A full account of these experiments is being published elsewhere.

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The 'Oxygen-Effect' in Ionizing Irradiation

IT is a well-established fact that ionizing irradiation damages a variety of cells to a greater extent if the irradiation takes place in presence of oxygen than under anaerobic conditions. The mechanism of this 'oxygen-effect' is not yet fully understood. It is generally believed[1-4] to be due to the deleterious effect on cells by the strongly oxidizing radical HO_2 and, to some extent, by hydrogen peroxide, which are formed on X-ray irradiation in aqueous media containing oxygen, as compared with the less powerful OH radical which, in addition to reducing hydrogen atoms, is formed on irradiation in nitrogen. The exception, so far, is a bacteriophage, for which evidence has been adduced[5,6] that it has a far greater sensitivity to reducing than to oxidizing radicals.

In the work, which is reported here, bacteria representing strict and facultative aerobes and anaerobes, as well as some yeasts, were exposed to X-rays in order to study whether the 'oxygen-effect' requires the maintenance of normal respiration during irradiation and whether it bears any relation to a particular type of cellular metabolism.

Known concentrations of washed cells, suspended in phosphate buffer + glucose, were irradiated (190 kVp., no added filtration, dose-rate $6{\cdot}5 \times 10^3$ r./min.) at doses of $6{\cdot}5$–$26{\cdot}0 \times 10^3$ r. (1–4 min. irradiation). The liquid phase, during irradiation, was either free from dissolved oxygen (the gas space containing nitrogen or hydrogen) or it was in equilibrium with oxygen of decreasing percentage (100 per cent oxygen; 20 or 5 per cent oxygen in nitrogen). In some experiments with 20 per cent and 5 per cent oxygen the nitrogen was replaced by carbon monoxide. Immediately after irradiation a known amount of cells was transferred either into fresh buffer solution + glucose or into a nutrient medium in manometer flasks, and the rate of some metabolic processes measured for up to ten hours. These included: oxygen uptake, carbon dioxide production, aerobic and anaerobic fermentation or acid production and utilization of hydrogen (*Vibrio desulphuricans*). In a nutrient medium the increase, for example, in oxygen uptake or anaerobic acid production with time is proportional to the increase of dry weight of bacteria, that is, it is a true reflexion of growth.

None of the metabolic reactions measured was significantly affected by irradiation, when measured in washed non-growing cells, except aerobic fermentation of baker's yeast, which was slightly inhibited. All cells examined, however, when transferred into growth-promoting media, showed an 'oxygen-effect', that is, a stronger inhibition of growth on irradiation in presence than in absence of oxygen. The relative sensitivity for oxygen-treated as compared to nitrogen-treated samples was approximately threefold for aerobic cells, which agrees with data in the literature[1,3,4]. It was much greater, however, for a strictly anaerobic organism (*Vibrio desulphuricans*) and for spores of an aerobic organism (*B. subtilis*), which were not affected by irradiation of up to 26,000 r. in nitrogen, that is, they gave rise to vegetative forms at the same rate as the controls, while growth after irradiation in presence of oxygen (air) was strongly inhibited.

In the case of *Sarcina lutea* it has been possible to abolish almost completely the 'oxygen-effect' at doses up to 26,000 r., if cell respiration was inhibited by respiratory poisons during the irradiation. Thus, after removal of the poison, the cells behaved as if they had been irradiated in nitrogen, when judged by the degree of growth inhibition and subsequent rate of recovery. The effective inhibitors were carbon monoxide, potassium cyanide, hydroxylamine and sodium azide. Urethane did not diminish the 'oxygen-effect'.

The mode of action of the effective poisons in their role as respiratory inhibitors is known[7-9]. They all block hydrogen transfer through the respiratory enzymic system by combining with cytochrome a_3 and stabilizing the remaining respiratory enzymic chain in the reduced form. Taking this mode of action as a guide in advancing a possible explanation for the 'oxygen-effect' in irradiation, it is suggested, at least for this bacterium, that the enhancement of irradiation damage (1) involves the enzymic respiratory mechanism, (2) requires at least part of the enzymic respiratory chain to be in the oxidized form during irradiation. This makes it possible that the impedance has been caused by a reducing agent.

The results form part of a body of work which will be reported fully elsewhere.

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Effects of Crystallization on the Glass–Rubber Transition in Polyethylene Terephthalate Filaments

MULTIFILAMENT yarn spun from polyethylene terephthalate polymer ('Terylene' polyester yarn) is non-crystalline and almost unoriented. After drawing, it becomes highly oriented and moderately well crystallized[1], and in this state at room temperature it has a high initial tensile modulus, and recovers almost completely from strains of up to 1 per cent[2].

It has recently been suggested[3] that the mechanical and electrical transitions in a number of substituted acrylic polymers are characteristic of the molecular structure: the results which are given here of our investigation into the tensile behaviour of polyethylene terephthalate filament yarn show, in addition, that the visco-elastic properties of a given polymer can be considerably modified by molecular orientation and crystallization. In particular, a con-