Meetings

Radioisotope Scanning

Medical isotopic scanning was the topic for a second symposium on this subject sponsored by the International Atomic Energy Agency in Athens, Greece, 20–24 April 1964. Approximately 162 invited participants from 26 countries and 5 international organizations attended.

When Cassen (Los Angeles) reported in 1951 the feasibility of area scanning in diagnostic medicine, he used a calcium tungstate crystal as the scintillation detector because sodium iodide crystals were not widely available. Since then the field has progressed diversely into theory, instrumentation, choice of labels and compounds, sites and organs scanned, and applications to large numbers of patients. As yet little unanimity exists. The conference was sparked by lively disputes which compared various approaches to the problem. The ultimate goal of obtaining a scan of high resolution and reliability with a low radiation exposure to the patient seems still in the future. No system reported at the meeting demonstrated the idealized objectives—the procedure should be brief, painless, and inexpensive; the instrument should be invariably accurate; technical aspects of the procedure should be simple and rapidly accomplished; and the medical interpretation of the data should be dependable.

Theory was described in detail for various scanning systems; it was clear that innovators will be obliged to keep in mind information-theory concepts. The dilemma between maximum sensitivity and maximum resolution continued to be a plaguing problem; distinguishing small lesions spatially is lost at the price of greater sensitivity.

Refinements of detectors, collimators, and display systems were reported at length. Moving detectors, which till now have had the widest clinical acceptance, continue to evolve with larger crystals and flexibility in collimators. An ingenious development by Kuhl (Philadelphia) employed two opposed detectors on a yoke to perform cylindrical and section scans. This idea is based on the multiple view, stereo, and tomographic methods that are well established in radiography for the separation of overlapping images. Static display systems also showed significant promise. The two main types were demonstrated in the scintillation camera of Anger (Berkeley) and the autofluoroscope of Bender (Buffalo). Both record concurrently the information from the entire field of view. The digital autofluoroscope now under development was acknowledged to be complex and expensive but to have potentially a higher resolution.

Much attention was devoted to the problems of data display and readout of the scan system. In the short interval since the publication of the *Proceedings of the 1962 Symposium on Medical Scanning*, surprising progress has occurred. Contrast enhancement systems have grown in several directions. Several esthetically pleasing methods of coding the counting rate by an array of colors are well worked out. Digital methods which were reported for improved visual interpretation included the scheme of Bascheiri (Rome) to examine the interval between pulses and select electronically a wider variety of dot patterns than have been used generally. Support was strong for the accumulation of data by numerical means directly on paper or tape and then analyzed by isocount plots or computers. It appears that the physician's fond desire for an immediately available pretty scan picture will not block permanently this approach to data processing.

Instrument development also showed the impact of increasing use of the low-energy gamma emitters. The advantages of higher counting efficiency and lightweight shielding were acknowledged even by those now unable to use these newer isotopes. Hence, there was promise in the plan of Ter Pergossian (St. Louis) to develop an x-ray amplifier type of camera, equipped with a input screen thicker than is normally used. The value of the low-energy gamma emitters was emphasized with proof of their clinical usefulness. Particularly impressive was Tc^{99m}; a list of its favorable attributes was reported by Harper (Chicago). In certain circumstances, other low-energy isotopes such as I^{125} and Hg^{197} were shown to be clinically valuable. Sodee (Cleveland) visualized with Hg^{197} Neohydrin not only brain tumors, but a wide variety of other primary and metastatic neoplasms.

The choice of isotopes and test compounds has widened, and it is in discovery of new localizing compounds that greatest hope for further progress seems to lie. Among several, Se^{75} methionine has been synthesized and used successfully for pancreatic visualization by Blau (Buffalo). Biochemists should be encouraged by these studies to produce new gamma-emitting analogues of amino acids and other compounds (antibodies, colloids, dyes, complexing agents, precursors) that will differentially concentrate in specific tissues. Taplin (Los Angeles) reported further progress with the use of aggregates of radioalbumin. Visualization of areas of regional pulmonary ischemia is now possible with this material. Wagner (Baltimore) used it to detect pulmonary embolization in a significant series of patients. This scanning procedure, using standard equipment, is an alternative method to the use of radioactive gases.

Remarkably, the sessions on clinical results failed to include any papers on the thyroid, though for several years it was the only scannable organ. Most earlier instruments were designed to seek thyroid lesions, and one observer even suggested that this early effort actually inhibited progress in other sites. This stenosis has obviously been passed. Successful scans were shown of lesions in the brain, lung, liver, kidney, spleen, pancreas, bone, lymph nodes, bone marrow, and soft tissues. Not all these sites were studied with equal success, and some of the procedures reported will probably never be used in the routine management of patients. It is certain, however, that scanning is no longer a technical stunt, but a technique affording information on a wide variety of organs and diseases. Scans can aid

in the interpretation of roentgenograms, and in decisions concerning surgical and medical therapy.

