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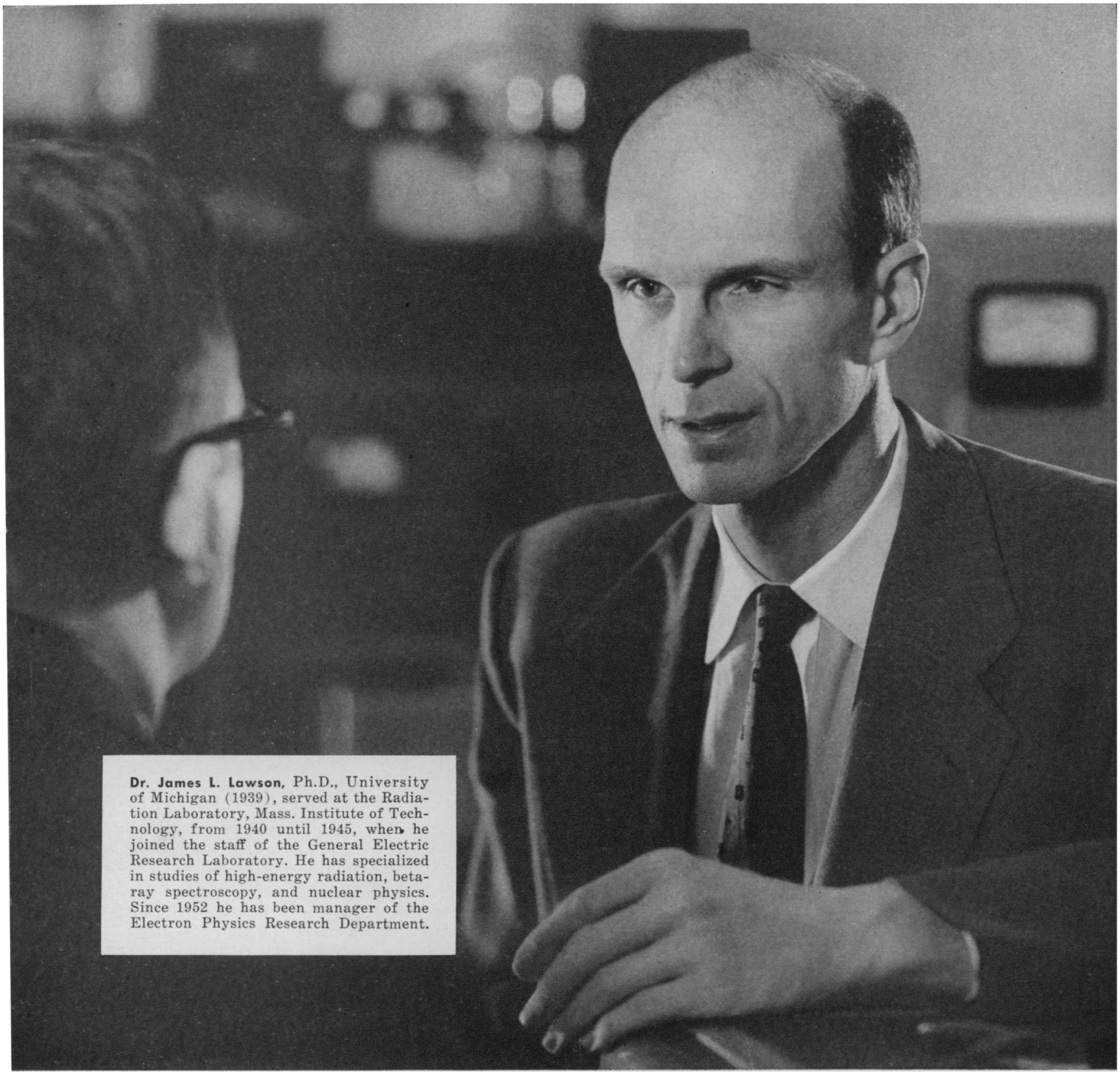

Dr. James L. Lawson, Ph.D., University of Michigan (1939), served at the Radiation Laboratory, Mass. Institute of Technology, from 1940 until 1945, when he joined the staff of the General Electric Research Laboratory. He has specialized in studies of high-energy radiation, beta-ray spectroscopy, and nuclear physics. Since 1952 he has been manager of the Electron Physics Research Department.

