system with 10-sec. sweep is used in order to improve the ratio of signal to noise and to ease the requirements on the computing circuitry. The system consists of the flying-spot scanner tube, interference microscope, multiplier phototube, and a photoformer for the continuous solution of the intensity-phase angle equation. A monitor presents a picture of the photoformer output, which represents the relative phase angle present in the cell and, therefore, the dry mass of the various portions of the cell on a grey scale. The photoformer output is fed to an integrator circuit which sums the phase angle in the entire field. The integration output at the end of each sweep, therefore, represents the total dry mass present in the optical field. The information from the integrator is continuously read out on a strip chart recorder.

Auxiliary pulse generating equipment is so arranged that the integrator may be made to sum only the information in a selected area of the field. The area being integrated is indicated on the monitor by brightening. This area may be a square or rectangle with a minimum size of about 2μ at the magnification at present used.

The grey scale dry-mass images of the living cell may be continuously recorded on 16-mm. motion picture film. When such a film is presented at a speed of 16 frames per sec. a time-lapse motion picture is obtained.

This system has several advantages over previously described techniques. (1) The data on the dry mass of whole cells or segments of cells are obtained and recorded by two methods every 10 sec. (2) The dry-mass images of the specimen are continuously displayed on the monitor tube during the course of the experiments. (3) The visual presentation of the dry-mass image makes the positioning of the brightened area of the raster quite easy and this permits continuous determination of the dry mass of selected areas of the cell.

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Ultra-Violet Television Microscopy

Several attempts to use ultra-violet-sensitive television cameras in association with ultra-violet microscopes to give an immediate display of the image have been reported[1]. From published photographs the sensitivity and image quality do not appear to be very high and results obtained with other types of image converters have also been disappointing. A newly developed E.M.I. 'Vidicon' camera tube incorporating a quartz window and a specially modified arsenic triselenide target layer appears to be very promising. The spectral response curve has a peak at 4000 Å. with a half-intensity band-width of about 1500 Å. The sensitivity at 2537 Å. is approximately 0·10 μamp./μW./cm.^{2}. This appears to be several times higher than previously reported values. The layer has unity gamma and reasonably low inertia.

This tube has been used in conjunction with quartz objectives and condenser, illuminated with monochromatic light of wave-length 2537 Å. from a low-pressure mercury lamp and simple monochromator. With a signal current of between 0·05 and 0·1 μamp., excellent images of living cells at magnifications of 3,000 times could be displayed on a television screen. The intensity of illumination was adequate even with the glycerine immersion objective of N.A. 1·25 and it was possible to take good-quality photographs of the screen using a 35-mm. camera with exposures as short as 1/25 sec. The great advantage of the system is that it enables microscopy to be carried out as easily with ultra-violet as with visible light. Focusing presents no problem and there are no special mechanical requirements. The lenses were mounted on a simple student-type microscope stand. Many fields containing large numbers of cells can be scanned in a short time and the very shallow depth of field makes it possible to focus the different levels through a relatively thick specimen, thus helping to build up a three-dimensional impression.

In this connexion the technique of immersion refractometry[2] has been adapted for ultra-violet work. The lens-like behaviour of an uncompressed spherical cell makes observation of internal structures difficult. This can be partly overcome by immersing such cells in a suitable protein medium having a refractive index approaching that of the cytoplasm. This method has enabled the structure of chromosomes to be seen very clearly in undamaged cells. Since, however, the cytoplasm of most cells shows some degree of absorption at 2537 Å. it is difficult to bring about actual reversal of contrast by immersion in protein alone. If a little nucleic acid is added to a less-concentrated protein solution it becomes possible to match the cytoplasm exactly against the surrounding medium or to make it appear bright instead of dark. This method opens up the possibility of measuring both the refractive index and absorption of living cells in the ultra-violet to obtain quantitative cytochemical information. It also makes it possible to vary at will the contrast of internal detail, a technique referred to elsewhere as "optical dissection"[3]. Finally, the method offers considerable promise for rapid microspectrophotometry. It is quite simple to scan any line across the image of a cell and display a light intensity curve on an oscilloscope screen. There is no difficulty in principle in converting such curves to an optical density scale and in feeding the results to an electronic integrator to measure the total mass of absorbing material.

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