

THE AUSTRALIAN NATIONAL UNIVERSITYFACULTY OF SCIENCEDEPARTMENT OF BIOCHEMISTRYANNUAL REPORT 19711. GENERAL COMMENTS

During 1971 the Department moved from temporary quarters to a permanent building on University Avenue. Various delays in the building programme postponed the transfer until June, so that the entire movement of apparatus, equipment and staff was undertaken in the short period between the two semesters. Nevertheless, and as a consequence of the willing and sustained effort of the entire staff and our postgraduate students, who undertook all packing and unpacking, the Departmental teaching programme commenced on time at the beginning of the second semester. Resumption of full activities in the staff laboratories was of necessity slower, but the whole Department is now well settled in its new home. An informal opening ceremony on November 12, presided over by the Pro-Chancellor, afforded an opportunity for an expression of gratitude to the many people concerned with establishing the Department, both from within the University and from outside it. On the evening of that day, the building was opened to the public for a display of its equipment and activities; the response, both numerically and in terms of interest, was considerable.

Occupation of a properly designed building will enable the Department to undertake various modifications in its teaching programme, especially in providing "project type" laboratory classes for undergraduate students, increasing the emphasis on seminars and discussion groups in advanced units and in planning for the presentation of further formal course work in biochemistry. The improved servicing and design of the new building has greatly facilitated development of our programmes of Honours and postgraduate instruction and staff research. The installation of an electron microscope provides an opportunity, long-awaited by all our research groups, for undertaking biochemical and ultrastructural studies in parallel. However, our inability to secure an experienced operator for the instrument (largely as a consequence of the restrictions imposed by the staffing formula) prevents the Department from achieving full value from the instrument and is a matter for some concern.

2. COURSES

- (a) Semester Units. The pressures on the Department during 1971 have prevented any large-scale changes in the pattern of undergraduate teaching. Six semester units were offered at the "pass" level, similar in content to those available in 1970. The unit described as "experimental" in the last Annual Report (Biochemistry III, now "Perspectives in Biochemistry") was retained, but with more emphasis on spoken presentation of scientific material. Further modification of assessment procedures took place in several units. In "Perspectives in Biochemistry", final gradings were determined by the accumulation of marks for either essays or seminars at three-weekly intervals throughout the semester. During the course each student wrote two essays and gave two seminars. In "Bioenergetics" the assessment was based on marks from two reports describing "project" experiments and on an oral examination. There was no final written paper. These changes were made as a further contribution to meeting the aims of departmental assessment, described in the report for 1970.
- (b) Our group of postgraduate students has shown no enthusiasm for the introduction of formal coursework into their training. They have, however, organised and participated in a fortnightly seminar programme throughout the year, in which a wide range of topics has been discussed. It is planned to continue and enlarge this programme in 1972, as a supplement to the normal fortnightly departmental seminars.

The postgraduate students' group have also made some initial approaches to the task of obtaining information about postdoctoral opportunities in biochemistry.

3. ENROLMENTS

Enrolments in biochemistry appear to have reached a steady proportion of the total in the Faculty.

EXAMINATION RESULTS

The values in the accompanying table make it clear that the level of achievement in units with "continuous assessment" (involving essays, seminars and project experiments) is higher than in others. (See the "pass" percentages for Biochemistry C02 and C04 and to a lesser extent, C03.) This appears to be a reflection of the level of interest in particular advanced units by the students who elect to enrol, the greater sense of personal involvement in the course work, the wider range of abilities tested, and the diminished reliance on memory. It is also noteworthy that the abilities tested are more closely akin to those which will be important in postgraduate activity.

4. STUDENT PARTICIPATION

- (a) Postgraduate and Honours Students. During the year it was agreed by the academic staff that elected representatives of the postgraduate students and the Honours group (and also the technical staff) should be asked to attend staff meetings, which are held about once a month. Thus all the various groupings of departmental members are represented at these meetings, though students and technical staff are not present for any discussions about academic progress or the assessment of individual students. The object has been to provide a regular opportunity for a general consideration of student viewpoints and to improve the communication of information back to the student body. Our experience to date suggests that the arrangement works well.
- (b) Undergraduate Students. The Student/Staff Liaison meetings have been convened three times during this year, with about 12 students attending on each occasion. The detailed discussions of the content and assessment methods for the various courses have produced some minor variations in previous practice. Despite the poor attendance and the absence of new issues of general importance, staff members feel that the opportunity for regular discussion is valuable and should be retained; we would, however, welcome evidence of a much greater enthusiasm among the students themselves!

5. WORK OF GRADUATE STUDENTS

Brief comments on the work of our postgraduate students is included below in the discussion of staff research activities.

