Editorial

The primary motivation for undertaking the considerable task of serving as Guest Editor of this Special Issue stems from the strong conviction that we absolutely must know more about the subject of nonionizing electromagnetic wave interactions with biological functioning. By presenting major collections of technical papers in reputable international publications, perhaps attention can be focused on this subject, with the result being that the need for more knowledge will be further emphasized. To not vigorously pursue increased knowledge on this subject is to condemn ourselves to a future with inadequately established safety standards and incomplete realization of major medical benefits.

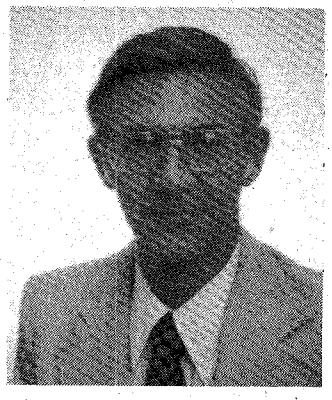
Man is continually exposed to invisible, highly complex, and constantly varying electromagnetic waves. Knowledge of this fact has existed for years, but only in the recent past have significant investigations been undertaken to define the mechanisms by which these waves influence biological functioning. This situation is perhaps related in time to the fact that we have only recently begun to understand the electrical extent and nature of many vital biological functions. As might be expected, the consequences of our expanding knowledge are many. For example, nonscientific versions of our increased understanding have been conveyed to the general public. Their reaction has been varied, and has often resulted in a highly skeptical view of all human exposure to electromagnetic waves. A typical response has been localized political actions to oppose the installation of new communications and radar systems, especially if these systems are considered esthetically undesirable. Frequently, the political actions are based on erroneous information regarding the nature and extent of biological system response to electromagnetic waves. In several cases, local political actions have been sufficient to result in the development of state-wide safety standards.

On a more positive note, the expanding knowledge of biological system and electromagnetic wave interactions has resulted in the development of medical devices useful in diagnostics and therapeutics. For example, the ability to reliably monitor heart rate and respiration has been demonstrated over a distance of approximately 30 m. Low-frequency magnetic fields are being used to augment osteogenesis. Electromagnetic systems for hyperthermic treatment of malignant tissues are undergoing clinical evaluation. Numerous other diagnostic and therapeutic devices are at various stages of planning and/or development.

In selecting manuscripts for this Special Issue, a dominant consideration was the breadth of interdisciplinary areas involved in studies of electromagnetic wave interactions with biological systems. It was not possible to thoroughly cover all engineering and biological aspects of these areas; consequently, manuscripts in key areas were selected. These areas are dosimetry, bioeffects, measurements, and medical applications of electromagnetic waves (hyperthermia and imaging). In dosimetry, there is much interest in the status of research concerned with energy deposition in models that incorporate both the thermal and the electromagnetic characteristics of biological systems. Because of this interest, an invited overview article is presented. Other dosimetry articles are concerned with specific absorption rates at different frequencies and under various grounding conditions. In the bioeffects area, there are important articles concerned with the response of biological systems to pulse-modulated fields. The measurements area provides new theoretical approaches involving aperture synthesis thermography and a thermodynamics approach to the thermoacoustic effect. Finally, the medical applications area contains informative articles concerned with microwave imaging of biological targets and the factors influencing the effectiveness of hyperthermia treatment.

The opportunity to edit this issue of the IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES is sincerely appreciated. It is hoped that this compilation of articles will both be useful to persons desiring state-of-the-knowledge information and stimulate efforts for additional investigations.

JAMES C. TOLER
Guest Editor



James C. Toler (F'81) manages the Biomedical Research Division in the Engineering Experiment Station at the Georgia Institute of Technology, Atlanta. His current research interests include the effects of biological system exposure to radiofrequency radiation, the electrical properties of biological materials, and the development of beneficial applications of electromagnetic waves in medicine and biology. He is a member of the Board of Directors of the Bioelectromagnetics Society and the IEEE Electromagnetic Compatibility Society. He also frequently reviews grant applications for government funding organizations and manuscripts for technical society publications. He has authored/coauthored 74 papers and reports. He has organized and chaired a bioeffects session for the European Electromagnetic Compatibility Symposium in Switerzland for the past several years.