Meetings

Instrumentation for Biomedical Sciences

Scientific instrumentation as applied in medical and biological research, surgery, and patient care was the main theme of the 1st National Biomedical Sciences Instrumentation Symposium of the Instrument Society of America, held in Los Angeles, 14–18 June. The meeting covered several recent and controversial areas of biomedical investigations, such as biomagnetism, fetal telemetry, clinical automation, and the use of simulators and computers in life science research and hospitals.

While the search for physiological and biological effects of magnetic and electromagnetic fields has been relatively disappointing, remarkable results on longevity of mice, growth rate, and oscillations of leukocyte count have been observed. Some explanation of field effects may be found in an alteration of immunological mechanisms separately studied. Another promising approach to biomagnetism appears to be at the molecular level and within the realm of quantum chemistry. Further arguments were offered relative to the unique para-diamagnetic metastable equilibria observed in cellular enzyme systems which contain metal and whose course of reaction can thus be influenced by external fields. Proper instrumentation for obtaining meaningful results in all such field effect studies was vividly demonstrated in the description of a research project for detecting and monitoring the effects on biological tissue and gross animals of low and high intensity electromagnetic fields. In these cases, the isolation from effects of corollary heating becomes important. Physiological effects in reproducible sequence have been observed on live, waking monkeys subjected to radiation at radio frequency. The experiments have also definitely established the influence of field exposure on the animals' electroencephalogram. These results tie in well with observations by others on the stimulation effects of microwave radiation on certain peripheral nerves of the sympathetic nervous system. From Ireland and Canada came reports on practical uses made in agriculture of the effects of magnetic fields—even the geomagnetic field—in accelerating the germination and growth of seedlings. Especially in Canada, with its long winters, controlled speeding up of spring and winter wheat is of great economic importance.

As in previous years, cardiographic instrumentation was a major topic of discussion. An ultrasonic doppler shift blood flowmeter was presented, which measures the doppler shift in frequency occurring when sound is scattered in moving blood. In vitro, the meter output was linear with respect to volume flow. In vivo, comparison of the doppler flowmeter with the pulsed ultrasonic flowmeter produced similar wave forms of flow through the abdominal aorta in continuous animal implants. Another development was documented by photographic records of oscillographic echograms produced by normal and diseased mitral valve function. Here, an ultrasonic scanning apparatus permits nondestructive observation of heart valve action, both pre- and postoperatively, without risk of injury to the patient.

Instrumentation was described for monitoring critical, vital functions of seriously ill persons through a constant-flow arteriovenous shunt (for T, pH, pO_2, and pCO_2). Also important is a method developed for the monitoring of the sugar content of blood in man.

Considerable debate has centered in recent months on computational procedures for handling cardiovascular analogue data, with particular emphasis on the electrocardiogram. Averaging techniques for elimination of noise in the electrocardiogram and impedance plethysmogram yielded, in their resultant shape, an improvement of the original signal. Various statistical and analytical computer methods were reviewed which may be used for the evaluation of the electrocardiogram, though difficulties because of the smallness of initial samples and the number of variables to be considered were repeatedly stressed. Problems and obstacles also exist in automation of electrophysiologic data, data reduction, and data identification, particularly in relation to continuity and consistency. While strides are being made in overcoming these difficulties, they do prevent immediate widespread medical utilization of otherwise advanced computer developments.

Detection and correlation of the fetal and maternal heart rate proved to be a topic of lively controversy, dramatically heightened by the juxtaposition of two papers on telemetric detection. Both described similar methods of monitoring and EKG representation, but were strongly divided on the issue of its clinical value.

One believed that many more years of experience with improved equipment will be required before the fetal cardiogram and observed heart rate can be properly interpreted and thus properly used by the clinician. He will have to await the development of adequate data acquisition and reduction systems and the comparison of such data with subsequent growth and development of the infant. The other paper ended with the conclusion that in view of the excellent fidelity of newer instruments, fetal cardiography is practical today, and urged the increased use of the fetal electrocardiogram. Transoceanic transmission of the fetal electrocardiogram between Milwaukee and Paris in the spring of 1963 was described and compared to earlier tests involving FM telephone transmissions in late 1961, and long-distance transmissions from Fort Wayne to Milwaukee in 1962. A paper strictly oriented to research reported on computer simulation of fetal-maternal EKG signals in order to study typical noise patterns. A search for optimal analytic parameters is the aim of this simulation project.

It is interesting, in this connection, to note the variety of simulation applications to life science research. Simulation of interspike intervals in various nerve-firing patterns lends itself readily to computer analysis. A wide range of observed nerve activity can be adequately described by such simu-

lation. In another example, computer simulation has been applied to human handwriting. Reading and understanding speech were found closely related to the physiology of handwriting. Equivalent current generators have been found to simulate successfully the heart as current source.