6. STAFF

Professor and Head of Department

L.M. Birt, Ph.D. (Melb.), D. Phil. (Oxon).

Senior Lecturers

L. Dalgarno, B.Agr.Sc., Ph.D. (Melb.).

F.L. Bygrave, M.Sc. (Otago), Ph.D. (Q'ld.).

M.J. Weidemann, B.Agr.Sc., Ph.D. (Melb.).

Lecturers

A.J. Howells, B.Agr.Sc., Ph.D. (Melb.).
R.C. Weir, B.Sc. (Adel.), Ph.D. (Lond.).

Senior Demonstrators

T.D. Rainforth, M.Sc. (Well.).
K.C. Reed, M.Sc. (Melb.).

Demonstrator

Mary W. Kelly, B.Sc. (Q'ld).

Research Assistants

Elizabeth Smith, Ph.D. (A.N.U.)
Mary L. Williams, B.Agr.Sc. (Melb.).

Head Technician

B. Thorpe.

VISITORS

Professor W. Bartley, Head of the Department of Biochemistry at the University of Sheffield has held a visiting Professorship in the Department during the year. He has contributed to the undergraduate semester units, the Honours programme and has participated in the work of Dr. Dalgarno's research group.

RESEARCH

- (a) (i) Professor Birt. (Investigation of bio-synthetic processes during adult development of the blowfly, *Lucilia*.)
Substantial progress has been made during the year in estimating the quantitative importance of synthetic processes *de novo* during adult development in the sheep blowfly. Dr. E. Smith (Research Assistant) has demonstrated the presence of hitherto unreported proteolytic capacity which appears to be responsible for degrading larval reserves of protein to the amino acids required for adult syntheses. K. Williams (Ph.D. student) has described in detail the characteristics of a sarcosomal system capable of amino-acid incorporation into protein, the synthesis *de novo* of sarcosomal cytochrome c and the rates of synthesis of bulk adult protein from free amino acids during metamorphosis. Miss A. Campbell (Ph.D. student) has investigated the rate of synthesis of α glycerophosphate dehydrogenase in the cytosol and the influence of metabolic inhibitors on this process. Definition of the general biochemical properties of the sterile insects used in all these studies continues. The group's work

during the year has provided a complete resolution of the ambiguities and contradictions present in the literature on protein synthesis during Dipteran metamorphosis.

- (ii) Dr. F.L. Bygrave. (Regulation of mitochondrial development and metabolism). Bygrave has continued work on the involvement of metal ions in cellular metabolism. Studies on the kinetics of calcium accumulation by rat liver mitochondria are in progress (with Mr. K.C. Reed). The binding of calcium by mitochondria and the isolation of a calcium-binding protein from these organelles have been investigated. The influence of calcium on the adenine nucleotide translocase of rat liver mitochondria is being examined (with Mr. T. Spencer, Ph.D. student). These studies are designed to provide further information about the relation between the structure and function of the mitochondrial membrane.

Biosynthetic mechanisms for phospholipid formation in the cell continue (with Mrs. M.L. Williams, Research Assistant). Attempts are being made to determine the relative importance of mitochondria and microsomes in this process (with M. Rao, a Colombo Plan student). In collaboration with Professor R.N. Robertson, studies on the mechanism of oxidative phosphorylation are continuing.

- (iii) Dr. L. Dalgarno. Dalgarno has continued biochemical work on the replication of arboviruses in vertebrate and mosquito cells grown in tissue culture (with D.P. Dennett, Ph.D. student and Miss M.W. Kelly) and has started an electron-microscopic study of their replication in mosquito cells (with Mr. R. Raghov, a Ph.D. student jointly supervised by Dr. T.D.C. Grace, CSIRO Division of Entomology). Studies on the physico-chemical properties of insect ribosomal RNA have continued; it has been shown that these RNA species have unique properties which distinguish them from bacterial and mammalian ribosomal RNA.

- (iv) Dr. M.J. Weidemann. Weidemann continues his studies on the interaction of insulin with rat liver plasma membranes, the metabolic regulation in lymphoid tissue and characterisation of the mitochondrial adenine-nucleotide transporting system. With Mr. P.D.R. House (Ph.D. student) preliminary studies have been undertaken on the kinetics of I^{125} -insulin binding to low-density plasma membranes from rat liver. Complementary studies on the interaction of insulin with membrane-bound enzymes have shown that the hormone depresses 3'-5' cyclic AMP levels by stimulating a specific phosphodiesterase. With D. Suter and P. Hickman (Ph.D. students) the regulation of glycolysis and the interaction of carbohydrate and fatty acid metabolism have been studied in whole and fragmented preparations of rat spleen. Work has also been commenced on determining the usefulness of the "graft versus host" reaction in rats as a model system for studying metabolic regulation in the transforming lymphocyte.

