David T. Canvin
1931-2010

David (Dave) Canvin died at the resort he owned on Desert Lake just north of Kingston on March 16, 2010 aged 78. He leaves behind his wife of 52 years Marie and his three sons, Steven, Paul and Robert. His daughter, Sarah, died in 2006 under tragic circumstances. Dave was an eminent plant scientist well known and respected not just in Canada but throughout the world.

Dave grew up on a small farm in Selkirk, Manitoba just north of Winnipeg. After high school, he attended the University of Manitoba in Winnipeg where he graduate with a B.S.A in Agriculture. He remained at the University of Manitoba obtaining an M.Sc.in Plant Science.

For his Ph.D., he joined Harry Beevers' research group in the department of biology at Purdue University. Beevers at that time was studying the means by which germinating seeds converted storage oil into carbohydrate for the growth of the developing embryo. To determine the pathway involved, Canvin fed a variety of ^{14}C labelled substrates to slices of germinating castor seed endosperm. This pioneering work showed that acetate, produced from the breakdown of fatty acids, was converted to glucose through the operation of the glyoxylate cycle and the reversal of glycolysis. This work, which was published in 1961 in the Journal of Biological Chemistry (Canvin, D.T. and Beever, H. JBC 236, 988-995) showed the power of radio isotopes in understanding metabolic pathways and established Canvin as an expert in this area. The significance of this early work was demonstrated by its selection as a Classic paper in a JBC publication in 2005 to commemorate 100 years of the journal. .

On completion of his Ph.D., Canvin returned, as a professor, to his alma mater, the University of Manitoba. However, his tenure there was short when he accepted a position in 1965 as professor of biology at Queen's University in Kingston, Ontario, where he was to spend the rest of his career.

At Queen's, he immediately established a research group. However, this time it was not on the breakdown, but on the synthesis of fatty acids in developing castor seeds . The descendents of the original castor plants established at Queen's by Canvin in 1965 are still grown in the greenhouse at Queen's University and are now used by plant biochemists such as Bill Plaxton.

Working with his graduate students, Hugh Drennan and Brian Zilkey, Canvin developed a sucrose density gradient procedure for separating the cellular components from castor endosperm, and showed that, unlike animals, fatty acid synthesis occurred in plastids not in the soluble phase of the cell (Zilkey, B.F. and Canvin, D.T. 1971 Can. J. Bot., 50, 323-336). This led to considerable controversy but was finally resolved by the demonstration by Ohrogge and Stumpf that acyl carrier protein, the essential component in fatty acid synthesis was predominantly in the plastid fraction of plant cells. This again stressed the uniqueness of plant metabolism and the essential role of plastids. It has now been shown that most biosynthetic pathways occur in plastids, an organelle unique to plants.

A number of lively debates between Canvin and one of us (DTD) regarding the origin of the carbon in fatty acid biosynthesis, led to a very fruitful collaboration that established the presence of a glycolytic pathway in plant plastids. These pathways were catalyzed by isozymes that were shown to be distinct from their cytosolic counterparts, work that established the importance of the compartmentation of plant metabolism and demonstrated that plant metabolism was quite different from what is found in animals.

In 1968, on Gleb Krotkov's sudden death, Dave Canvin took over the supervision of Gleb's research group which led him into the area of photosynthesis and photorespiration. Krotkov had shown that when photosynthesis was terminated by extinguishing the light source, there was a burst of carbon dioxide release from the leaves. The amount released was dependent upon the level of oxygen. In an elaborate experiment involving multiple isotopes, Canvin showed that carbon was liberated not just on the termination of illumination but during the whole of photosynthesis and that it represented as much as 25% of the carbon the had been newly fixed by photosynthesis. From the measurement of oxygen isotope exchange in leaves, he concluded that photorespiration was an integral part of photosynthesis. It was not until much later that the oxygenase activity of rubisco was found and shown to be responsible for this release of newly fixed carbon. His pioneering work on gas exchange cemented his reputation as one of the premier experimentalists of his generation.

Canvin's work on photorespiration led inevitably to him working on green algae and cyanobacteria that appeared to lack the process. He showed that these organisms could concentrate carbon dioxide in their cells, effectively outcompeting oxygen at the active site of rubisco. Through collaboration with a number of student and post-docs Dave's team demonstrated that the "CO2 Concentrating" mechanism was the product of active CO2 and HCO3- transport. Although the major focus of Canvin's work was carbon metabolism, over the years his lab also produced a range of important discoveries on the processes and location of nitrate and nitrite reduction in plant cells.

When one considers Canvin's research, it is clear that he was at the forefront in establishing new areas of plant metabolism that are now taken for granted. Looking back, it is clear that his work played a major role in changing the way we envisage plant growth and development. He was a technical expert who was unrelenting in his demand for accuracy. This was illustrated by an advanced undergraduate course on the use of isotopes. This course was viewed as the most technically demanding undergraduate laboratory course in the department and trained a generation of exceptionally talented biochemical researchers. The first experiment consisted of each student being given a black bottle in which Canvin had placed a carefully measured amount of water. The students were supplied with a radioactive solution. All they had to do was pipette some of this solution into the bottle, measure the reduction in radioactivity and hence deduce the volume of water, but it had to be very accurate and students could not proceed with the next experiment until they got it right. As the course progressed students carried out experiments measuring 14CO2 gas exchange and tracing 14C labelled substrates as they were metabolized through a variety of pathways.

Canvin's impact, however, goes beyond a simple discussion of his research accomplishments. He was a great mentor not just to his students and postdocs, but to his university colleagues and just about anyone who knew him. He would give endlessly of his time and expertise to help anyone willing to work hard and strive for excellence. He did not suffer fools gladly. He would challenge every scientific conclusion from a wide range of fields and expected the proponent to defend their position in discussions that could last for hours, days or years. His integrity and honesty were absolute.

Outside of research, he made many contributions at Queen's, within Canada and internationally. He served on the Queen's Senate, was President of the Faculty Association, the Head of Biology

Department and Dean of Graduate Studies. In all these areas, he made a very significant contribution to the university.

Nationally, he served and was chair of the NSERC Plant Biology Grants Committee, a member of the Ontario Graduate Programme Appraisal Committee, a member of the Technical Advisory Committee on Nuclear Fuel Waste Management, Chair of the Committee of Heads of Biology in Ontario, Secretary- Treasurer of the Biological Council of Canada and Director of the Botanical Association.

As far as the CSPP is concerned, he served as Secretary-Treasurer, Vice-President and President, and in 1981 he was awarded the CSPP Gold Medal.

Internationally, he served on the editorial board of Plant Physiology, Planta, Cell and Environment, Photosynthesis Research and the Canadian Journal of Biochemistry. He was twice a consultant to the Food and Agriculture Organization (FAO) of the UN and twice a consultant to the FAO/International Atomic Energy Agency. In 1977, he was elected a Fellow of the Royal Society of Canada.

Perhaps as a reversion to his early life on the farm, in 1995 Dave Canvin retired from Queen's to fulfil a revelation that had occurred to him while in hospital for a bypass operation on his leg. Much to everyone's surprise he bought and operated Snug Harbour resort situated on beautiful Desert Lake about 35 miles north of Kingston. There he could be found mending cottage roofs, renting boats or simply drinking a beer with cottagers or visitors.

In all respects, he was a remarkable man who made a major contribution to our understanding of plants but who was also someone whom it was a privilege to know and have as a friend.

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(Author's title given as of the time of writing)