

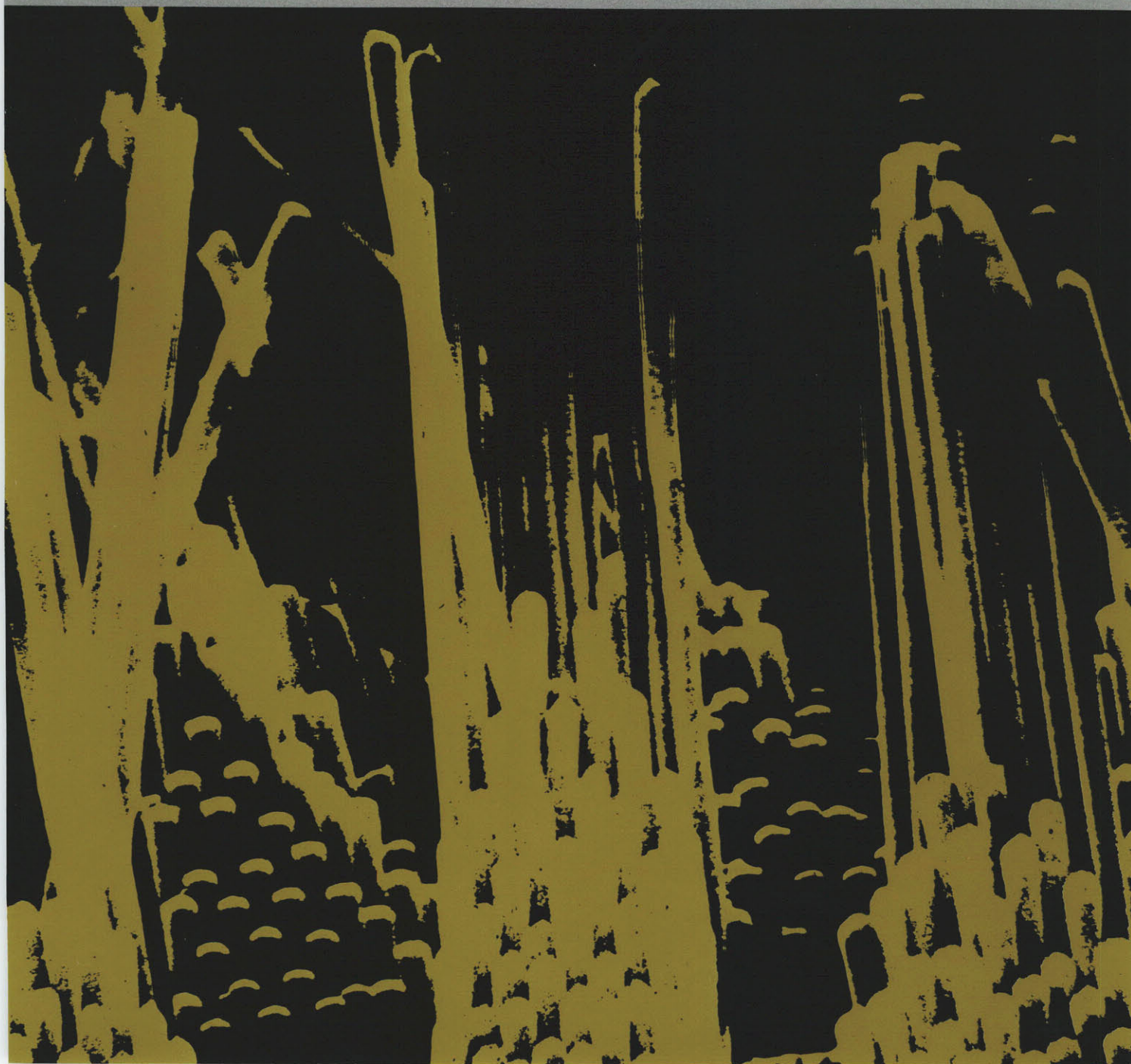
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