Work on the nucleotide translocase system has concentrated on the development of assays for ADP binding and on techniques for releasing ADP-binding proteins from rat heart mitochondria as a preliminary step towards isolating the adenine nucleotide carrier.

(v) Dr. A.J. Howells

- (a) The biochemistry of eye pigmentation in *Drosophila*. The levels of the various enzymes and intermediates of the ommochrome pigment pathway are being established at different stages of development in order to localise developmental controls (with Miss R. Austin, Ph.D. student). Particular attention is being given to the properties of tryptophan pyrrolase, which is probably the rate-limiting enzyme in the pathway.
- (b) Nucleic acid and protein synthesis in *Drosophila*. A new technique developed by R. Davey (Ph.D. student) is being used to determine simultaneously the levels of a large number of different transfer-RNA species at different

stages of development. This technique will be used, in conjunction with a recently defined cell-free system, to investigate the importance of translational control of protein synthesis during adult development. Studies on comparative rates of ribosome synthesis in a wild-type strain and a ribosome-deficient mutant are being continued.

- (vi) Dr. R.C. Weir. An investigation of the control of DNA synthesis in eggs and embryos of the frog, *Xenopus levis*, is continuing. The purification and characterisation of enzymes involved in DNA synthesis has been commenced.

(b) RESEARCH GRANTS

The following grants have been received from the A.R.G.C. for 1971. Professor Birt, \$6,811 (personnel and maintenance); Dr. Bygrave, \$8,095 (for personnel and chemicals) and, with Professor R.N. Robertson, \$2,200 (for chemicals); Dr. L. Dalgarno, \$4,597 (for personnel and maintenance); Dr. M.J. Weidemann, \$5,500 (for equipment and maintenance); Dr. A.J. Howells, \$1,750 (for maintenance).

Dr. F.L. Bygrave also received a grant of \$3,500 (for animals and chemicals) from the A.C.T. Cancer Society.

(c) OTHER ACTIVITIES

Employment Prospects

The staff of the department continues to be aware of the need for amassing reasonably precise information about employment prospects for graduates in biochemistry, for the guidance of undergraduate students. During 1971, we have continued to collect advertisements for biochemists appearing in newspapers throughout Australia. In collaboration with Dr. G. Cox of the Biochemistry Department, JCSMR and with the support of the Australian Biochemical Society, letters are being sent to advertisers seeking information about the number and qualifications of the applicants for each

advertised post. A preliminary analysis of the response indicates that there is a steady demand (approximately five new posts advertised per week) for "biochemists" having a first degree (either pass or Honours), with relatively small numbers of applicants per post (an average of about six, ranging from 0-15). More detailed information will be available from the survey early next year.

7. PUBLICATIONS

Barritt, Lenore C.* & Birt, L.M. Development of *Lucilia cuprina*. Journal of Insect Physiology, 17: 1169-1183 (1971).

Bartley, W.,[‡] Birt, L.M. and Banks, P.[‡] Biochemie, Eine Einführung für Mediziner. 319 pp. Verlagchemie GmbH and John Wiley & Sons Ltd.(1970).

Birt, L.M. Structural and enzymic development of blowfly mitochondria. In Autonomy and Biogenesis of Mitochondria and Chloroplasts, pp. 130-139. North Holland Publishing Co. (1971).

Bygrave, F.L., Reed, K.C. and Spencer, T. Co-operative interactions in energy-dependent accumulation of Ca^{++} by isolated rat liver mitochondria. Nature New Biology, Vol. 230: 89 (1971).

Bygrave, F.L. and Roberts, J.B. Incorporation of ethanolamine into subfractions of rat liver. Proceedings of the Australian Biochemical Society, Vol. 4:34 (1971).

Campbell, Anne J. & Birt, L.M. The appearance of soluble glycerophosphate dehydrogenase activity during the adult development of *Lucilia*. Proceedings of the Australian Biochemical Society, Vol. 4: 99 (1971).

Dalgarno, L., Hosking, Dianne M.* and Shen, Cynthia H.* Steps in the biosynthesis of ribosomal RNA in cultured *Aedes aegypti* cells. Proceedings of the Australian Biochemical Society, Vol. 4: 107 (1971).

Davey, R.A. and Howells, A.J. The isolation of *Drosophila* tRNA and its esterification with amino acids *in vitro*. Proceedings of the Australian Biochemical Society, Vol. 4: 107 (1971).

* Former member. Based on work done while a member of Department.

‡ Not a member of this University.

