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Cover Page Footnote

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Left: Professor Jonathan Poulton, Emeritus faculty of the University of Iowa. Right: Photograph of a black cherry tree.

Solving the Mystery of the "Cyanide Bomb"

A Profile Story of Professor Jonathan Poulton by Tyler Jackson

He was raised in a religious family, took classes in Greek and Latin, and... ended up as a plant biochemist. No, that was not a typo. As uncommon and unbelievable as this sounds, a retired professor here at the University of Iowa, Dr. Jonathan Poulton, did just this. Jonathan thought hard about a career with religion and decided perhaps this wasn't the correct direction to go. So he took as many science courses in the United Kingdom's equivalent of high school (a grand total of three courses) over two years and applied to programs at Oxford as a biochemist. His decision to pursue biochemistry came over a dinner in which Jonathan elaborates, "a biochemistry undergraduate at Cambridge University was invited over for dinner one night and, within an hour of chatting with him, I suddenly knew what I wanted to do for the rest of my life." "It was the perfect marriage," Dr. Poulton states, "between chemistry and biology." This is where Jonathan's academic journey began.

Jonathan, now armed with new knowledge, applied to Oxford University and was interviewed at St. Peter's College. He was offered a scholarship there and began a four-year biochemistry degree, focusing principally on animal and microbial metabolism. It was during his final semester as an undergraduate that Jonathan received unexpected guidance regarding the next phase of his academic career. He had to enroll in a required course on Plant Biochemistry. He wasn't excited by that prospect, especially since it was being taught by a Prof. Butt! However, after attending a few lectures about what plants can do that animals and microbes cannot, Jonathan reconsidered applying for a job in clinical biochemistry and decided that "plants were where it was at." On graduating with his bachelor's degree, he was offered a position in Prof. Vernon Butt's lab for a D.Phil. in Plant Biochemistry. Apart from undertaking a little teaching, Jonathan focused on his lab research, specifically on "how plants make lignin", the polymer that makes up wood we see in everyday life. Jonathan was asked to elucidate a specific step in the lignin biochemical pathway in spinach by isolating and studying the enzyme that catalyzes that chemical reaction. Three years later, as Jonathan was wrapping up his research and writing the thesis for his doctorate, he puzzled about what to do after graduation. Jonathan subsequently won an Alexander von Humboldt Forschung scholarship to pay his way to undertake post-doc research with Prof. Grisebach at Freiburg University in Germany. Jonathan hopes everyone finds their own Professor Butt during their endeavors.

After two years there, Jonathan again faced the question "What should I do now?" He contemplated returning to England, but higher education was suffering from the political situation in Britain. By chance, Prof. Grisebach was hosting the internationally renowned plant biochemist Prof. Eric Conn (University of California-Davis) and asked whether Jonathan would go to dinner with this seminar speaker. To be honest, Jonathan was none too excited about this invitation but, after having heard Prof. Conn's seminar on how plants defend themselves against herbivores, he went! Just think about it! If animals get attacked by predators, they can get up and run away, but plants cannot.

Plants must rely on physical and/or chemical defense systems to protect themselves. One defense system that over 2,000 species of plants employ is to release the respiratory poison hydrogen cyanide (HCN) when they are attacked by herbivores. Since this compound cannot freely float around in the plant due to its toxicity, plants keep the cyanide as part of a sugar derivative called a cyanogenic glycoside. When the tissue is disrupted by attacking herbivores, enzymes quickly break down the glycoside to release cyanide. Prof. Conn's research was to try to determine how this "cyanide bomb" doesn't explode until tissue disruption, i.e. how the glycoside and its breakdown enzymes are kept apart until the tissue is damaged by herbivores.

In 1977, Jonathan moved to America and enjoyed "two and a half great years" at UC Davis. A highlight of his research was to determine along with other members of Prof. Conn's research team that in sorghum leaves premature detonation of the "cyanide bomb" is prevented by the glycoside being housed in the epidermis (skin layer) whereas the catabolic enzymes are located in the underlying mesophyll tissue. Only when the leaves are disrupted by herbivores or by mechanical damage will the bomb explode.

