

2.1.8.5

3 p

3a/1968

THE AUSTRALIAN NATIONAL UNIVERSITY

John Curtin School of Medical Research

Annual Report 1967

Electron Microscope Unit

ELECTRON MICROSCOPE UNIT

STAFF

Professorial Fellow and Head of Unit:

E.H. Mercer, Ph.D.(Leeds), D.Sc.(Adel.), (to
September).

Electron Microscopist (Fellow):

M.C. Taylor, M.Sc.(Tas.).

Fellow:

A.A. Barton, B.Sc., M.B., B.S.(Lond.).

Research Fellow:

J.D. Pickett-Heaps, B.A., Ph.D.(Cantab.).

RESEARCH WORK

Introduction

In September Dr. Mercer resigned from his position as Professorial Fellow and Head of the Unit. It has been agreed that for the next two years the Unit should be attached to the Department of Experimental Pathology for administrative purposes.

The facilities of the Unit have been used to meet the needs of a number of projects depending on the study of fine structure of cells and tissues; however, the majority of workers now come from other Departments in the School and University.

Molecules and particles (Taylor, Wrigley)

Standard techniques for visualizing biological molecules and particles have been used in a number of applications. (i) Sericesthis Iridescent Virus (SIV). Studies of the ultrastructure of this virus have been

continued in collaboration with Dr. A.J. Gibbs¹. When whole virus is treated with oxymetazoline hydrochloride, subunits can be seen in negative stain on the icosahedral surface of the particle. Subunits of the same size and arranged in striking triangular rafts are often seen in preparations of disrupted virus. This evidence suggests that the surface of SIV has 1442 capsomers; the previously suggested figure of 812 is ruled out. Two methods of chemical analysis have failed to confirm the presence of a mucopolysaccharide coat: (a) chromatography (analysis by Dr. W.H. Murphy³), (b) specific staining (method suggested by Dr. J. Pickett-Heaps). (ii) The lengths of DNA molecules from rabbit pox virus have been measured (Tomkins¹, Bellet¹, Taylor). (iii) Preliminary work has been done on visualizing casein micelles to study variations in size, shape and composition (McKenzie³).

Techniques for electron microscopy (Taylor, Wrigley)

(a) Studies on the interaction of electrons with photographic emulsions (Valentine⁴ and Wrigley) have been continued with the aim of specifying the best emulsion-development combination for any given electron microscope application.

(b) A technique for accurate calibration of instrumental magnification has been developed using catalase crystals as an internal standard. These crystals were calibrated by comparison with polycrystalline gold using low-angle electron diffraction. It is possible to measure absolute dimensions to an accuracy of 4% and relative dimensions to 1.5%.

Leprosy (Barton, Barton²)

Lesions similar to lepromatous leprosy can be produced by injecting polystyrene particles into the sciatic nerve. Endoneurial fibroblasts remove this material and the nerve continues to conduct. Destruction of the nerve as in tuberculous leprosy seems to occur when Schwann cells are involved.

Studies of disability, deformity and mutilation following neurectomy have shown that plantar ulcers are due to a disorder of posture which causes vascular damage and anoxic necrosis of the skin.

Tumours (Barton, Barton²)

The alkylating agent thiotepa causes an alteration in the structure of cytoplasmic matrix and rapid formation of membranes. These provide a channel by which the damaged cytoplasm is voided from the cell. It is thought that this form of excretion forms the means by which tumours continue to maintain their structure.

Small Intestine (Pitha)

A study of the changes which occur in the small intestine following vascular occlusion, neurectomy and intestinal obstruction have shown this organ as having very considerable powers of regeneration. This is associated with the large numbers of undifferentiated cells in the mucosa and submucosa. A new cell type termed a clear fibroblast cell appears to be important in the maintenance of this structure.

Plant cell ultrastructure and differentiation (Pickett-Heaps)

Tritiated cinnamic acid has been used in radio-autography as a highly specific tracer in xylem wall

synthesis. Biochemical analysis showed that it was only converted into lignin residues; ultrastructural studies indicated that xylem wall thickenings were massively and specifically labelled, with a concurrent cytoplasmic labelling associated with endoplasmic reticulum, golgi bodies and vesicles.

