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OCULAR EFFECTS OF MICROWAVE RADIATION

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INTRODUCTION

Microwave cataract is the only hazard associated with exposure to microwave radiation environments that has been documented to occur in man. Because the basic mechanisms and threshold values for human injury are not fully understood, the parameters of hazard that have been established for microwave radiation are not realistic. This has resulted in an unwarranted economic and operational burden on the military establishment. The purpose of this applied research investigation is to provide the data prerequisite for delineating the parameter of hazard on a sound biological basis.

During the past year, an increased incidence of microwave cataracts has been documented in personnel exposed to environments of radiofrequency radiation. Similar to the previously reported cases, almost all of the new cases had known exposures to field strengths above 10 milliwatts per square centimeter. The remainder had similar opportunity for such exposure. The very fact that increasing numbers of personnel are being exposed to such levels of irradiation adds a new dimension to this program.

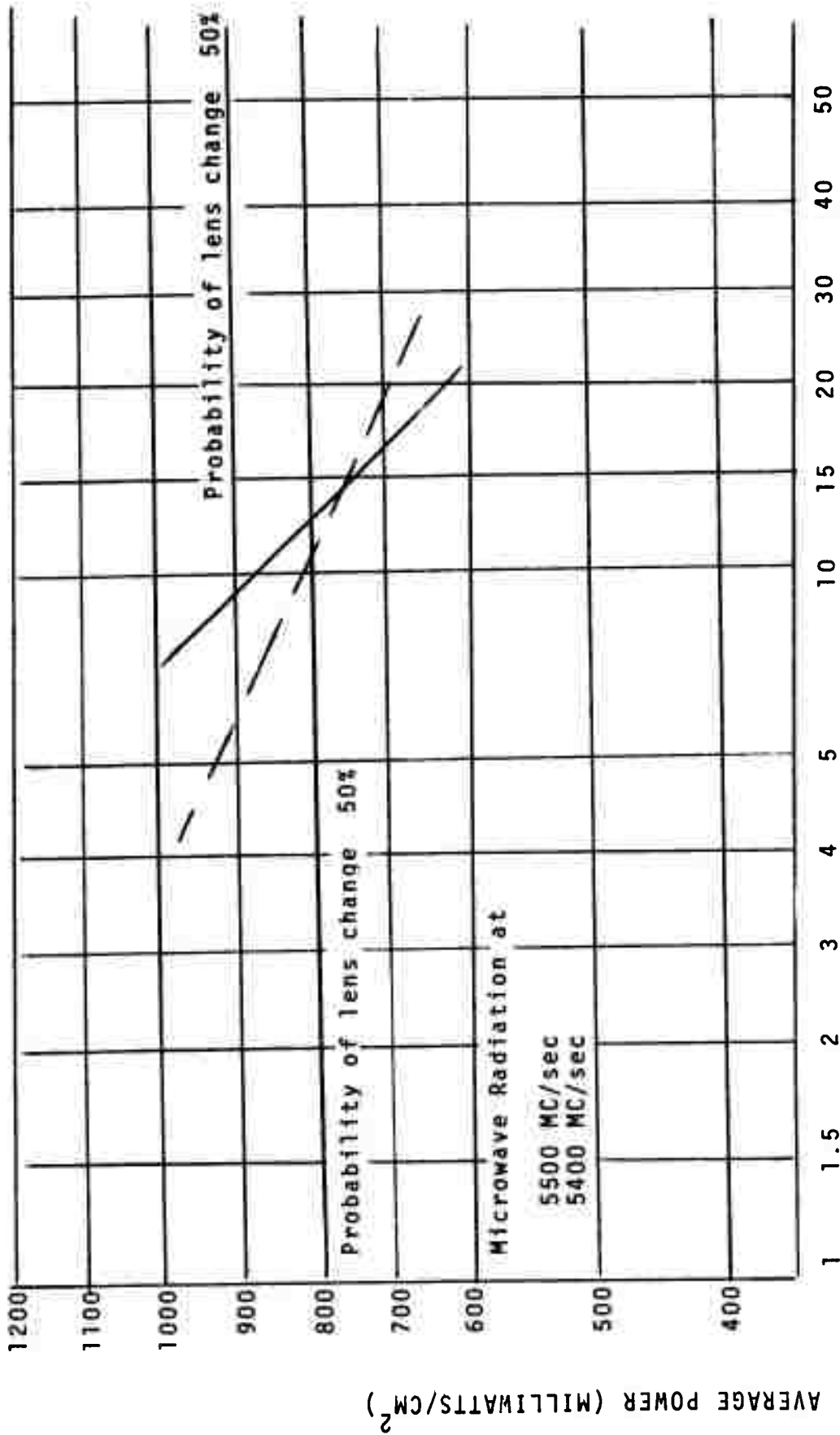
Collaborating with the Principal Investigator in the course of this study were Dr. I. Kaplan, Dr. H. Schmidt, Mr. G. Grosf of the Zaret Foundation and Professor S. W. Rosenthal and Mr. L. Birenbaum of the Electrophysics Department of Polytechnic Institute of Brooklyn.

EXPERIMENTAL DATA

Utilizing our previously reported techniques, which provides for qualitative and quantitative control of the microwave energy entering the eye, rabbit eyes were irradiated. In all cases, the left eye was exposed to either pulsed or continuous wave emission at 5400 megacycles (megahertz) per second and the right eye served as an unexposed control. During the month following irradiation, the eyes were examined for evidence of lenticular opacification.

The lens changes induced by acute exposure to 5400 MC were found to be directly related to average power irrespective of the wave form, whether continuous or pulsed, and, in the latter instances, irrespective of peak power or pulse duration. As before, irreversible opacification in the lens was required as an end point.

The results of lens injury are plotted in dashed line for exposures at 5400 MC and compared to our previous data plotted in solid line for exposures at 5500 MC on the following graph.



EXPOSURE TIME (MINUTES)

DISCUSSION

An important feature of the work performed to date has been related to the precise control of the microwave radiation energy entering the exposed eye of the rabbit. The unique flexibility of the exposure apparatus has permitted exact comparison of the following factors:

1. Frequency dependence at 5500 versus 5400 MC/sec.
2. Continuous versus pulsed emission, and
3. Average versus peak power.

Further, it has been possible to monitor the energy absorbed by the eye throughout each exposure.

Expressing threshold in terms of 50% probability and utilizing the portion of the curve where the intensity-duration function is linear readily permits graphic comparison of the dose relationship between 5400 and 5500 MC data. Examination of the graph demonstrates a remarkable general agreement of the two curves.

CONCLUSION

The experiments conducted at 5400 MC corroborate the previous findings of this investigation performed at 5500 MC. For these two frequencies, the results may be summarized briefly as follows:

1. Acute microwave capacities are directly related to average power density.
2. Time-power relationships for such cataracto-genesis can be determined by biological assay.
3. The various microwave emission factors can be segregated and controlled.
4. For the two points in the spectrum so far studied, there is no significant frequency dependent effect.

The data accumulated to date demonstrate that the technique for irradiation has been firmly established and the results have become predictable. Therefore, it is now desirable to phase in primate experiments for direct extrapolation to man.