- Kelly, Mary W. & Dalgarno, L. The growth of arboviruses in continuously cultured mosquito cells. Proceedings of the Australian Biochemical Society, Vol. 4: 76 (1971).
- House, P.D.R. Insulin binding to rat liver plasma membranes. Proceedings of the Australian Biochemical Society, Vol. 4: 75 (1971).
- House, P.D.R. Kinetics of I^{125} -insulin binding to rat liver plasma membranes. FEBS Letters, Vol. 16: 339-343 (1971).
- Michaelis, Frances B.* & Dalgarno, L. Biochemical aspects of the attachment of a pig-kidney monolayer cell line to glass surfaces. Experimental Cell Research, Vol. 65: 43-48 (1971).
- Nurmi, Susan & Birt, L.M. Mitochondrial amino acid pools in developing adults of *Lucilia*. Proceedings of the Australian Biochemical Society, Vol. 4:66 (1971).
- Smith, Elizabeth & Birt, L.M. Proteolytic activity during development of the blowfly, *Lucilia*. Proceedings of the Australian Biochemical Society, Vol. 4: 100 (1971).
- Spencer, T. & Bygrave, F.L. The influence of calcium ions on the atractyloside-sensitive translocation of adenine nucleotides by rat liver mitochondria. Proceedings of the Australian Biochemical Society, Vol. 4: 97 (1971).
- Spencer, T. & Bygrave, F.L. Stimulation by calcium ions of atractyloside-sensitive-adenine nucleotide translocation in rat liver mitochondria. Biochemical and Biophysical Research Communications, Vol. 43: 1290-1296 (1971).
- Weidemann, M.J., Erdelt, H.[†] & Klingenberg, M.[†] The mechanism of bongkreikic acid inhibition of adenine nucleotide translocation in heart mitochondria. Proceedings of the Australian Biochemical Society, Vol. 4: 97 (1971).
- Williams, K.L. & Birt, L.M. Amino acid incorporation into thoracic mitochondria of *Lucilia* during adult development. Proceedings of the Australian Biochemical Society, Vol. 4: 100, 1971.
- Williams, K.L. & Birt, L.M. Incorporation *in vitro* of ^{14}C -leucine into the mitochondrial protein of *Lucilia cuprina*: I. Basic requirements. European Journal of Biochemistry, Vol. 22: 87-95 (1971).

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† Not a member of this University.

Williams, K.L. & Birt, L.M. Incorporation *in vitro* of ^{14}C -leucine into the mitochondrial protein of *Lucilia cuprina*: II. Energy requirements. European Journal of Biochemistry, Vol. 22: 96-103 (1971).

Williams, Mary L. & Bygrave, F.L. Incorporation of ethanolamine into subfractions of mitochondria isolated from rat liver. Proceedings of the Australian Biochemical Society, Vol. 4: 35 (1971).

THE AUSTRALIAN NATIONAL UNIVERSITY

DEPARTMENT OF BIOCHEMISTRY ANALYSIS OF STUDENT PERFORMANCE

1 Subject or unit	Percentage of Number Enrolled ^(c)						Percentage of Number Sitting ^(c)															
	2 Enrolled as at 30.4.71 (a)		3 Sitting		4 Wastage (i.e. 2 - 3)		5 Failure		6 Sitting		7 High Distinction		8 Distinction		9 Credit		10 Pass with Merit		11 Pass		12 Fail	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Biochem. B01	95	(100)	93	(98)	2	(2)	15	(16)	93	(100)	2	(2)	8	(9)	15	(16)	-	-	53	(57)	15	(16)
Biochem. C01	32	(100)	32	(100)	0	(0)	0	(0)	32	(100)	2	(6)	5	(16)	8	(26)	-	-	17	(52)	-	-
Biochem. C02	18	(100)	18	(100)	0	(0)	0	(0)	18	(100)	Nil	(0)	3	(17)	12	(66)	-	-	3	(17)	-	-
Biochem. C03	15	(100)	15	(100)	0	(0)	0	(0)	15	(100)	Nil	(0)	3	(20)	8	(53)	-	-	4	(27)	-	-
Biochem. C04	16	(100)	10	(100)	6		0	(0)	10	(100)	1	(10)	4	(40)	3	(30)	-	-	2	(20)	-	-
Biochem. C05	22	(100)	22	(100)	0	(0)	3	(14)	22	(100)	Nil	(0)	4	(18)	7	(32)	-	-	8	(36)	3	(14)

	Enrolled (as at 30 April 1971)	Sitting	Results
Final Honours	8	8	3 H1; 4 H2A; 1 H2B
Masters' Qualifying	1	1	N
Masters Degree	Nil		
Ph.D.	10 (plus 3 staff candidates)		