A 'Warburg' Respirometer for Measurements Under Continuous Irradiation

For investigations of recovery phenomena in micro-organisms, respiration rates under continuous X-irradiation had to be measured in situ and without handling the samples. A special Warburg respirometer was designed, incorporating an X-ray tube mounted below its water-bath.

A commercially available instrument (Fotowarburg F 26, C. Braun, Melsungen, Germany) was modified. The optical system was removed and the glass bottom of the water-bath replaced by an aluminium sheet, 5 mm thick. This was milled out to a thickness of 0.3 mm at 4 positions. The thin areas were 3 cm by 5 cm with 8 cm between them.

A 100 kVp X-ray tube (type FA 100/2, C. H. F. Müller, Hamburg, Germany) was mounted on a chain-driven sledge below the water-bath and moved by remote control. Accurate positioning was effected reproducibly

by electric relays which cut the current to the motor driving the chain.

Both the Warburg assembly and the X-ray tube were enclosed in 5 mm lead sheet. Flap doors in the shielding allowed adjustment of the Warburg controls. The power supply was brought in through holes in the bottom. The connecting tubes from the manometers to the recorder were guided through a 5 mm slit made by overlapping lead sheets.

The manometric recorder used (Longator, C. Braun, Melsungen) provided for 7 simultaneous traces. One was used for the thermobarometer and 6 for the experimental vessels.

The X-ray beam from the tube run at 100 kVp, 20 mAmp, was collimated by a 5 mm lead applicator. Isodose curves were measured in air using a thimble-chamber and a Siemens dosimeter. One vessel was exposed at a time. The dose-rate from scattered radiation to the other vessels was less than 1% of the experimental dose-rate if they were mounted close to the bottom of the water-bath. The dose-rate in the cell suspension was determined to be 4.8 Krads/min by ferrous sulphate dosimetry ($G \text{ Fe}^{+++} = 15.5$)¹.

Zusammenfassung. Der Aufbau einer Apparatur zur manometrischen Respirationsmessung kontinuierlicher Röntgenstrahlung wird beschrieben.

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Basic design of the apparatus: the front flap-doors and the manometers are removed. Explanation: (a) waterbath of F26; (b) control panel of F26; (c) X-ray tube; (d) cooling water and high voltage; (e) sledge; (f) rail for the sledge; (g) motor; (h) front panel of relay box, (i) shielding.

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Reinigung mikrobiologischer Objekte zur Vorbereitung elektronenmikroskopischer Präparate durch Ultrafiltration

Bei der Vorbereitung der Präparate für das Elektronenmikroskop ist es nötig, dass die zu beobachtenden Objekte von Lösungen (Nährböden, lösliche Zellbestandteile usw.), in denen sie sich vor der Isolierung befanden, gereinigt werden. Die studierten Objekte werden daher gewöhnlich in destilliertes Wasser oder in eine Lösung flüchtiger Salze überführt. Wenn es sich um nicht feste, um brüchige, faserige oder netzförmige Strukturen und um kleine Materialmengen handelt und wenn es notwendig ist, bei der Reinigung auch grössere Moleküle (Polypeptide, Eiweißstoffe oder Fragmente von Nukleinsäuren usw.) zu entfernen, stösst der Reinigungsprozess auf eine Reihe von Hindernissen.

Als Beispiel kann die Vorbereitung der Präparate von Mykoplasmen und L-Formen der Mikroorganismen oder

Bakteriophagen aus Kulturen mit einer verhältnismässig niedrigen Anzahl von Partikeln pro Volumeinheit dienen. Autoren von Arbeiten über die Vorbereitung von Bakteriophagen für die Elektronenmikroskopie¹⁻⁴ führen an, dass es möglich ist, die Reinigung von Phagolysaten

¹ S. BRENNER, G. STREISINGER, R. W. HORNE, S. P. CHAMPE, I. BARNETT, S. BENZER und M. W. REES, *J. molec. Biol.* **7**, 281 (1959).

² D. E. BRADLEY, *The Morphology and Physiology of Bacteriophages as Revealed by Electron Microscope*, *J. R. microsc. Soc.* **84**, 257 (1965).

³ D. E. BRADLEY, *Bact. Rev.* **31**, 230 (1967).

⁴ A. S. TICHONENKO, in *Elektronmikroskopische metody issledovaniya biologicheskikh objektov*, (Verlag Nauka, Moskau 1963), p. 30.