Meetings

Microbeam and Partial Cell Irradiation

An Advanced Study Institute sponsored by the North Atlantic Treaty Organization (NATO), to discuss microbeam and partial cell irradiation together with ancillary techniques was held in Cannes, France, at the end of 1967. The organizing committee comprised H. Glubrecht (Hanover), M. Bessis (Paris), and C. L. Smith (Cambridge); they brought together 14 lecturers and 35 students, most of whom had already begun to build or use microbeam apparatus.

Glubrecht welcomed the participants and gave the introductory lecture. He pointed out the value of experiments in which small areas only a few microns in diameter in single cells can be irradiated, both as a tool in cellular microsurgery and as a complement to conventional, whole culture irradiation. Relative to radiobiology as a whole, this powerful tool has still been very little used. It would seem to be particularly applicable to studies on variations in cellular radiosensitivity during the cell cycle, now that synchronized cultures are readily obtainable. Glubrecht also emphasized that ancillary techniques which are both quantitative and applicable at the single-cell level must be developed because they provide possibilities of evaluating the biological effects of the radiation.

The first set of scientific sessions was concerned with the design, construction, and calibration of microbeams of ionizing radiation. It included lectures by R. Uretz (Chicago) on 1- to 2-Mev protons, Smith on 3- to 10-Mev α-particles, D. Ernst (Hanover) on 5- to 10-key x-rays, and A. Rickinson (Cambridge) on 30- to 100-kev electrons. Uretz advised that unless other conditions dictated absolutely that a proton microbeam should be used, the upkeep of an accelerator for the production of protons solely for microbeam work was hardly justified and α-particles should provide a satisfactory alternative. Since ionizing microbeams are almost invariably produced by direct collimation, there was a long discussion on the fabrication of small holes. Many of the methods now available for making these holes are relatively new. The importance of perfect contact between surfaces in ensuring good collimation was also emphasized.

Interest then turned to ultraviolet microbeams and a lecture on their design and construction by Uretz was followed by one on dosimetry by Ernst. Both of these talks led to lively discussion of the difficulties involved. P. Dendy (Cambridge) and A. Forer (Cambridge) considered the contralocalizing effects which might arise due to (i) a modified diffraction pattern produced by obstructions in the optical light path; (ii) dispersion in the quartz cover slip on which the biological material is growing; and (iii) dispersion within the cells themselves. In each case it is important to know the fraction of light lost from the image and the spatial distribution of this unwanted radiation. There was general agreement that, theoretically, a microspot 0.2 μ in diameter could be obtained using one of the Zeiss "Ultrafluar" objectives. However, opinions differed over the practical limit in a particular biological situation. It is perhaps of interest to note that no work using a microbeam less than 1 μ in diameter has yet been published and the most commonly used diameters range from 2.5 to 5 μ. R. Rustad (Cleveland) gave details of an extremely simple, but effective ultraviolet microbeam which has recently been built in their laboratory.

Several workers gave brief lectures to illustrate the use of an ultraviolet microbeam—Forer on studies of movement of anaphase chromosomes; S. Naruse (Tsu-Shi, Mie-Ken, Japan) on paling and darkening of interphase nucleoli and mitotic chromosomes in eight different cell types; G. Moreno (Paris) on an electron-microscope study of the effects of localized ultraviolet irradiation of the nucleus, nucleolus, and cytoplasm; and L. Zech (Stockholm) on the functional transformation of protozoan nuclei by microbeam irradiation.

An interesting lecture by Bessis showed clearly that laser beams will play an increasingly important role in future microbeam work. M. Lutz (Paris) illustrated both the advantages and some of the disadvantages of a laser compared with a conventional source of incoherent light. D. Rounds (Pasadena) and F. Johnson (Pasadena) gave up-to-date information on the production of laser beams of different wavelengths. F. Barnes (Boulder) discussed the theoretical implications and outlined some simple experiments concerning thermal chemical damage to biological material resulting from the high-energy flux in a laser pulse. These lectures proved particularly valuable to biologists, since laser technology is a very rapidly developing subject. The radiobiologist with a particular problem in mind will wish to use wavelengths of radiation which fall within a fairly well-defined range and it became obvious that the number of available laser wavelengths increases almost daily. If laser radiations are to be used as a biological tool, frequent reappraisal of the situation is essential.

In concluding this part of the program T. R. Munro (Cambridge) and J. Petrova (Prague) gave lectures on partial cell irradiation. This subject is closely related to microbeam work but usually relies on some physical property of the radiation or biological properties of the material being studied to achieve a degree of localization rather than direct collimation or focusing. The volume irradiated is normally greater than with a microbeam, but both authors gave ample evidence that these methods can be very elegant.

All the remaining lectures were concerned with techniques which are ancillary to microbeam work. Munro gave numerous details of the specialized tissue-culture techniques which are appropriate to small numbers of cells, particularly for the long-term observation of single cells. The handling of small numbers of cells presents problems which are not apparent if tissue culture is effected on a larger scale. Munro's talk made it clear that firsthand advice from a person with practical experience is invaluable.

S. Inoué (Philadelphia) gave a series of lectures on polarization microscopy and microbeam irradiation with polarized ultraviolet light starting from the simple physical principles and leading ultimately to an elucidation of the packing arrangement of the chromosomes in the living sperm head of the cave cricket.

Other lectures in this section of the program were concerned with microspectrophotometry, interference microscopy, x-ray absorption microscopy, x-ray microfluorescence analysis, and autoradiography.

Microbeam work must be effected at

the single-cell level; it was clear from the later sessions that the choice of techniques for assessing quantitatively the changes caused by radiation in a single cell is still very limited. The search must continue for new assay procedures and further efforts must be made to improve the stoichiometry of some of the methods already available.

H. Glubrecht proposed a vote of thanks to the sponsors and Professor Serlupi Crescenzi replied on behalf of NATO.

The general consensus of opinion was that a meeting of 40 to 50 persons certainly provides an opportunity for the maximum interchange of information and ideas in a way which is not possible at a larger meeting.

A more detailed account of the meeting is being prepared. Requests for copies should be addressed to P. P. Dendy, Department of Radiotherapeutics, University of Cambridge, Tennis Court Road, Cambridge, England.

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Calendar of Events

Courses

Epidemiology, University of Minnesota, 16 June–6 July (funded by a USPHS grant). Courses include fundamentals of epidemiology and biostatics, epidemiology of cancer and cardiovascular diseases, and topics in infectious disease epidemiology. Although primarily intended for teachers of preventive medicine and epidemiology in medical schools, registration is open to postdoctoral fellows, graduate students, and residents in departments of preventive medicine in medical schools. Fee: $120. (Dr. Leonard M. Schuman, Director, Graduate Summer Session in Epidemiology, University of Minnesota School of Public Health, 1158 Mayo Building, Minneapolis 55455)

Fundamentals of Optics, University of Rochester, a 2-week summer course. It is an intensive course on optical engineering and the underlying optical science; designed for physicists and engineers in industry and government laboratories. Participants must have the equivalent of a bachelor's degree in physics or engineering. Tuition: $400. (Fundamentals of Optics, Institute of Optics, Bausch & Lomb Building, University of Rochester, Rochester, N.Y. 14627)

Elements of Simulation, State University of New York at Buffalo, 3–7 June. A background in the use of digital computers is desirable. Enrollment is limited to 40. Fee: $175. (Office for Continuing Education, Millard Fillmore College, Hayes A, State University of New York at Buffalo, Buffalo 14214)