In 1979, Jonathan again faced the same challenge of determining how best to further his academic career. Deciding to stay in the U.S., he applied for 27 assistant professor positions. "I was very disappointed to get 25 'Dear John' letters saying that they were not interested in me." The only two universities that decided to interview him were the University of Iowa and MIT (Massachusetts Institute of Technology). When he came to the University of Iowa for interview, there was waist-high snow outside Hamburg Inn and, because he "came in his California coat", he discovered "what wind chill was for the first time!" Jonathan was offered and accepted an assistant professor position. In 1979, the Botany Department was above the present-day Chemistry Department. After settling in, Jonathan extended his work on the anatomy of the "cyanide bomb" by investigating the phenomenon in black cherry seeds, which, along with seeds of bitter almonds, peaches and apricots, release large amounts of HCN on tissue disruption. Jonathan did not have much teaching experience when he arrived at UI. To combat this inexperience, Jonathan sat in on the introductory botany course taught by former Botany Professor Robert Embree. This allowed Jonathan to refresh himself on some of the botany that he'd learned way back when and hadn't reviewed since. The following semester, he quickly "overcame fears of standing in front of all those people" (125 students) and absolutely loved teaching this class as well as his plant biochemistry course. So began Dr. Poulton's 31-year teaching and research career at the University of Iowa.

Among his other responsibilities were advising students, administrative duties, and "attending faculty meetings" (the latter mentioned in an unsettling tone of voice). Prof. Poulton worked his way up the system and was promoted to associate professor in 1986, eventually achieving full professorship in 1992. Aside from teaching and research, he was also involved in helping undergraduates join research labs through his leadership role in the Biology Honors Program. He always advised students to "get involved in research" and, if possible, also teaching. The purpose was for his advisees "to get a feel for whether these things are right for them." At its April 2010 Recognition Ceremony, the University of Iowa Honors Program presented its Student and Staff Award for Outstanding Honors Advising to Prof. Poulton. This new award recognized his 16 years of extraordinary effort as the Biology Honors Advisor. Prof. Poulton also taught in large settings aside from the Honors Program, namely the "Principles of Biology" course in Macbride Auditorium, where he lectured to 450 students. "It felt like preaching from the mound; it wasn't teaching."

During the first 15 years of his Iowa career, he worked principally at the protein level, purifying and characterizing novel enzymes on both the synthetic and degradative pathways of several groups of plant natural products, including flavonoids, coumarins, cyanogenic glycosides and glucosinolates. When contemplating his research, he reminisces that "we were blessed with good grants throughout the years." In large part due to a sabbatical semester at Virginia Tech in 1995, his lab then incorporated molecular approaches to identify, clone, sequence, and study expression of genes encoding enzymes involved in natural product metabolism. A funding highpoint came in 2000 when, in collaboration with colleagues Ming-Che Shih and Chi-Lien Cheng, he was awarded a $1.6 million grant to investigate the functional genomics of two families of *Arabidopsis thaliana* genes. “What a luxury that was!” he said.

Prof. Poulton retired from UI in 2010. He had been advised by other retirees that "It's better that you go away during the first couple of weeks of the semester after you retire because, once you come back to campus, you'll find that it's totally different." He followed this advice and on returning in third week he realized it was no longer his home. He knew that the great ride was over. That didn't make the experience less memorable than it was. Later that semester, Prof. Poulton was asked by one of his former colleagues to give a guest lecture on photosynthesis, a lecture that he’d done a myriad of times before. It was a 75-minute lecture shortly after lunch and, on that afternoon, it seemed to be a long session for both professor and students! That was a warning sign for Dr. Poulton that maybe teaching was a thing of the past! Prof. Poulton doesn't regret a moment of his career as a professor and often reminisces about all the good times (but "grading exams less so!"). Nowadays, he volunteers in the Department of Biology Greenhouse during the winter. Each summer, he crosses daylilies in an attempt to create a true blue daylily, a fitting conclusion to a career rich with phenomenal stories, research, and teaching. He remains a firm believer in this maxim: "If you receive advice or recommendations from other people, seriously consider them and, if you believe this is right for you, follow them."