From Seed to Seed

Seed to Seed, The Secret Life of Plants. (2006). By Nicholas Harberd. Bloomsbury Publishing Plc. Hardback, 302 pp. Price £16.99. ISBN: 0-7475-7039-6.

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I bought this book last summer when it was published, based on a couple of early reviews. I read the first half in July 2006, when I was away from home, 10-20 pages or so a night. It was a nice way to wind down at the end of the day and I enjoyed it, but upon returning home I put it aside. About 6 months later, when I was asked to review the book, I read the 2nd half, and then re-read the entire book again, in one sitting. Overall, I recommend this book. It will be a fun read for scientists, especially those that work with, or are considering working with, *Arabidopsis*. It would also be a nice gift for non-scientist family members or friends who wonder what it is that scientists do.

The book is a diary of ruminations/introspections about plant development and about the main research topic of Nick Harberd's laboratory. His intended audience is initially non-scientists; many of the explanations come about from questions his children ask him about what he does at work. Harberd's group studies restraint of plant growth. This restraint is mediated by a group of transcriptional regulators, the so-called DELLA proteins. The story started in the 1990s, when the group studied an *Arabidopsis* mutant called *gai* (for gibberellin insensitive). Gibberellic acid (GA) is a plant hormone that causes plants to grow, but how the hormone did that was not known at the time. The *gai* mutant was dwarf, but had normal amounts of GA. When the *gai* gene was cloned, they found that it encoded a DELLA protein, and found that the *gai* mutant was dwarf because a part of the protein (the DELLA bit) was deleted in the mutant version. This part of the protein was recently[(1)] shown to interact with the gibberellin receptor and to thereby target DELLA proteins for degradation. Once DELLAs are gone, the plant can grow. The *gai* version of the DELLA protein doesn't disappear. Proof of the relief of restraint hypothesis? Plants lacking both GA and DELLA proteins are tall.

Harberd's group had made a major discovery about the DELLA proteins in 2002.[(2)] But as 2004 begins he feels stuck, says he has no bright ideas about what experiments to do next. A conversation with his son about a class project (watching beans grow) inspires him to try to think about plants in the real world. He decides that keeping a diary might jumpstart his imagination.

The premise that holds the diary together is an *Arabidopsis* plant growing in nature, not in the laboratory. It is funny how he finds the plant—he'd been looking around for an *Arabidopsis* plant outside somewhere, without luck. He checks The Flora of Norfolk to get ideas for where to look. Accompanying the description of habitat is a sketch of the plant, with a gravestone in the background. Voila, he tries a nearby churchyard and finds three *Arabidopsis* plants. He selects one of these as his subject and decides to watch over it throughout its life cycle. Throughout the year, he rides his bicycle out to check on the plant, so there is a lot of time for natural history and the changing landscape of each season. The writing style is often poetic (''seedlings are tiny crucifixes planted in the grave''). Many entries begin by describing the weather that day, presumably an understandable obsession in England. In March there is a bit of high drama, when a slug is caught nibbling the plant, but luckily it moves on; later when something else chomps on the plant and nearly destroys it, Harberd cheats a little and constructs a chicken wire fence for protection.

As the year proceeds, Harberd manages to cover in some depth almost all aspects of what is happening in the plant. He doesn't shy away from using technical terms, but the explanations are easy to follow. For example in February, to tell how his plant managed to survive the cold winter (it had started growth in late summer), he explains transcription and translation, cold-regulated transcription factors, and cold-induced gene activation cascades. In March he starts to provide a history of the research in his group. My favorite part, about how the *gai* gene was cloned (in 1996) by transposon tagging, is both lucid and suspenseful. When the progeny from his plant finally germinate in September, he notes that one is taller, since it is shaded by a nearby dandelion leaf, then explains the details of light perception by the photoreversible photoreceptor protein phytochrome, including how it is shuttled from the cytoplasm to the nucleus, where it binds to the transcription factor PIF3. He also covers microRNAs, scaling laws, the ABC model of flower development, how plant pigmentation patterns are controlled, root development, the ubiquitin/proteasome degradation machinery, etc.

The concept of the diary does end up working for him — in mid-year he gets unstuck—he decides he should work not only on how DELLA proteins do what they do, but on WHY. Why is it beneficial to the plant to control its growth? Perhaps DELLAs help the plant decide when to grow or not, for example, when presented with stressful conditions (he gets this idea while walking in a salt marsh). The experiments to test these ideas are nicely described in the 2nd half of the year. His daughter joins in the game, suggesting in October that he should use DELLAs to keep a tree that is shading their garden from getting any bigger.

There might be some artistic license in the timeline, since as near as I can work out, the research discussed in October as

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an unfolding new discovery was already accepted for publication in April of the same year.[3]

The text is interspersed with very nice hand-drawn diagrams, not only to illustrate various features of the plant life cycle and structure, but also to explain different experimental treatments and the predicted outcomes of the manipulations.

We get a sense of his personality and why he is driven to find things out. During the year, he sometimes feels overwhelmed with the obligations of traveling to meetings, writing grants and manuscripts (although he does manage a couple of nice vacations). He worries that perhaps competitors should talk more. He vows in October to continue to be astonished — once we know something everyone says, well, of course that's how it works, no surprise. That science/nature is wonder-ful and that we should not lose that sensation as we know more mechanistically. But there is a feeling of distance—only his children are mentioned by name. In November he says that he has ''too much to do, …. a research group to inspire and manage'', but the diary gives no sense of how he does that. You don't get a strong sense of laboratory dynamics, or that the choice of research direction, design of experiments, or discussion of the results are a group effort. He has successful collaborations, but how they came to be and how they work is not explained. Similarly, writing manuscripts about the work is painted as a solitary exercise. The acknowledgements do list and thank the present and past members of his laboratory, and his collaborators.

An afterword written in summer 2005 updates us as to what has happened with the two manuscripts being prepared in fall 2004; one was published in early 2006,[4] while the other has not yet appeared. That's our business—sometimes frustrating but you keep trying because you want to find things out.

References

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