A cytochemical localisation procedure has been developed for plant polysaccharides using silver-hexamine. Golgi bodies, starch grains and cell walls react very strongly under certain conditions, and control experiments indicate that the ultrastructural localisation can be highly specific. The staining reaction can also be used to detect other compounds, and is considered promising for further development.

Differentiation in Triticium and Chara has been further studied. In particular, formation of the antheridium and spermatogenesis have revealed further the importance of microtubules in differentiation and morphogenesis in plant cells.

TEACHING AND OTHER ACTIVITIES

There were three students proceeding to the degree of Doctor of Philosophy. Mr. N.G. Wrigley commenced in January and during the year M.R. Dickson and J. Pitha were admitted to the degree.

PUBLICATIONS

BARTON, A.A. and BARTON, Mary².

'The relation of nerve fibres to *Mycobacterium leprae* 1. The phagocytic activity of cells in damaged nerve'. Int. J. Lepr., 35, 382-387 (1967).

DICKSON, M.R.

'A spiral sleeve in rotifer cilia tips'.
J. Cell Sci. 1, 471-474 (1966).

DICKSON, M.R. and MERCER, E.H.

'Fine structural changes accompanying desiccation
in *Philodina roseola* (Rotifera)'. J. Microsc. 6,
331-348 (1967).

DIXON, K.E.⁵ and MERCER, E.H.

'The formation of the cyst wall of the metacercaria
of *Fasciola hepatica* L'. Z. Zellforsch. 77,
345-360 (1967).

MERCER, E.H. and DIXON, K.E.⁵

'Fine structure of the cystogenic cells of the
cercaria of *Fasciola hepatica* L'. Z. Zellforsch.
77, 331-344 (1967).

MERCER, E.H. and NICHOLAS, W.L.⁵

'The ultrastructure of the capsule of the larval
stages of *Moniliformis dubius* (Acanthocephala)
in the cockroach *Periplaneta americana*'.
Parasitology, 57, 169-174 (1967).

PICKETT-HEAPS, J.D.

'Ultrastructure and differentiation in *Chara* sp.
I. Vegetative Cells'. Aust. J. Biol. Sci. 20,
539-551 (1967).

PICKETT-HEAPS, J.D.

'Ultrastructure and differentiation in *Chara* sp.
II. Mitosis'. Aust. J. Biol. Sci., 20, 883-894
(1967).

PICKETT-HEAPS, J.D.

'The use of radioautography in investigating
wall secretion in plant cells'. Protoplasma 64,
49-66 (1967).

PICKETT-HEAPS, J.D.

'Further observation on the Golgi apparatus and its functions in cells of the wheat seedling'.

J. Ultrastruct. Res. 18, 287-303 (1967).

PICKETT-HEAPS, J.D.

'The effects of colchicine on the ultrastructure of dividing plant cells, xylem wall differentiation, and distribution of cytoplasmic microtubules'.

Dev. Biol. 15, 206-236 (1967).

PICKETT-HEAPS, J.D.

'Preliminary attempts at polysaccharide localisation in root tip cells'. J. Histochem. Cytochem. 15, 442-455 (1967).

PUBLICATIONS IN THE PRESS

BARTON, A.A. and BARTON, Mary².

'Plantar ulcers occurring in mice after neurectomy. A light and electron microscope study'.

Aust. J. exp. Biol. med. Sci.

BARTON, A.A. and BARTON, Mary².

'The functions of membranes in neoplastic cells partially resistant to thiotepea'. Int. J. Cancer.

PICKETT-HEAPS, J.D.

'Ultrastructure and differentiation in Chara sp. III. Formation of the antheridium'. Aust. J. Biol. Sci.

PICKETT-HEAPS, J.D.

'Xylem wall deposition; radioautographic studies using lignin precursors'. Protoplasma.

PICKETT-HEAPS, J.D.

'Further ultrastructural observations on
polysaccharide localization in plant cells'.

J. Cell Sci.

-
- 1 Member of the Department of Microbiology
 - 2 Member of the Department of Experimental Pathology
 - 3 Member of the Department of Physical Biochemistry
 - 4 Medical Research Council, London.
 - 5 Member of the Department of Zoology, SGS.