subtitle "Tracing evolution from molecules to genes to phenotypes". Most authors would have gone from genes to phenotypes without bothering with the molecular level. But not Craig, who states that one of her goals is "to illustrate the ease with which evolutionary studies of spiders and silk proteins can cross traditional molecular and organismal borders". Thus silk proteins are "the perfect system through which to study evolutionary conflicts among molecular genetic constraint, protein architectural constraint, protein diversity and selection". Indeed, silk has evolved to function as a dead material outside the animal's body. And silk is only one step (spinning) removed from the protein in its native form; the chain from gene to raw protein to dehydrated protein fibre is brief.

But more importantly, the fibre, once drawn — whether as a simple drag safety line or as a structural member in a web — is the phenotype that is selected more or less on its own, distinct from its creator. This is unusual for a protein and suggests that silk might allow for shortcuts in the study of protein evolution — yet another reason why studying silk might provide interesting insights into the more general aspects of protein folding.

Be that as it may, Craig's *Spider Webs and Silks* brings a fascinating and important subject to a potentially broad audience. And it might even turn some arachnophobes into arachnophiles. ■

*Fritz Vollrath is in the Department of Zoology, South Parks Road, University of Oxford, Oxford OX1 3PS, UK.*

# From genes to biochemistry

**George Beadle, an Uncommon Farmer: The Emergence of Genetics in the 20th Century**
by Paul Berg & Maxine Singer
*Cold Spring Harbor Laboratory Press: 2003. 383pp. $35, £25*

**Benno Müller-Hill**

Genetics is a young science, having its roots just 100 or so years ago in the rediscovery of Gregor Mendel's work on inheritance in peas. These days, this history is left out of most textbooks and is rarely taught at university. Today's students learn only about what has happened in the past five years, not about the pioneering work that opened up their field — they know nothing of the giants on whose shoulders they stand. If you ask today's advanced genetics students about George Beadle (1903–1989), you would be met with a deafening silence. So it is fortunate that Paul Berg and Maxine Singer took the time to write a book about this great pioneer.

CALTECH

**Field work: at Cornell, George Beadle (kneeling) studied maize genetics with Barbara McClintock (right).**

They describe Beadle's family and his childhood and youth on a farm close to Wahoo, Nebraska. His father prevented his elder brother from going to agricultural college, but when this brother died after being kicked by a horse on the farm, George was allowed to go the agricultural college in Lincoln, where he developed an interest in maize genetics. His intelligence and hard work impressed his teachers, who sent him to Cornell University in Ithaca, New York, where he continued to work on maize genetics. There he met Barbara McClintock, who demonstrated that maize has ten chromosomes. But her supervisor was not amused when she published this under her own name without including him as a co-author.

Beadle's work on maize genetics earned him a PhD in 1929, after which he moved to the California Institute of Technology, which was an exciting place to be. Thomas Hunt Morgan had just moved there, and the authors describe his fly group in a separate chapter that is a must for students. I would have liked to hear more. For example, the authors mention that the undergraduate Alfred Sturtevant produced the first linear map of five genes of the fruitfly's X chromosome, and that Morgan allowed him to publish his results without demanding his own name on the paper. Berg and Singer don't comment on this, but how many professors would allow this today?

Beadle started collaborating with Boris Ephrussi, who was on sabbatical there, to try and understand what a gene produces. For Morgan and his group, the gene was abstract, but Beadle and Ephrussi wanted to come closer to biochemistry. They concentrated on *Drosophila* mutants with different eye colours, *vermilion* and *cinnabar*. After five years they concluded that tryptophan is converted by the vermilion gene into a substance of unknown structure. So it was a blow in 1940 when they read in the journal *Naturwissenschaften* that Adolf Butenandt had identified the compound as 3-hydroxykynurenine. Five years' work and then scooped!

Ephrussi then moved into a different field but Beadle stuck to the problem. During a lecture by his postdoc Edward Tatum, Beadle had the idea of treating microorganisms with mutagens and isolating mutants that are unable to produce amino acids, hormones or other substances. These mutants will then show that one gene produces one enzyme. Tatum did the experiment using the fungus *Neurospora*. It worked like a charm, and hundreds of such mutants were isolated and analysed. What worked well with *Neurospora* worked even better with the bacterium *Escherichia coli*. One of Tatum's students, Joshua Lederberg, showed that such mutants could be isolated, and demonstrated genetic exchange between two mutants of *E. coli*. In 1958, Beadle, Lederberg and Tatum shared a Nobel prize for their work. As Ephrussi wrote to a friend: "I suddenly felt my life wasted."

