The Quantum Electronics Issue*

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THIS FIRST ISSUE of the PROCEEDINGS OF THE IEEE is devoted to "Quantum Electronics." The title developed from the idea that some electronic systems such as microwave and optical masers which were best described by quantum mechanics should be called quantum electronics. Subsequently, the general fields of materials, resonators, and systems involved in masers have become generally encompassed by the term quantum electronics.

The papers contained within this volume will appeal to many different interests. The nonspecialist will find the review papers most rewarding. We are especially fortunate in having two excellent comprehensive review papers which will be helpful to those researchers just entering the optical maser field.

The paper by Drs. Yariv and Gordon is an excellent introduction to optical maser phenomena, and devotes considerable effort to expounding upon both the theoretical and experimental efforts in the field. The second review paper of paramount importance is by Prof. N. Bloembergen on the subject of nonlinear optical interactions. This paper summarizes an extensive analysis by Prof. Bloembergen and his co-workers at Harvard on the general interactions of electromagnetic waves with crystals. The practicable significance of this work lies in the problem of utilizing optical masers for communication—a problem dear to many hearts. By intelligently utilizing the nonlinear interaction equations of waves and crystals, methods of harmonic generation, frequency mixing, and optical modulation are more readily understood.

Methods of generating coherent light waves were described only four years ago (by Schawlow and Townes), and the generation of such waves has been demonstrated in a large number of ways with a large variety of materials starting about two years ago (by Maiman). However, it should be noted that the utilization of optical masers for practicable communication as of this date, has not started. There are a number of reasons why that threshold has not been crossed, and there are also a number of reasons why most investigators believe that the threshold is within our reach. It may be well to discuss these points here.

Important present sources (optical masers) of coherent light are either high power (kilowatts to megawatts) inefficient pulsed sources or low power (milliwatt) continuous sources. A considerable effort is required to provide at least medium power reasonably efficient continuous sources which are practicable. This effort is, of course, in process, and it is very likely that the problem of suitable sources will be solved within a quite short time.

The second problem for the engineer of the communication system is the development of wide-band light modulators. A number of solutions are presently proposed—a whole section of this journal (these papers follow the review by Prof. Bloembergen) is devoted to means of modulating and detecting coherent radiation. Nevertheless, it may be quite a considerable time before an optical maser communication system will be operational and practical. The present status is the most interesting time for the researcher; however the era of optical maser communication engineering is not far distant.

For those readers already in this field, both physicists and engineers, a wealth of timely research reports is contained in this issue. New materials, new systems, new modulators, new detectors, and new frequencies of operation are discussed, and the editor is happy to commend these papers to your critical evaluation.

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