Dr. Mudnick, Rough-on-Rats Rudnick, etc.

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Abstract: Professor Rudnick’s contributions to biology, geology, archeology and good housekeeping are reviewed.

INTRODUCTION

Other talks in this session have focused on Professor Rudnick’s contributions to physical acoustics through long-range research efforts. In his fifty-year career as a physicist and an acoustician, there have been many other investigations which were short-term, but interesting, sometimes important, and usually amusing. Some of the research presented in this talk resulted in publications and others have only been preserved by “oral histories.”

CLEAN LAUNDRY, SONIC SURGERY, AND JET NOISE: THE PENN STATE ERA

Throughout the history of science, the development of a new tool usually gives rise to new discoveries and new applications. This was certainly the case with the high-power siren developed by Allen and Rudnick (1). Since the siren was at Penn State, a Land Grant College, two applications were tested immediately: pest control and cleaner clothes. Because of the general interest level of the subjects, both lead to wide-spread press coverage and to subsequent JASA publications that “set the record straight.”

In the paper entitled “Sonic Laundering” (2), a pan of soap and water was placed above the siren. The measurements showed that a 60 minute sonic treatment gave “whiter whites” than three “excellent commercial laundries, all using good but different washing formulas in fifty washes . . . totaling 3,000 to 3,500 minutes with fifty changes of soap and water.” The fact that sonic techniques were never popular with housewives might be explained by the next series of measurements.

By 1950, there was already a considerable literature on the biological effects of intense liquid-borne (but not airborne) sounds. In a series of experiments (3,4) which might have enflamed animal rights activists today, the lethality of high-amplitude airborne sound was measured for mice and insects. Exposure to sound levels between 160 and 165 dB SPL killed white mice within a minute. The cause of death was determined, by both “internal and external” thermocouples, to be heating. Being a careful experimentalist, the “heat death” hypothesis was confirmed by shaving mice to remove their fur which was heated rapidly by the absorption of high-intensity sound. The bald mice lasted two-and-a-half minutes. Mosquitoes, blow flies and meal worms were dead in seconds and the post mortem examination reports on these and other insects cited assorted a variety of horrible consequences: “loss of many body scales, some legs,” “wings badly shattered,” “hairs twisted and bent,” etc.

Once the wire-service reporters got hold of this, it became distorted to the point that Rudnick was world-famous for having invented a method of ultrasonic surgery (5). When he returned from the ASA meeting where his results were reported, he was deluged with fan mail and telegrams. One letter was from a distinguished surgeon in Mexico City who asked if he might bring a sick boy to State College for emergency surgery.

Based on his newly established expertise in the area of the biological effects of high-intensity sound, he was asked by the U. S. Navy to measure the sound levels on the flight decks of aircraft carriers. The Navy was worried that the introduction of jet aircraft to the crowded decks could cause significant hearing damage. Izzy’s measurements confirmed this hypothesis, but the sailors were unwilling to wear hearing protectors because they felt it conflicted with their macho image. Apparently, Izzy was as good a psychologist as he was a biologist, because he wrote an article for the ship’s newspaper pointing out that, in addition to hearing loss, high-intensity sound exposure was also suspected to cause impotence. The next day, it was observed that all of the crew on the flight deck were wearing hearing protectors (presumably on their heads).
THE U. C. L. A. ERA

Although not as popular as his biological experiments, Izzy's measurements of the acoustic absorption of sand and soil with varying amounts of water (6) did earn him the title around campus of "Professor Mudnick." Apparently, this research from the late-1940's was influential well into the 1980's. When Philip Brownell was designing the series of experiments which established that scorpions locate prey by sound propagated through sand (7), he visited Izzy's lab to get transducers and instruction on their use.

One of the joys of being a member of Izzy's research group during the 1970's was the fact that his fame was well established and therefore his lab was visited frequently by people seeking his advice in a wide variety of acoustical matters. When such a visitor would arrive, it was his policy to invite any of his graduate students who were around at the time to join him and his visitor in his office to discuss the visitor's problem. One such visitor was Daniel Stat. He collected Peruvian bottles which, when blown, produced a loud (=100 dB SPL) high-frequency (1-4 kHz) sound.

Stat arrived at Izzy's office with about a dozen of these bottles in two suitcases, some from as early as 500 B.C. He wanted to know how the whistles worked and why he experienced the strange sensation of a fluctuating low-frequency tone when two or more of the whistles were blown simultaneously. Although Stat was amazed by the fact that Izzy could provide both answers instantly, the students were not surprised. Based on the size and frequency, the whistle had to be a Helmholtz resonator. The low-frequency note was an effect produced by the nonlinearity of the ear's response known for two centuries as "Tartini tones" (8).

After the initial consultation, Izzy made his laboratory and instrumentation available for carefully controlled quantitative measurements of the spectra of seventy-three samples of the Peruvian archeological treasures. Although the measurements yielded interesting results which demonstrated that the whistle frequencies were strongly correlated with the cultures that produced the bottles, that those frequencies were in a band where human hearing was most sensitive, and that the "standard" archeological interpretation of the bottle's whistle as an "amusing way to vent the liquid" was probably incorrect (9),

The press once again, was able to sensationalize the discovery by focusing on the bottles' alleged ability to induce altered states of consciousness (a phrase which was popular in the 1970's). In addition to stories in the science sections of The Los Angeles Times (10) and the New York Times (11), the story also ran in the National Enquirer (12) with the headline "Researcher Unlocks Ancient Secret ... Centuries-Old Indian Bottles Were Made to Induce Trances - & They Work."

The debate surrounding the Peruvian whistling bottles will probably never be settled, but Izzy Rudnick's ability to induce "altered states of consciousness" is well established. He taught his students by example and this summary should establish him as a shining example of an acoustician who was willing to apply his knowledge to a limitless variety of problems.

REFERENCES

8. Tartini, G., Trattato di Musica, Padua (1754).