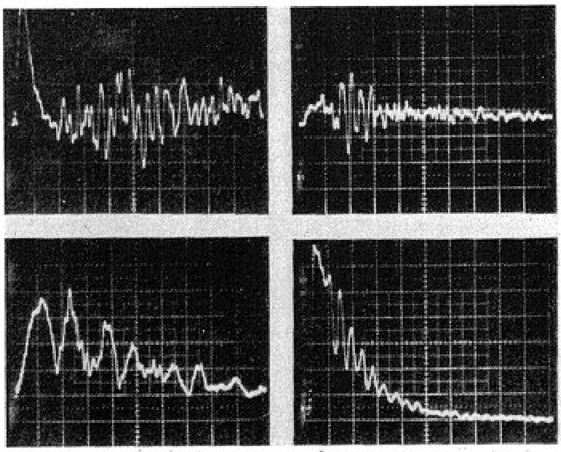

Fig. 3. Brain-implanted hydrophone responses to pulsed microwave irradiation in the cat (left) and guinea pig (right) at 5.655 GHz (top) and 2.450 GHz (bottom). Horizontal scale was 20 μs/div. Vertical scales were 20 μV/div for the cat; 100 and 200 μV/div for the guinea pig at 2.450 and 5.655 GHz, respectively.

the cat are shown in Fig. 6, where a peak in hydrophone outputs was observed at 39 kHz. Observation of the predominant mode in the cat brain vibrations induced at 2.450 GHz, as seen in Fig. 3, plainly indicates a fundamental frequency near 40 kHz, and Fig. 6 shows a fairly sharp frequency response of the brain to microwave-induced thermoelastic stimulation.

The acoustic and microwave pulse-evoked brainstem potentials in rats were similar to those previously reported by others [20].

IV. Discussion

The above results clearly indicate that pulsed microwaves induce acoustic pressure waves in the brain, thus confirming earlier theoretical predictions.

The applicator-applied 2.450 GHz pluses resulted in a distinct vibration at 39 kHz, as shown by the "tuning curve" (Fig. 6) response obtained in the pulse-burst irradiations. A fundamental brain mode near this frequency was expected on the basis of previous theoretical work [1] and from experimental data obtained in the study of microwave-induced cochlear microphonics [6].

More information as to the nature of the hydrophone signals was available from the rat experiments, where on-line spectral analysis was employed. As seen in Figs. 4 and 5, the hydrophone output signals resembled those recorded from the cat and guinea pig, and the accompanying spectrum of each recording shows a rich harmonic content consisting of many modes of vibration. That the records of the various subjects were not identical was not surprising because the transducer radiation pattern was not omnidirectional, and precise positioning of the device in terms of stereotaxic position and disk orientation was not attempted in these initial experiments. The shorter, 5.655 GHz pulses appeared to stimulate more high-frequency modes than did the 5–6 μs wide pulses at 2.450 GHz. The persistent vibrational mode near 60 kHz is attributed to the fundamental radial oscillation of the brain, and it is close to that theoretically predicted [1], [16]. The higher frequency modes also were expected to be naturally

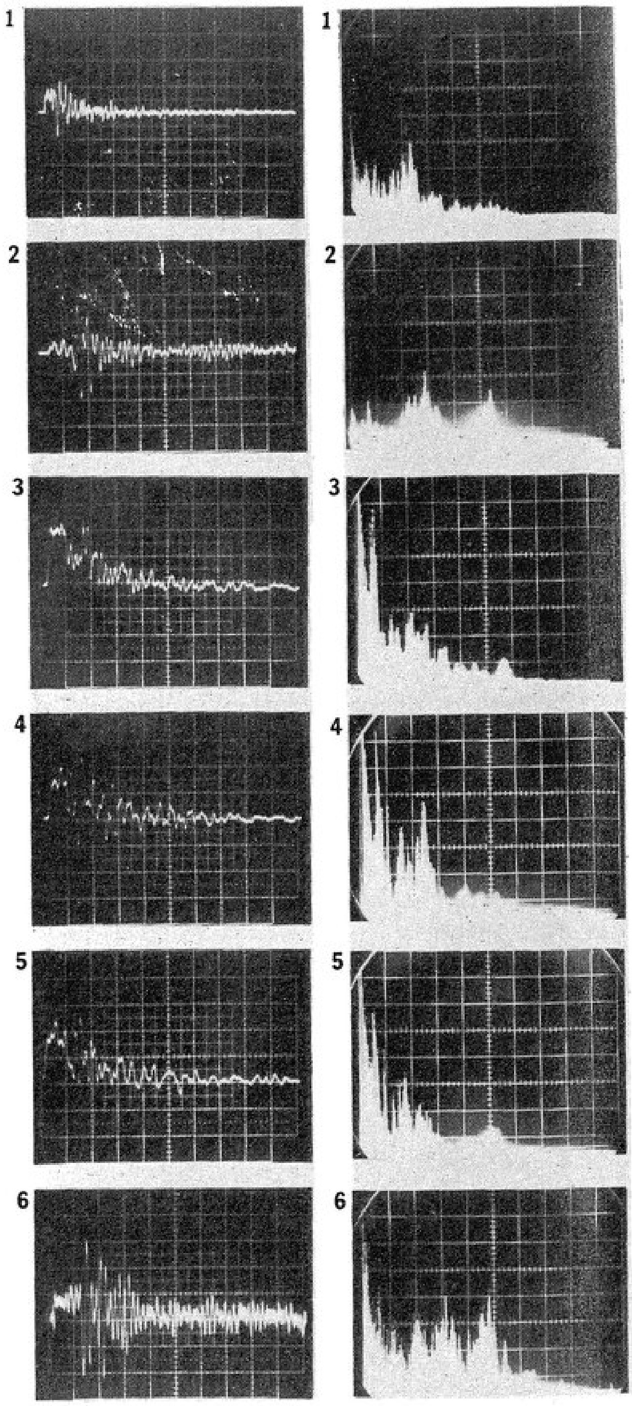

Fig. 4. Hydrophone response waveforms (left) and spectra (right) for six rats irradiated with pulsed 5.655 GHz. The spectral traces used a linear vertical display of 0.1 V/div, a center frequency of 500 kHz with a dispersion of 100 kHz/div. Vertical scales for the hydrophone waveforms were 100 μV/div for rats 4, 5, and 6, 500 μV/div for rats 2 and 3, 200 μV/div for rat 3. Horizontal scale factor for the hydrophone waveforms was 10 μs/div except for rat 1, which was 20 μs/div.

stimulated by the impinging microwaves [1], [16]. It should be mentioned that the theoretically predicted frequencies are independent of heating patterns, and that they are functions only of the propagation velocity of pressure waves and size of the head.

While the second harmonics near 100 kHz were nearly identical to the 102 kHz predicted by the thermoelastic theory [1], [16], the hydrophone outputs consist of higher order