# NEUROPHYSIOLOGICAL INVESTIGATIONS IN THE COLLICULUS INFERIOR OF *RHINOLOPHUS FERRUMEQUINUM*

*by*

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The horseshoe-bat *Rhinolophus ferrumequinum* is the best known representative of those bats using constant frequency sounds for echolocation. Schnitzler (1968) has shown, that horseshoe-bats compensate Dopplershifts during flight by lowering the emitted constant frequency so that the heard echofrequency always remains at about 83.4 kHz. His results suggest that horseshoe-bats use the constant frequency part of their orientation sounds for detection and measuring of flight velocities by means of Doppler shifts.

The investigation reported here intends to give some clues how constant frequency echoes are processed in the main auditory centre, the colliculus inferior, and how *Rhinolophus* extracts information for orientation from these echo signals.

From 19 Nembutal-anesthetized horseshoe-bats evoked potential of the colliculus inferior were elicited by pure tones from 10 to 100 kHz. The experimental set-up closely follows that used by Grinnell (1963) for similar studies in *Myotis*. The anesthetized bat was secured to a tapered board and put in an electrically shielded chamber. The room was heated to 36-38°C. Small Silver-silver-chloride electrodes were placed on the collicular surface and the recorded potentials fed into a differential amplifier. The evoked potentials were displayed on a Tektronix 564 storage oscilloscope. By means of a square wave generator, a Wavetek oscillator and an electronic switch pure tone signals were produced with a duration of 30 msec and a rise- and falltime of 0.5 msec. The intensity of the tone stimuli was varied by an amplifier and an attenuator over a range of 110 db. The sound pressure level was monitored by a calibrated Brüel & Kjaer microphone. The condenser loudspeaker could be moved in a hemispherical plane, so that tone stimuli could be delivered from any angle within 90° above, 90° below, 90° to the right and to the left of the bat's head.

Typical evoked potentials obtained from the colliculus inferior by pure tone stimulation consist of a fast first peak followed by a more or less prominent second slower one. Auditory thresholds of the horseshoe-bat were determined in the following way: the intensity of a tone stimulus which elicited an evoked potential barely visible above the 5$\mu$V noise level was considered as the threshold intensity of a given stimulus. Intensities are measured in db (re 0.0002 dyn/cm$^2$).

First we measured the directional sensitivity of the colliculus. The bat's head was placed in the centre of the hemisphere and thresholds of the collicular evoked response were determined for 30 kHz stimuli at different stimulus angles. The result contains averaged data from 7 bats. In all cases the stimulus direction of lowest thresholds was about 30° contralateral to the recorded colliculus and 30° above horizon and the direction of highest thresholds 60° ipsilateral and 90° below horizon. The directionality increases with stimulus frequency. For 30kHz tones the average threshold difference between angles of minimal and maximal threshold is 32 db, for 60 kHz 41 db and for 83.3 kHz — the approximate heard echo frequency — 54 db. For 83.3 kHz stimuli there is a second region of low thresholds 30° ipsilateral and 30° above horizon. The steep threshold gradients in relation to stimulus direction is greatly affected by the shape and position of the pinnae. In one case the difference between the direction of lowest and highest threshold was 72 db in normal ear-position. When the pinnae of this bat are folded back completely the directional sensivity decreases from 72 db to 38 db of maximal threshold difference. Moreover the pattern of directionality is completely altered. The direction of lowest threshold shifted from 15° contralateral and 30°