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Betty J. Evans
BETTY J. EVANS
Historian

APPROVED.

FOR THE COMMANDANT:

[illegible]
MAJOR, USAF (MSC)
Director of Administrative
Services

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acclimatization to altitude; development of physiologic instrumentation and recording devices for in-flight and orbital physiologic measurements on both animals and man; basic studies on carbon dioxide removal and recycling and collection of waste water and water vapor in closed artificial environments; comparison of the performance and physiological differences between groups of physically conditioned subjects and inactive or non-conditioned subjects; hyperventilation; prevention of dysbarism; effects of intermittent hypoxia on various enzyme systems and end products of metabolism; development of a minaturized carbon dioxide sensor; development of a hypoxia warning device; and gas photosynthetic ratio of complex green plant systems.

Radiobiology. Biomedical aspects of radiation hazards encountered in the manufacture, operation, and maintenance of atomic weapons and nuclear propulsion systems were of primary concern to the radiobiologists. Nine in-house studies were in progress in search of answers to such problems as a rapid method of assessing the extent of radiation injury in personnel exposed to nuclear radiation; effect of other stresses (fatigue, temperature extremes, noise, hypoxia, etc.) on human reaction to ionizing radiation; training and life-support requirements of experimental animals (monkeys) used as passengers in space capsules; development of a standardized radiation dosimetric technique; biological effects of different types of radiation; biological effects of cosmic rays; effects of ionizing radiation on mental and physical performance efficiency; determination of long-term results of total body irradiation; establishment of permissible levels of exposure for personnel involved

with nuclear powered aircraft, rockets, or satellites.

To supplement the in-house tasks, work on the following problems was contracted out to civilian institutions: development of a drug or a compound to protect humans against radiation damage; effect of radiation on neutron and glial cells of the central nervous system; results of total body irradiation on humans; and effects of repeated low dose exposure to ionizing radiation on animal reaction to subsequent larger doses of gamma radiation.

A radiology section was established within the department on 3 August for the purpose of rendering diagnostic x-ray and fluoroscopy service as required in the SAM research and consultation activities. While at Randolph radiology work was accomplished through the base hospital x-ray facilities and SAM requirements had to be integrated into the clinical workload of the hospital. The Brooks radiology section, equipped to take, process, and catalogue x-ray films, was created solely for SAM support purposes, including such studies as monitoring the pulmonary condition of chamber operators, pre- and post-experiment x-ray records on test subjects, and complete radiology work-ups necessary in evaluating questions concerning flying status for consultation patients. Most of the workload consisted of consultation cases. Col. Gerrit Hekhuis, USAF, MC, chief of Radiobiology, did the fluoroscopy examinations, read the x-ray films, and wrote the laboratory reports. During its first seven weeks operation, 207 patients were examined.[12]

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12. Radiology Section Activity Report, 21 Sep 59, in files Dept Radiobiology.

USAF Radiobiology Laboratory, Austin, Texas. In addition to its Brooks laboratories, the Department of Radiobiology operated the USAF Radiobiology Laboratory, established in Austin, Texas, in 1950, as a joint undertaking with the University of Texas. The Radiobiology in-house program was divided between its two separate facilities.

Research at the Austin Laboratory, uninterrputed by the Brooks move, progressed in the areas of chemical protection against ionizing radiation, radiological physics, chronic irradiation effects, and behavior and performance of irradiated animals.

The monkey breeding colony, begun in the spring of 1957, to produce uniformly healthy, American born animals, was increased after initial experiences indicated such an undertaking was practicable. Foreign sources for procurement of Macaca rhesus monkeys (particularly India) were periodically uncertain due to the influence of religious groups who attached a sacred significance to monkeys and objected to their use as experimental animals. It was particularly important, therefore, to use American born animals in experiments likely to attract wide publicity, such as those connected with missile or satellite life-support systems. A good nucleus of native born monkeys had been produced and the veterinarians hoped that, through selective mating, ultimately an improved breed of experimental animal could be evolved.[13]

An improvement in animal handling technique was made at the Austin veterinary medicine section with the design and construction of a new

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13. Semi-Annual Progress Report of The Radiobiological Laboratory of the University of Texas and the USAF, Austin, Texas, 1 April-30 September 1959, p. 126-128, in files Department of Radiobiology.

"metabolism chair." Biomedical study of monkeys, both normal and sick, was complicated by the strugglings of alarmed animals. Sedation was not practical because it altered or interfered with the measurements sought. Certain studies were not possible when only manual restraint by veterinary personnel was employed, and restraint boards available were cumbersome and generally unsatisfactory. For the previous eighteen months the laboratory staff worked on the design of an animal restraint chair to simplify handling and collection of samples. From several models constructed and tested a satisfactory chair was developed. Although the entire staff contributed to the project, Capt. Donald B. Gisler, chief of the Veterinary Medical Group, and E. M. Robinson coordinated the work and perfected the final design.

Constructed of aluminum and fiber glass, the chair was equipped with a loose nylon restraint harness and recepticles for collecting fecal and urine samples. Tests revealed the animals readily adapted to the chair, appeared comfortable and alert but comparatively docile for protracted periods of time. The chest and heart were easily accessible for examination, excretory samples were free of contamination by food and debris, and body areas ordinarily used for injection or blood sampling were readily accessible. Both animal and chair could be maintained in a hygienic and sanitary condition--this latter a particular improvement over caging a sick animal. It was anticipated this device would lead to more valid and reproducible data and would make possible a more comprehensive study of radiation effects. Undoubtedly as the chair was put into regular use, additional modifications and adjustments

would become necessary, especially for periods of protracted restraint. However, the laboratory staff felt very pleased with the innovation and felt it had excellent possibilities.[14]

A clinical microbiology laboratory was organized, staffed, and equipped at the Austin facility. The advantages of such a service were many. Previously many animals (some irreplacable in long-term experiments) were lost to disease entities which might have been controlled by proper therapy had a laboratory diagnosis been possible. Better medical evaluation of animals selected as experimental subjects was possible by the use of a variety of clinical tests, as well as more thorough post-mortem studies. Clinical methods for animal study could be patterned after those used in man in order to more easily extrapolate such data to man.[15]

Toxicology. A Department of Toxicology was organized during this period with the primary function of exploring chemical and morphological alterations in mammalian tissues and fluids that are associated with the handling and employment of potentially toxic chemicals and their combustion products. Dr. Vernon Montgomery was appointed chief of this department and reported for duty on 1 September. He began to equip the laboratory and plan an outline of research for this activity.

SPACE MEDICINE DIVISION

The four departments of this division were still not fully staffed, and plans were being made to enlarge both the staff and program as soon

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14. Ibid., p. 9-13.
15. Ibid., p. 13-14.