phosphate. There is a good correlation between titres of neutralizing antibodies determined in tissue cultures and titres determined in the elution test using 39 antisera from persons vaccinated with *LSc*, *2ab* in Germany, summer 1962.

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[1] Woods, W. A., and Robbins, Fr. C., *Proc. U.S. Nat. Acad. Sci.*, **47**, 1501 (1961).
[2] Thomssen, R., Maass, G., and Haas, R., *Z. Hyg. Infekt.-Kr.*, **148**, 14 (1961).
[3] Thomssen, R., and Maass, G., *Z. Hyg. Infekt.-Kr.*, **148**, 466 (1962).
[4] Levintow, L., and Darnell, J. E., *J. Biol. Chem.*, **235**, 70 (1960).
[5] Thomssen, R., *Z. f. Naturfg.* (in preparation).

PSYCHOLOGY

Chronic Implantation of Electrodes into the Olfactory Bulb

A precise method of chronic implantation of large electrodes into brain structures is to locate the generator of a signal and then to place the electrodes in a manner which will record the maximum electrical activity. Freeman[1] has developed such a method for implanting into the prepyriform cortex utilizing the electrical field produced in this area by electrical activation of the lateral olfactory tract. This method was adapted for chronically implanting bipolar electrodes into the olfactory bulb of cats.

A monopolar monitoring electrode, No. 32 stainless steel wire, was implanted into the vicinity of the prepyriform cortex using standard Horsely–Clarke stereotaxic co-ordinates (*A*17, *L*5, *V*–2). A bipolar stimulating electrode was lowered into the brain (co-ordinates approximately *A*24, *L*5) until it was possible with this electrode to evoke electrically in the prepyriform cortex a potential which was evident on the monopolar monitoring electrode. The appearance of this potential indicated the activation of lateral olfactory tract fibres[1].

Stimulation of the lateral olfactory tract also produced an evoked potential in the bulb. The prominent features of this potential were a surface negative wave (peak latency 4–8 msec) followed by a slower positive wave (peak latency 20–25 msec) with maximum amplitudes at the anterior portions of the bulb. This potential could be recorded anywhere from the outer surface of the bulb, and was accompanied by an internally recordable potential of opposite polarity. The electrical field of the bulb can be considered in terms of a dipole layer with one pole on the outer surface of the bulb and the other located within[2]. The evoked potential can be used to define this electrical field for orientation of the electrodes with respect to field potentials.

To implant into the olfactory bulb, the frontal sinus ipsilateral to the stimulating electrode was opened and small holes were drilled through the bone overlying the olfactory bulb. Bipolar electrodes (usually two) with a tip separation of approximately 2·0 mm were angled forward and down into the bulb. To minimize neural damage at the recording site, the electrodes were directed toward anterior ventral areas of the bulb. A bipolar electrode was advanced into the bulb until the zero isopotential of the evoked potential was straddled with the tips in opposite poles. The zero isopotential has been shown to lie in the vicinity of the mitral cell layer[3,4].

Following recovery from the operation, two spontaneous wave-forms were observed. A slow surface negative wave corresponding to that reported by Ottoson[5] was recorded during inspiration. Also prominent were bursts of sinusoidal waves of approximately 40 c.p.s. similar to those reported by Adrian[6], Hernández-Péon *et al*,[7], and others. The spatial distribution of the activity within the bursts was similar to that of the evoked potential. That the generator or generators of both were straddled is evidenced by the monopolar records in Fig. 1 in which approximate mirror-image potentials are seen.

By implanting electrodes with an evoked potential for orientation the electrodes are optimally placed within the electrical field of the brain structure, and one records primarily locally generated spontaneous electrical signals. The investigator can take full advantage of the differential amplification techniques available. Since the monopolarly recorded signals are largely 180° out of phase, the use of a difference amplifier permits vectorial addition of the two signals to a respectable amplitude as well as the rejection of common mode activity. Olfactory bulb spontaneous activity recorded in this manner is ordinarily greater than 1 mV peak to peak. Signals of almost 5 mV were recorded on occasion from one animal.

Monopolarly and bipolarly recorded signals from such preparations are at present being used to examine wave activity at different parts of the bulb and to compare olfactory bulb activity with the electrical activity of the prepyriform cortex.

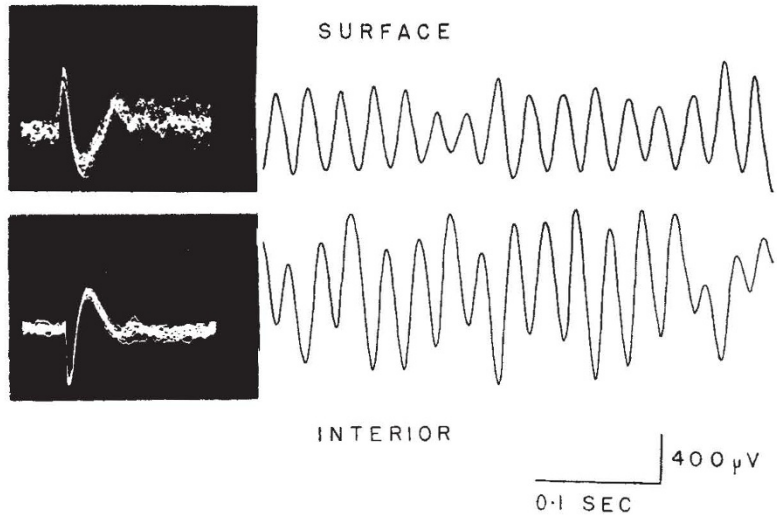

Fig. 1. Monopolar recordings from the leads of a bipolar electrode in the olfactory bulb of the cat. Left, 10 superimposed oscilloscopic tracings of the evoked potential used for implantation. Right, recordings of the spontaneous bursting activity from the same leads after recovery from the operation. Calibration for spontaneous activity only

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[1] Freeman, W. J., *J. Neurophysiol.*, **22**, 644 (1959).
[2] Boudreau, J. C., and Freeman, W. J., *Nature*, **193**, 782 (1962).
[3] Orrego, F., *Arch. Ital. Biol.*, **99**, 446 (1961).
[4] Von Baumgarten, R., Green, J. D., and Mancia, M., *Electroenceph. Clin. Neurophysiol.*, **14**, 621 (1962).
[5] Ottoson, D., *Acta Physiol. Scand.*, **47**, 136 (1959).
[6] Adrian, E. D., *Electroenceph. Clin. Neurophysiol.*, **2**, 377 (1950).
[7] Hernández-Péon, R., Lavin, A., Alcocer-Cuarón, C., and Marcelin, J. P., *Electroenceph. Clin. Neurophysiol.*, **12**, 41 (1960).