Of particular—and from a humane standpoint urgent—interest is a development ultimately meant to make the blind man's fingers "see." An electronic environment sensor transduces optical information into types of sensory information accessible to a blind person, such as pressure outputs which can be fed to the pressure receptors of the human hand as the person moves around.

No biomedical instrumentation symposium in our time could possibly ignore outer space. Applications to space travel and outer space research were presented in many of the sessions, culminating in a program solely devoted to bioinstrumentation in the aerospace age. The status of the art of monitoring chimpanzee and man during space travel was surveyed and included a system for measuring effects of environmental variables on physiological stress. Even though man has made successful space flights, it is still important to conduct further research on both man and animal in their orbital flights.

An instrumentation system using implanted arterial and venous catheters obtains cardiac output, arterial and venous blood pressure, blood protein, and electrocardiograms. Other projects are devoted to the environment of outer space and the environment of the space capsule. A photometric scanning and telemetering device, though still in the developmental stage, has shown wide application in the realms of exobiology and telemetered biomedical responses. Potentially, it could become a valuable tool for man on interplanetary missions and similar explorations of long duration. The paucity of knowledge of major and trace gases inside the manned space vehicle points to an area urgently awaiting further concentrated efforts by the biomedical engineer. This important life support aspect might well determine the duration of the space mission and also, if not adequately monitored, cause the mission to be aborted. Conventional laboratory instrumentation employing gas chromatography, optical absorption, or mass spectrometry offers some potential.

Numerous modifications, however, must be made in the transition from laboratory to space qualified hardware.

Still on telemetering of physiological data of humans in flight—though much closer to earth than outer space—one paper dealt with parachute jumping. Interesting results were obtained from a telemetry system using RF transmission techniques. Head accelerations, for instance, were +6 to +8 G vertically, +9.6 to −9.6 G laterally, and +3.8 to −12 G horizontally; heart rate, 180 prior to jump, decreased to 156 during free fall, returned to 180 at ground impact. Similar variation in breathing rate was 40 to 55 to 48 breaths per minute.

A session on spectroscopy showed the variety of research programs for which one single method can be successfully used. Of immediate medical interest is the infrared determination of protein structure and its application to the clinical analysis of calculi and gallstones.

Advantages, problems, and different methods of automation in hospitals and medical laboratories were noted. The presentations surveyed excellently current developments throughout the country and showed examples of effective uses of automation.

Other new developments covered at the meeting included new methods of monitoring air pollution, and its effect on human health and plant life; the great strides in automation and data processing in clinical pathology, pathologic anatomy, and clinical chemistry (a punch card system in operation was described and illustrated for the latter application); and finally, the impressive developments and the impatiently hoped for progress in the field of artificial organs. Scientists are still working on artificial intracorporeal hearts (32 hours in a live dog are now reported) and on improving the artificial kidney (by bacteria removal through filtering), and have developed an artificial "gastrointestinal pacemaker" whose use in the treatment of paralytic ileus was reported successful in over 60 patients.

After a review of some of the recent advances of the biomedical instrumentation engineer, this man himself and his problems were considered. Three sessions were devoted to questions of how to educate him and how to put him to work. It was also noted that two more schools, Wake Forest College and the University of Florida, have joined the number of those which are offering now, or planning for future

addition, curricula in interdisciplinary biomedical engineering education.

On the question of organizing effective engineering support to life science research and hospitals, it became apparent that the concept of centralized engineering facilities, rather than the reliance on individual engineers assigned to individual research projects, is slowly proving its value and gaining ever increasing recognition. Pioneered years ago for the intramural research program of the National Institutes of Health, the centralization system has been adopted recently by several other research organizations. Central support facilities represented at the symposium —among speakers and audience—included such newcomers as the Eastern and Western Research Support Centers of the Veterans Administration, the engineering center at the Bowman Gray School of Medicine, and the new Center for Computer Technology under the auspices of the Massachusetts Institute of Technology. The operation of two other biomedical engineering support centers at the University of Oregon and the University of California was described.

The meeting was sponsored by the Instrument Society of America with three cooperating societies—American Society of Clinical Pathology, National Society for Medical Research, and Society for Applied Spectroscopy. The full text of the papers will be published in book form by Plenum Press, New York City.

Appreciation of the help of the following in summarizing the contents of the 20 sessions and over 80 papers is noted: H. S. Dordick, C. D. Ferris, R. Jonnard, R. I. Larsen, L. L. May, H. V. Pipberger, J. C. Roberts, G. H. Sullivan, T. B. Weber, and G. Z. Williams.

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Cell Division and Cancer

The hypothesis that cancer involves an abnormality in the control of cell division was the major theme at an international symposium on the control of cell division and the induction of cancer held 1–7 July at Lima, Peru, and Cali, Colombia.

The organizers brought two groups of individuals together, those interested in the control of cell division, and those interested in the induction of