*The* RESEARCH LABORATORY *of* ELECTRONICS

# PROGRESS REPORT

NO. 133

JANUARY 1–DECEMBER 31, 1990





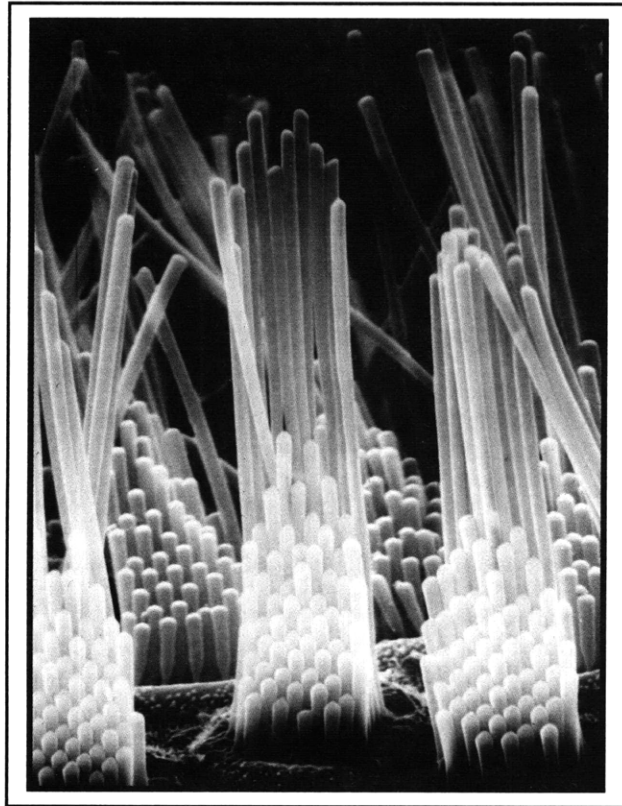
# ***RLE Progress Report***

**No. 133**

**January 1 - December 31, 1990**

Submitted by

Professor Jonathan Allen  
Professor Daniel Kleppner



**Research Laboratory of Electronics  
Massachusetts Institute of Technology  
Cambridge, Massachusetts**

## RLE Progress Report No. 133

**Cover and title page:** In 1991, we celebrate two big anniversaries—the RadLab’s 50th and RLE’s 45th. The Research Laboratory of Electronics, which was established in 1946, grew out of MIT’s wartime Radiation Laboratory (1940-45). In honor of the milestones that we are sharing this year, the cover of *RLE Progress Report No. 133* notes the rich tradition of communications research in RLE.

In the early days of RLE, former RadLab staff member Professor Jerome B. Wiesner, collaborating with Professors Yuk Wing Lee and Norbert Wiener, developed practical applications for the theory of nonlinear systems. By combining the methods and techniques of mathematicians and communication engineers, the study of communication theory in RLE was not confined to electrical systems.

As new theories of modern communication were introduced in the 1950s, they were applied to new studies of the nervous system. Professor Walter A. Rosenblith worked with Professor Norbert Wiener to apply statistical communication techniques to the field of communication biophysics. This research established quantitative relations between neuroelectric data and the characteristics of sensory stimuli.

This tradition continues today. For example, members of RLE’s Auditory Physiology Group are studying the sound-induced motions of mechanically sensitive cells (hair cells) in the inner ear, which contain microscopic hairs that vibrate when the ear is stimulated by sound. These vibrations are transduced by the hair cells to excite nerve fibers that carry the information about the sound stimulus to the brain. Shown on the cover is a scanning electron micrograph of the microscopic sensory hairs of a lizard, prepared by Dr. Ruth Anne Eatock. Approximately 60 hairs project from each sensory receptor cell, and the receptor cells are organized by length (2 to 20 microns for the cells shown) in an orderly staircase array. The mechanical properties of these sensory hairs play an important role in determining the neural code for sound.

Dr. Eatock, a former postdoctoral fellow in RLE under the direction of Professor Thomas F. Weiss, is presently an Assistant Professor in the Physiology Department at the University of Rochester.

**Our special thanks** to the following staff members of the RLE Communications Group: Mary J. Ziegler for her exceptional editing, formatting, and scanning; Mary S. Greene for proofreading and preparation of the publications and personnel chapters; and Rita C. McKinnon for her help with proofreading. We also want to thank David W. Foss, Manager of the RLE Computer Facility, for his technical assistance.

We thank the faculty, staff, and students of RLE for their generous cooperation.

Editor:	Barbara Passero
Design and Illustration:	Robert H. Priest
Photography:	John F. Cook
Printer:	DS Graphics, Pepperell, Massachusetts
Typesetting:	This report was produced with IBM’s BookMaster Software. Mylar negatives were printed on an IBM 4250-II electro-erosion printer.

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ISSN 0163-9218



# Introduction

## ***The Research Laboratory of Electronics***

The Research Laboratory of Electronics (RLE) was established in 1946 as the Institute's first interdepartmental laboratory. Originally organized under the joint sponsorship of the Departments of Physics and Electrical Engineering, RLE has broadened its interests to cover a wide range of research.

The RLE environment provides both the freedom of action essential in an academic institution and the availability of large-scale laboratory facilities and services required by researchers. RLE's interdisciplinary setting offers many opportunities for creative and collaborative research. By fostering this powerful combination of research and education, RLE effectively penetrates beyond the horizon of new ideas and information.

## ***RLE Progress Report***

*RLE Progress Report Number 133* describes research programs at RLE for the period January 1 through December 31, 1990. Each chapter of the *Progress Report* contains both a statement of research objectives and a summary of research efforts for research projects listed. Faculty, research staff, students and others who participated in these projects are identified at the beginning of each project, along with sources of funding.

There are three appendices at the end of the report: Appendix A is a bibliography of RLE publications and papers presented by RLE staff during 1989; Appendix B is a roster of current RLE staff; and Appendix C is an index of RLE sponsors. In addition, the Project Staff and Subject Index provides access to the information in this report.

*RLE Progress Report Number 133* was produced by the RLE Communications Office. Further inquiries may be addressed to:

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