The conference showed that radioisotope scanning has evolved into a biomedical research tool that can be tailored for diverse kinetic studies in man and animals. The profile scans by Pochin (London) showed the fate of injected radiothyronines and demonstrated that useful quantitative information on the distribution and turnover of labeled metabolites is readily obtained by such methods.

An important byproduct of the meeting was the appointment of a task force committee to develop for the International Commission of Radiation Units (ICRU) standard terminology and definitions for scanning. The committee, consisting of W. J. MacIntyre (Cleveland), S. Fedoruk (Saskatoon), C. C. Harris (Oak Ridge), D. Kuhl (Philadelphia), and J. Mallard (London), will also develop standard phantoms for scanning research and calibration.

All the papers will be published as soon as possible by the International Atomic Energy Agency.

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Human Factors in Electronics

The challenge of interdisciplinary technology was the theme of the 5th national symposium on Human Factors in Electronics, held in San Diego, California, 5–6 May 1964. The welcoming address was given by Sam Ackerman (General Dynamics/Astronautics) who represented J. R. Dempsey (president, GD/A). Their plea for cooperative endeavors among scientists and engineers emphasized the application in the applied areas with respect to the national defense posture and the efficient utilization of our human resources. The keynote address was delivered by Lt. Col. Billie McIntosh who represented E. Konecci (Office of Advanced Research and Technology, NASA). McIntosh stressed the interdisciplinary roots of cybernetics and its application of space hardware to systems engineering. He stated the need for the coupling of research with system design to ensure continued vigor and freshness in the former and continued progress in the latter. He pointed out the key problem in cybernetics is to first understand what the human brain really is and what it actually does. He also stressed the necessity for added analysis to reduce the costs of testing, increased use of information by improved retrieval methods, and emphasis on mathematical formulations of functional relationships between variables. McIntosh concluded by making a strong plea for a "crusade" attack on the real problems. He proposed devising a cost effectiveness yardstick for research, and an interdisciplinary approach to systems engineering that will result in cross-fertilized solutions to the understanding of man, his capabilities, and limitations, thus arriving at methods for calculating and measuring human reliability in advanced aerospace systems.

Don Flickinger stressed the importance of crew safety considerations in human factors tradeoffs with other design requirements, and the need for better astronaut selection criteria than past performance on stressful jobs. Flickinger also prognosticated that there would probably be no manned commercial space vehicle system within the lifetime of any of his audience.

The work of Warren S. McCulloch epitomizes the benefits to be derived from interdisciplinary teamwork. McCulloch described recent work at M.I.T. in neuroanatomy, physical modeling of the nervous system by electronics, mathematical theory-construction, and the processing of information by the nervous system (especially of the reticular formation of the central nervous system and spinal cord). He emphasized that the limiting factor in psychiatry and psychology was the lack of a suitable calculus or logic to describe what specific functions permit long-duration taus or time-delays in the feedback circuits and cybernetic nets so basic to complex performance.

Immediately following his interesting talk, McCulloch chaired a round-table state-of-the-arts session that included Larry Fogel, Ward Edwards, H. Zierhut, F. A. Muckler, and R. O. Besco. They described recent trends and accomplishments, current problems, and criticisms of work in the fields of bionics and artificial intelligence, psychotechnology, industrial design, control system research, and manual controls, respectively. Besco pointed out the need for a standardized nomenclature and set of dependent variables to allow human factors data to be placed on continua or at least cross-correlated and compared. He pointed out that vehicle control can be best described in terms of energy expenditure parameters. Muckler emphasized our inability to determine the microstructure of behavior, to specify mission requirements, and then to allocate functions to man and machine in an effective manner. The panel collectively emphasized the points made by the keynote address and decried the great proliferation of the trivia in the technical literature and the failure to isolate and work on the real problems that face the profession. Edwards underscored the information processing, human biases, and bandwidth problems of decision making. Zierhut begged for solutions to the practical day-to-day problems of design hardware and systems and the necessity for relying on intuition in lieu of quantitative knowledge of human performance. Fogel discussed and deplored the lack of precise terminology and operational definition in the theory/modeling/simulating subareas of human factors, usually designated as bionics and artificial intelligence. A lively discussion between the panel and audience followed the formal presentation that considered the question of cultural restraints involved with social engineering—how can the scientist help a backward society become prepared to accept and live with new technology and destructive capability. The relationships between basic and applied areas and how we can speed up the process of obtaining more useful data were also discussed during this period.

The technical sessions contained papers that ranged from basic research with no immediate application to any system to the most applied human engineering studies. The meeting was notable for the number of papers that were concerned with the use of computers and simulators either by way of data reduction, model construction, or stimulus production. This is indeed the age of automation and of the computer and this trend is obvious from the composition of the papers and discussion at this symposium. Another trend that can be discerned is the reduction in the number of tracking studies that were given at the meeting. This trend was also commented upon by Muckler at the round-table discussion. This and the servo-theory approach to human behavior is evidently losing some of its former enthusiasm which may indicate some maturity in the area of man-machine system dynamical control. Another trend might be noted,