MW 319
Glaser

ESR Studies of Hydrogen Atoms in Irradiated Water and Alcohol Mixtures at 77°K

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Hydrogen atoms produced in irradiated biological systems may lead to biological damage. Using ESR techniques, we have observed hydrogen atoms in ^{60}Co γ-irradiated water—alcohol mixtures at 77° K, in addition to the trapped electrons reported previously. Hydrogen atoms are not observed in water or alcohol alone at 77° K. We have investigated hydrogen atom stabilization in these systems by measuring H· yield as a function of radiation dose, alcohol concentration and electron scavenger concentration for various alcohols. In methanol-water mixtures the H· atom yield rises to a sharp maximum at 35% to 55% methanol concentration (w/w) and then declines. At this maximum, the yield versus ^{60}Co-dose curve begins to saturate at about 1 Mrad. In 1 : 1 ethanol-water mixtures, the H· yield is approximately 4 times that in 1 : 1 methanol-water mixtures. Bleaching of the samples with white light increases the H· yield by a factor of 2, suggesting mobilization of trapped electrons and their interaction with the medium to produce additional H· atoms. The presence of an electron scavenger (1·M acetone) did not affect the initial H· concentration but did reduce the additional production of H· by bleaching. This indicates that there is also another mechanism of H· production, perhaps through excitation, which does not involve trapped electrons.

An Electron Spin Resonance Study of Tumourous Female Breast Tissue

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For the past two years, we have extended the study of the time variation of free radical concentration in tumourous tissue from the previously reported animal work, to that of the human female.

Tissue was taken from 132 patients. In each instance, tissue was taken from the periphery of the tumour, the adjacent stroma and distant tissue. All samples were processed in accordance with the standard protocol we described previously.

The findings indicate the following: malignant tumours yielded high free radical concentrations as compared to benign tumours or normal tissue; the smaller the cancer the higher the concentration; and the distant tissue had equivalent concentrations.

A dynamic curve was constructed for human breast cancer with the experimental part of the curve extrapolated back to a single cell.

The curve indicates that no substantial improvement in prognosis can be expected unless much earlier diagnosis is brought about. A suggestion as to a possible means for such earlier diagnosis is described.

"Application of Microwave Frequency Measurements to Identify Pathological Compounds in Biological Specimens"

By K. Bakin and E. E. Stickley

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Dielectric relaxation times of dipole liquids have a direct proportionality to average molecular radius and viscosity and are inversely proportional to temperature. If the molecule is other than spherical, a form factor is used to modify the Debye equation which describes these relationships. The Debye model is capable of characterizing the size and form of the molecule when appropriate determinations of the dielectric properties are available.

[Using dielectric relaxation times and surface impedance measurements]

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Surface impedance measurements with a simple wave guide apparatus have been used to evaluate the complex dielectric constant. Many dipole liquids show unique responses depending on frequency. Following preliminary studies on compounds for which the geometrical parameters are known, exploratory trials have been made to find suspected variations of shape or configuration among compounds present in pathological situations. The sensitivity of the method appears to support its applicability in this area, as refinements in the procedures and in sample preparation are being developed further.

Radiation Biology

** The Time Factor in Radiobiology

By E. W. Emery

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In an irradiation of extremely short duration the action of the radiation may be modified by physical or chemical effects of the high dose rate. On a longer time-scale, comparable with the delivery of a radiation dose by conventional equipment or with the duration of a course of treatment in radiotherapy, time influences the result largely through changes in the biological system on which the radiation acts.

** Stochastic Factors in Radiation Effects

By A. M. Kellerer

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Dose-effect relations in radiobiology are an expression of statistical fluctuations in the response of irradiated biological objects. Quantitative radiobiology seeks to explain these fluctuations by the statistics of energy absorption in the irradiated medium. While earlier attempts were based on simple Poissonian statistics, somewhat more sophisticated models involving the linear energy transfer are now commonly being used.

However, these approaches are limited. The actual microscopic patterns of energy deposition are far more complicated than the conventional track models would indicate. A more adequate description and a realistic theory of radiation quality has been made possible by the new concepts of microdosimetry.

A theory of the statistics of energy absorption is in itself not sufficient for the analysis of dose-effect relations. Radiation response can, in general, only be understood as the interplay of physical, as well as biological random factors. The stochastic nature of the biological processes may in many cases even be dominant. The conventional procedures of curve fitting fail to separate the different stochastic factors, because the number of free parameters in the possible models is usually too large. More general mathematical methods must, therefore, be used in the interpretation of dose-effect relations. Some of these techniques, specifically the analysis of the moments, are outlined.

** Physical Interaction Events and Cellular Radiobiology

By C. A. Tobias

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The physical properties that characterize radiation effects in a nearly monoenergetic parallel beam of charged particles are particle flux density, charge, and velocity distribution. These determine measurable dosimetric quantities of LET distribution and macroscopic dose (LET × flux density). Velocity and charge determine spatial distribution of ionizing events. A variety of cellular radiobiological experiments contributed to our understanding of the nature of molecular lesions that are relevant for a given type of biological effect and to obtain some information on the statistical distribution of such events. Two general types of events seem to explain many of the findings. Single ionization events have a yield proportional to LET and are affected by oxygen,