Uniting scientific skills

Dr. James L. Lawson of General Electric leads research studies in nuclear and electron physics

As manager of *electron physics research* at the General Electric Research Laboratory, Dr. James L. Lawson is responsible for programs ranging from nuclear physics to high-temperature electronics and the study of information theory.

Dr. Lawson's group, which includes scientists of many and varied skills, is uniquely able to undertake research projects requiring versatility, as well as co-operative effort. An example is the work now being directed toward the peaceful use of fusion power. In programs of such broad scope, success depends particularly on those leaders of research who — as scientists themselves — can understand, encourage, and integrate the work of other scientists.

While making contributions to his chosen profession, nuclear physics, Dr. Lawson is at the same time contributing as a *research leader* to an atmosphere in which scientists have the incentives, the tools, and the freedom to seek out new knowledge.

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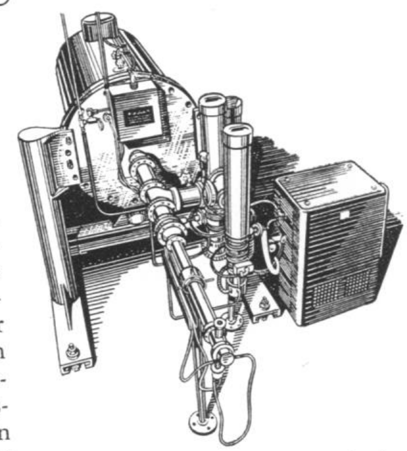
The Effects of Ionizing Radiation in Liquid Systems - V

Determination of the effects of ionizing radiation in liquid systems is a challenging problem. Many physical models of the liquid phase have been proposed, and some success has attended their use. Although short-range molecular order appears to exist, complete disorder occurs at distances substantially greater than the molecule size, where the individual molecules wander through the system in a random manner[1]. This condition, combined with the difficulty of measuring directly the changes in physical and chemical properties of the liquid molecules, complicates the analysis of ionizing-radiation effects in liquid systems.



Versatile 1-Mev Van de Graaff accelerates electrons or positive ions and produces x-rays or neutrons for radiation research.

Experimental Techniques

The experimental techniques usually adopted to study radiation effects are: measurement of the change of some solute in solution, or measurement of the yield of some product formed by the action of radiation. Analyses of radiation-formed products can be used to develop a mechanism for explaining the interaction of the incident radiation. Several Van de Graaff® accelerators, including those at the University of Notre Dame and the Brookhaven National Laboratory, are presently being used in studies of liquids under electron or x-ray bombardment.

Water Studies

One of the best-known liquids, which has received a great deal of attention from radiation chemists because of its importance in many radiobiological and radiochemical systems, is water. The generally accepted result of the interaction of a charged particle with a water molecule is dissociation, resulting in the production of free H and OH radicals. These may combine to re-form water or the molecular products H_2O_2 and H_2, or they may diffuse from the site of their formation to react with solute molecules in solution[2]. Studies of the kinetic behavior of these radicals have been important in analyzing many radiation-induced reactions.

A typical experimental method of studying the effects of these radicals is to investigate the radiation yield in the wet and dry states. This will give the percentage of radiation-induced changes caused by the transfer of radiation energy from the solvent molecules to the solute. The addition of scavenger molecules which compete with the solute for radicals will give some indication of the relative reactivity of the radicals.[3]

Energy Levels

Since the energy of dissociation of typical liquid molecules is of the order of tens of electron volts, while the energy transferred from the incident radiation may be many hundreds of electron volts, it is difficult to measure the direct effect on the individual molecules. Although values of ionization and excitation energy have been extrapolated from gas-phase studies, it is not easy to relate the effect of the molecular binding energy in the solution to the dissociation energy. About the best that can be done is to obtain as uniform as possible a distribution of radiation energy throughout the system and to assume that all secondary electrons have the same probability of interaction as the primary beam. The yield is then calculated in terms of the number of molecules changed per unit-energy input. The unit is the so-called G value which measures the number of molecules changed or formed per 100 electron volts.

Although the analysis of radiation-induced changes in liquid systems is complex, great strides have been made during the past few years. *With the availability of homogeneous beams of charged particles from Van de Graaff accelerators, which permit wide selection of energy and current values, it is expected that even greater success will be attained in the near future.*

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References:
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2. A. O. Allen, Rad. Res. 1, 85, 1954
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