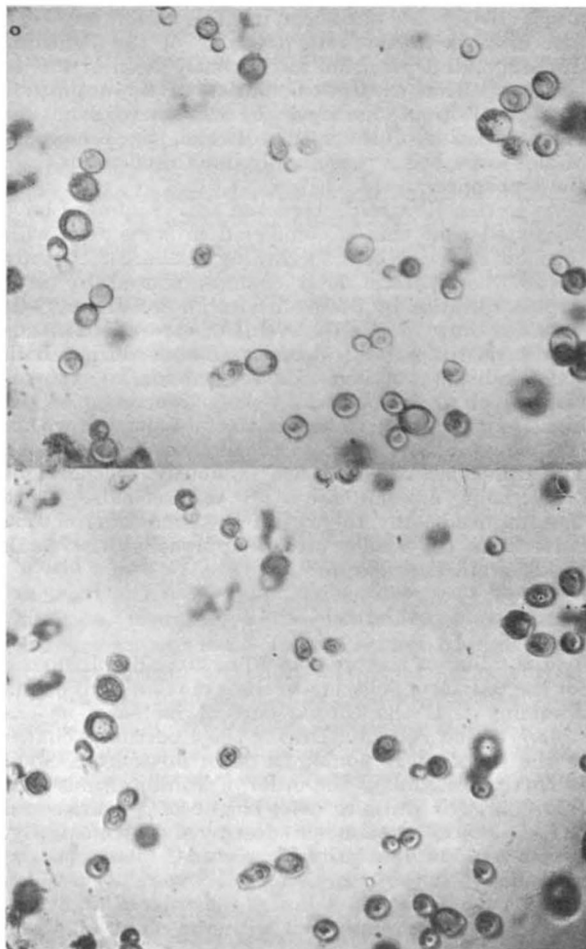
Increased Ultra-violet Absorption of Cells Following Irradiation with Ultra-violet Light*

PREVIOUS investigations[1] have indicated that one of the responses of cells to various injurious agents (for example, lethal ultra-violet light and X-rays) is the release into the intercellular fluids of nucleic acid-like proliferation-promoting factors ('intercellular wound hormones'). Considerable evidence indicates that these active factors are produced in the living cell as a response to injury[2]. The present investigations were aimed at determining by direct observation of living cells whether there is an actual increase in cellular nucleic acids, purines or pyrimidines, during the course of injury. For this purpose, ultra-violet photomicrography was employed, following techniques well established by Caspersson[3].



TWO ULTRA-VIOLET PHOTOMICROGRAPHS OF *S. cerevisiæ* FROM A TYPICAL SERIES, SHOWING INCREASED ABSORPTION OF ULTRA-VIOLET FOLLOWING IRRADIATION WITH SUB-LETHAL DOSES ON THE MICROSCOPE STAGES AT $\lambda = 2800$ A. ABOVE, BEGINNING OF EXPERIMENT; BELOW, SAME FIELD ½ HR. LATER.

A Zeiss quartz microscope was used, with 2·5-mm. glycerine immersion objective, 10× eyepiece, and quartz double monochromator illuminator. A cadmium spark light source was used for $\lambda = 2800$ A. and a General Electric type *H*-3 high-pressure mercury arc for $\lambda = 2537$ A. A hole cut in the outer glass jacket of the mercury arc permitted passage of the ultra-violet. The organism was *S. cerevisiæ* (Fleischmann bakers' yeast). This was suspended in isotonic salt solution or water, sealed under a quartz coverslip on a quartz slide, and irradiated continuously on the microscope stage with the lethal radiation employed as the microscope illuminant. Photomicrographs were taken at the beginning of the experiment, and at fifteen-minute intervals during the course of irradiation.

The plates showed a progressive increase in the ultra-violet absorption of the cells during irradiation. Since the wave-lengths employed were in the range highly absorbed by purines and pyrimidines[4], one can interpret the results as indicating a production by the injured cells of nucleic acid-like materials. This is consistent with the previous results[2] indicating that proliferation-promoting intercellular hormones are produced in living, injured cells as a response to injury. Two photomicrographs from a typical series are shown in the figure.

In Mitchell's studies of the possible relationship of nucleic acids to the radiosensitivity of tumours, he found an increase in the ultra-violet absorption near 2600 A. of carcinoma tissue and normal epithelium irradiated with X-rays or gamma rays *in vivo* and afterwards examined in section by ultra-violet photomicrography. He interpreted the increased absorption as due to purines or pyrimidines, and not to thymonucleic acid (negative Feulgen reaction). From *in vitro* experiments, he concluded that the effect was not due to direct photochemical changes in the cytoplasm. The supposed purine or pyrimidine nature of the absorbing materials, their apparent production as a result of the effects of lethal agents (X-rays and gamma rays), and their evident formation by living, injured cells rather than as a direct photochemical effect, all suggest that Mitchell was observing the production of the proliferation-promoting factors we have been investigating. If this is true, it points to the advisability of a careful study to determine whether the production of proliferation-promoting factors by injured cells is an initial result of the irradiation of tumours by X-rays and gamma rays. The release of such factors into the tumour mass and surrounding tissues might conceivably play an important part in the variability of the response of tumours to irradiation.

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