

also to all students of experimental taxonomy and of the origin of cultivated plants.

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NEW METHODS IN CELL PHYSIOLOGY

Weiterentwicklung der Zellphysiologischen Methoden

Angewandt auf Krebs, Photosynthese und Wirkungsweise der Röntgenstrahlen, Arbeiten aus den Jahren 1945–1961 (New Methods of Cell Physiology: Applied to Cancer, Photosynthesis and Mechanism of X-ray Action. Developed 1945–1961). Von Otto Heinrich Warburg. Pp. xv + 644. (Stuttgart: Georg Thieme Verlag; London: John Wiley and Sons, Ltd.; New York: Interscience Publishers, 1962.) 138 D.M.; 259s.; 34.50 dollars.

THE title of this book is a misnomer, for it is a collection of 95 papers, 20 of them hitherto unpublished, from the Max Planck Institut in Berlin, the work of Prof. Otto Warburg and his assistants from 1945 until 1961. Several of the papers repeat each other with minor variations. Apart from a chemical actinometer, which Prof. Warburg himself gave up using in 1954, the new methods are numerous improvements to the constant-volume manometric apparatus, culminating in the 'universal flask' of 1960, which has a single side-arm, a side-arm with twin inter-communicating bulbs, and a third side-arm leading to a trough above the centre well.

I myself am not one of those who think that the Warburg flask finally died with the introduction of the photo-multiplier. There is a continuing place for a tool so quick, easy and flexible for measuring rates of gas exchange. The limitation of the manometric method is that it will give useful measurements over only a relatively small range of rates; it cannot be scaled down, and thus often cannot satisfactorily be applied to other analytical techniques. This does not matter so much, perhaps, when one is using homogeneous populations of micro-organisms or cell fragments; with more complicated tissues it can raise almost unanswerable problems of cell damage in slices, or of proportions of cell types, as in much tumour work.

A difficulty which confronts experts in a versatile technique is that they become almost prisoners of the method. It is saddening to observe that in the present collection of papers, isotopic tracers and paper chromatography raise their heads only once each. Other methods of measuring gas exchange—carbon dioxide or oxygen electrodes, nuclear magnetic resonance—are not discussed, a pity, since an objective appreciation by such a master of technique would be very valuable. This reticence extends even to such relatively trivial matters as the use of diethanolamine or carbonate/bicarbonate mixtures for maintaining a constant concentration of carbon dioxide in the flask.

The establishment of the quantum efficiency of photosynthesis in *Chlorella* at around 4, using the technique of over-compensation, is a triumph which sweeps many of these criticisms aside; it has opened the way to much valuable research in the past few years. The controversy over respiration and tumour genesis, on the other hand, seems to have reached a dead end, since Prof. Warburg himself has changed his ground by admitting that measurements of aerobic glycolysis are too untrustworthy to be

meaningful. The rate of anaerobic glycolysis in cells is not necessarily related to respiration-rates at all. As for aerobic glycolysis, pyruvate and lactic dehydrogenase is such a splendid system for measuring redox potentials that Holzer and others have used it to estimate the NAD/NADH₂ ratio *in vivo*. Manometer users in general, mesmerized by the bicarbonate ion, might have paid more attention to the concentrations of intermediary metabolites in tumour and wondered whether the defect in carbohydrate metabolism lay in the pyruvic oxidase step; might have wondered also whether pyruvate was acting as a general hydrogen acceptor for NADH₂.

There may well be a relative lack of cytochrome c in tumour cells; but one is reminded of phage-infected bacteria, in which synthesis of cellular protein ceases, except for that necessary to provide energy for phage reduplication. This is not to suggest that cancer is caused by a virus, rather that in these growing cells, self-starved as it were, every reserve protein molecule is catabolized and the limiting factor becomes the supply of prosthetic groups.

Umbreit, Burris and Stauffer's work, in spite of its limitations, will retain its pride of place, since this is not a laboratory manual. Its chief charm lies in the evocation of the years 1920–40, when Warburg, Weiland and Willstätter, Meyerhof, Embden and Parnas marched and wheeled on the plains of Germany, searching for the whites of each others' eyes before firing off their highly individualistic cannon.

J. H. OTTAWAY

CELL BIOLOGY

International Review of Cytology

Vol. 12. Edited by G. H. Bourne and J. F. Danielli. (Prepared under the auspices of the International Society for Cell Biology.) Pp. viii + 424. 1961. 107s. 6d. Vol. 13. Pp. ix + 393. 1962. 107s. 6d. (New York: Academic Press, Inc.; London: Academic Press, Inc. (London), Ltd.)

THE editors' interpretation of the scope of cytology is, legitimately, a wide one, embracing biochemistry, biophysics and molecular biology simultaneously with gross histology, and this eclecticism would seem to imply that the series is intended for the non-specialist and must be so judged. I feel, therefore, that authors may reasonably be expected to offer comprehensive critical surveys of recent literature, summaries of older work, assessments of the importance of their subjects to cytology, and, ideally, novel points of view or interpretations; the subjects chosen should be those in which there have been recent advances of general significance to cytology. Such reviews could be most valuable correctives to the present fragmentation of cytology into specialist disciplines.

Some authors come close to this ideal: Hamerton with a masterly survey of sex chromatin, Hsu with a lively, if excessively verbose, treatment of aneuploidy. Yčas (the coding hypothesis), Taylor (chromosome reproduction), Flickinger (gene action and protein synthesis) and Evans (chromosome aberrations) provide a sensible and useful group of topical reviews. Some, less ambitiously, provide workman-like essays in limited, but important, fields: Austin (fertilization *in vitro*) and Finean (myelin structure), although 'workman-like' is an inappropriate adjective for Finean's electron micrographs; others deal with