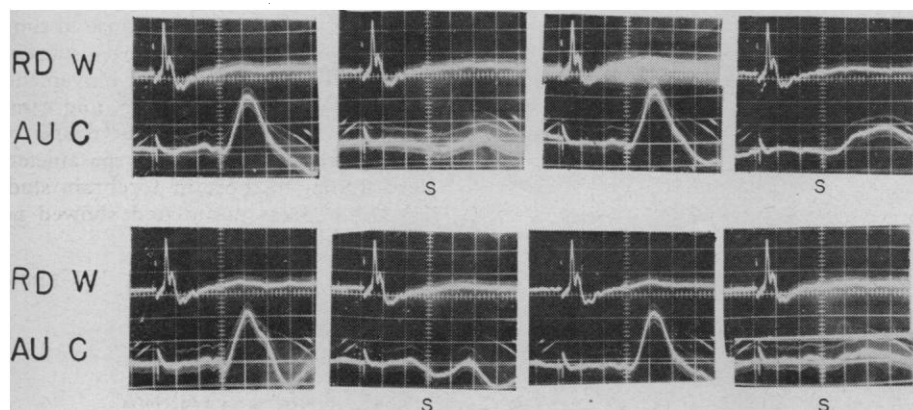


Fig. 1. Cat No. 62. Eight consecutive responses at the round window (RD W) and the auditory cortex (AU C) to a click. S indicates that the region of the olivocochlear bundle was stimulated with a series of shocks at 4 volts in the manner described in the text, before the click was presented. Note the suppression of the cortical response without any change in the round window response. One large division vertically is 5  $\mu$ v and horizontally is 5 msec.