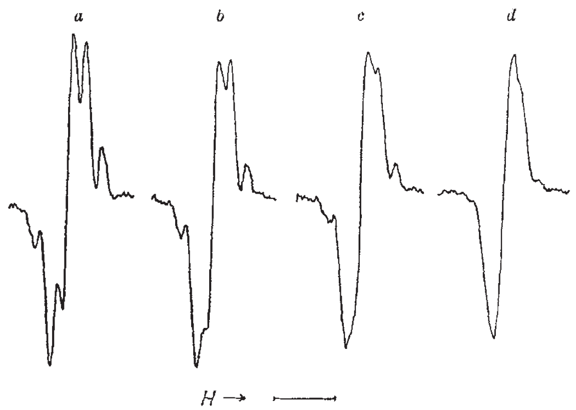
RADIOBIOLOGY

Changes in the Electron Spin Resonance Spectrum of Glycine with Increasing Doses of Radiation

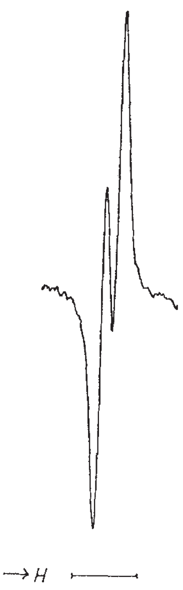
It has been reported[1] that paramagnetic centres are produced in glycine by equal doses of γ-rays, fast neutrons and α-particles in the proportions 1 : 0·7 : 0·1. As the lower efficiency of the α-particles might well be due to the high linear energy transfer along their tracks, an investigation of the effects of very high doses of electrons on the electron spin resonance spectrum of glycine and related substances seemed worth while.

For irradiations we used a 1·5-MeV. Metropolitan-Vickers linear accelerator capable of delivering approximately 10^4 rads per pulse at the position of the sample of deoxyribonucleic acid, the duration of a single pulse being 2 μsec. Derivatives of the microwave absorption against magnetic field strength were recorded. The electron spin resonance spectrometer used for this work operates on 9,350 Mc./s. and utilizes heterodyne detection of an audio-modulated signal.



36·8 gauss

Fig. 1. Derivative of absorption signal of glycine, irradiated in air with *a*, 20 Mrads ; *b*, 50 Mrads ; *c*, 100 Mrads ; *d*, 200 Mrads



36·8 gauss

Fig. 2. Derivative of absorption signal of gelatine irradiated in air with 20 Mrads

In glycine which has received a dose of 20 Mrads the differential curve shown in Fig. 1*a* is obtained, displaying five peaks, whereas with still lower doses of the order of kilorads, triplets have been observed[2].

Increasing the dosage from 20 Mrads to 200 Mrads changes the shape of the absorption curve in a manner shown in Fig. 1*a*–*d* until only a broad single peak is left.

In gelatine, however, as in other substances containing glycine as glycylglycine[3], a double peak shown in Fig. 2 is obtained, which does not change in the same range of doses. The paramagnetic centre which causes this double peak may be identical with that which causes the two large side peaks in glycine. The central peak, on the other hand, may be due to a different centre, which is produced more efficiently at high doses. The two side-peaks would in this way vanish progressively in relation to the central peak.

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Electron Spin Resonance in Irradiated Deoxyribonucleic Acid

Radiation-induced electron spin resonance in deoxyribonucleic acid has already been briefly reported[1]. We have studied the electron spin resonance spectra of samples of deoxyribonucleic acid irradiated *in vacuo*, in air and in nitric oxide. These gases are known to affect electron spin resonance signals[2,3] and to influence biological effects of radiation[4,5].

The deoxyribonucleic acid was kindly provided by Prof. J. A. V. Butler. It had been prepared from calf thymus and contained 0·7 per cent by weight of protein and, when exposed to room air, some 15 per cent of water. Pulses of electrons from a 1·5-MeV. Metropolitan-Vickers linear accelerator were used for irradiating the samples, the pulse duration being 2 μsec. and the dose per pulse about 10^4 rads. Total doses up to 10^8 rad were given in some experiments. The electron spin resonance spectrometer operated at 9,350 Mc./s. and employed heterodyne detection of an audiomodulated signal. First derivatives of the absorption curves were recorded.

The samples were placed in thin-walled glass tubes in which they could be kept under vacuum before, during and after the irradiation. They were irradiated in one part of the tube and then slid along to the unirradiated end before testing in the electron spin resonance spectrometer. The high doses were given in many short bursts, separated by long enough intervals to prevent overheating of the material.

If the samples were dried *in vacuo* for 24 hr. prior to irradiation and were then irradiated either *in vacuo* or in the presence of dry air or nitric oxide a good