Laboratory of Environmental Biophysics:
Summary Statement
by James R. Fouts

The Laboratory of Environmental Biophysics is primarily concerned with the biological effects of physical factors present in our environment. At the present time, the efforts of the Branch are focussed primarily in two main areas, namely nonionizing radiation (microwaves) and noise (including both auditory and nonauditory effects).

Nonionizing Radiation

The objectives of the nonionizing radiation research program are as follows: (1) to develop microwave exposure systems for bioeffects research; (2) to develop and test techniques for measuring microwave energy absorption; (3) to determine the effect of microwaves on isolated nerve preparations; (4) to determine how 2450 MHz microwave radiation interacts with biological systems at all levels; (5) to study the effect of long-term exposure of experimental animals to 915 MHz and 2450 MHz microwave radiation on their CNS and behavior; (6) to ascertain the effect of 60 Hz fields from high voltage transmission lines on the CNS of mammals.

During the past year a waveguide system for exposing isolated nerves to microwave radiation has been fabricated and tested. In addition, a 2450-MHz absorber-lined horn system has been modified to permit exposure of pregnant mice. Equipment has also been built to measure the colonic temperature of mice during microwave exposure. Studies on the biological effects of 2450 MHz radiation on a variety of in vitro systems has failed to reveal any significant changes in the irradiated systems other than those that could be directly attributable to heating. However, a small decrease in fertility was observed when male quail that had been exposed in ovo to microwaves were mated with either control or exposed females.

One of the most important areas in nonionizing radiation research is the effect of prolonged low level exposure to microwaves. The long-term effects of the exposure of rats to 915 MHz and 2450 MHz is currently the subject of investigation by two contractors. Preliminary results suggest that exposure of pregnant rats to 915 MHz radiation does not alter the relative numbers of viable offspring and stillborns. Studies on the long-term effects of microwave exposure on the CNS and behavior of rats are still ongoing. The effect of long-term exposure of rats to 60 Hz fields is the subject of a third contract.

Noise

Much of the effort in the noise program is directed towards a better understanding of both the physiology of the inner ear and the basic transduction mechanism whereby sound is converted into electrical nerve impulses. Such basic studies are necessary before the effects of auditory and chemical insults on the hearing process can be understood.

Areas under current investigation include (1) the role of electrolyte composition and flux on the function of the guinea pig cochlea, (2) the development of an optical fiber motion detector for auditory system measurements, (3) the development of electrophysiological techniques to recover speech from the cochleas of live, anesthetized guinea pigs, (4) the effect of noise and ototoxic agents (e.g., methylmercury) on the electrolyte metabolism of the cochlea, (5) the effect of ototoxic insult on the coding of complex signals in the auditory system, and (6) the development of an impact noise generator for hearing loss studies.

In order to understand the basic mechanisms of electrolyte transport in the guinea pig cochlea, the flux of K+, Na+, and Cl- from the perilymph to endolymph has been studied using isotopic tech-
niques. The endolymph actively takes up $K^+$ and extrudes $Na^+$. Ouabain and anoxia both suppress this active transport. While chloride normally diffuses passively from perilymph to endolymph, anoxia decreases the uptake of $Cl^-$ by the endolymph. The effect of exposure to intense noise on the cochlea electrolyte levels is currently under investigation. Methylmercury, a known ototoxic agent, causes suppression of the cochlea and microphonic potential while the endolymphatic potential remains unchanged.

Work has continued on the development of an optical fiber motion detector for measurement of the ossicular chain at displacement levels (1–100Å) corresponding to normal sound levels (40–80 dB SPL). Such a system would permit reliable measurement of the motion of the basilar membrane. Experiments with speech recovered from the inner ears of anesthetized guinea pigs indicate that signals imparted by normal acoustic methods or via direct activation with piezoelectric transducers are more easily discriminated by listener panels than speech that is processed through hearing aids. Efforts to use a minicomputer to determine the auditory response to speech and speechlike signals, including pseudorandom noise, have been hampered by delays in obtaining key computer hardware. Finally, work has begun on the development of an impact noise generator for hearing loss studies.

**Personnel**

Activities of Branch personnel have been numerous and varied. Many functions are interagency involving things like opinions on criteria documents (noise and microwaves especially), review of contracts and grant proposals to other agencies, and various committees.

**Dr. Adnan Akay:** recently joined the Branch; he is presently involved in working on impact noise effects.

**Dr. Reginald Cook:** member, Interagency Noise Effects Panel; member, Committee of Hearing, Bioacoustics and Biomechanics of the National Research Council, National Academy of Science; member Working Group 83 on Noise Effects on the Fetus; invited lecturer, seminars on effects of noise, courses on speech, hearing and acoustical engineering, UNC and NCSU.

**Dr. Teruzo Konishi:** member of Technical Committee, Physiophysiological Section, Acoustical Society of America.

**Dr. Donald McRee:** Adjunct appointment, NCSU; Coordinator, US-USSR Cooperative Program on Health Effects of Non-ionizing Radiation; NIEHS representative on Interdepartmental Radiation Advisory Committee (IRAC) on Biological Effects of Nonionizing Radiation; Chairman of Scientific Information Exchange Working Group; representative for DHEW on Interagency Advisory Committee on Electric Field Effects from High Voltage Transmission Lines (organized by ERDA); representative on American-National Standards Institute C-95 Committee on Safety Standards of Non-ionizing Radiation.