But the story does not end here. When the experimental problem was solved and Beadle had convinced the sceptics, he moved into the field of administration at Caltech, first as chairman of the biological faculty and then as president. He excelled at hiring excellent faculty and defended Linus Pauling when he was attacked as a communist. Even after his retirement, Beadle returned to a familiar problem: was teosinte, a wild grass from Mexico, really the predecessor of maize?

The book tells us in detail about Beadle's two marriages, the salaries he earned (but not their equivalent values today), his journeys by ship and by train, and the fact that he succumbed to Alzheimer's disease. There is plenty here for everyone. Those interested in the history of genetics will want to read the whole book, but today's students would benefit from just a few chapters. ■

*Benno Müller-Hill is at the Institute of Genetics, Cologne University, Weyertal 121, 50931 Cologne, Germany.*

# A recipe for success?

**Organic Syntheses Database**
*Wiley/Organic Syntheses, Inc: 2003. http://www.interscience.wiley.com/db/os*
*Available through a site licence.*

**John Mann**

The total synthesis of complex natural products remains one of the most tangible and often elegant demonstrations of the chemist's craft. Some practitioners have turned these endeavours into something approaching an art form. It is also often

Installation

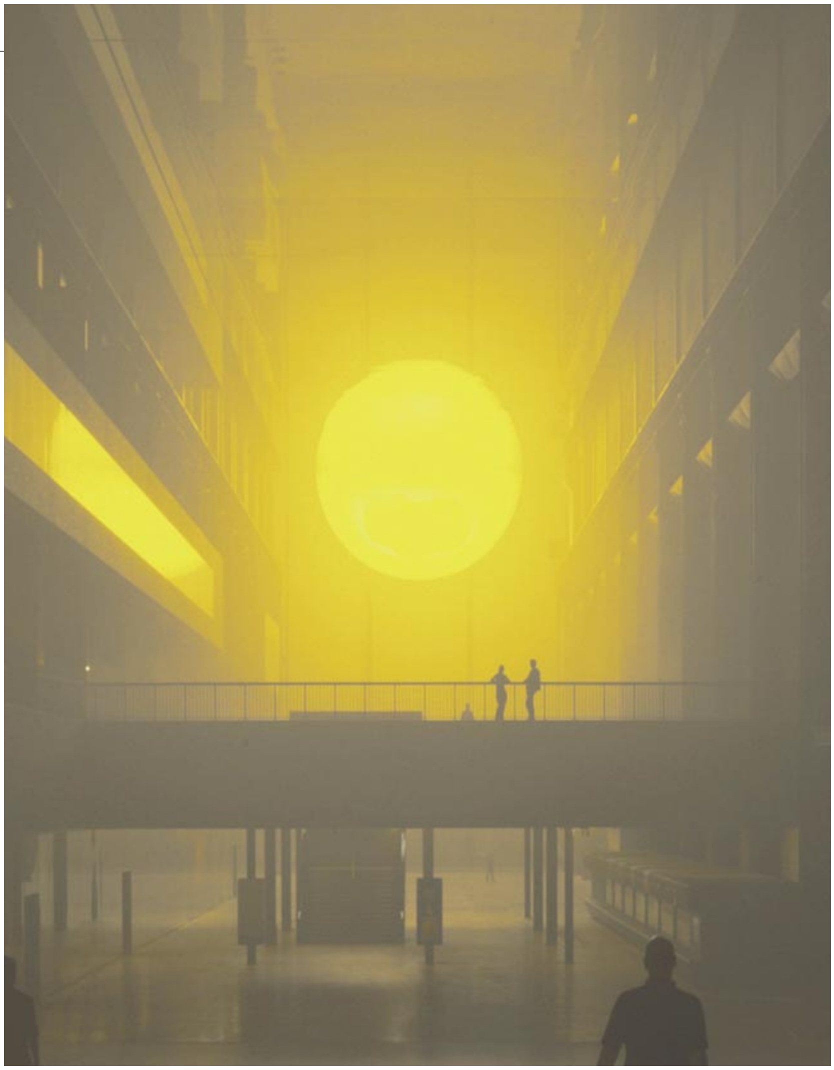
## Making haze

Built specifically for the vast, multistorey space of the Turbine Hall at Tate Modern in London, Olafur Eliasson's installation *The Weather Project* is mesmerizing. A huge sun blazes at the far end of the hall, its light diffused by artificial fog, creating a dynamic microclimate.

The Danish–Icelandic artist's work investigates the dichotomy between nature and culture. Here he tackles the weather, a ubiquitous topic of conversation, which he says "somehow defines a sense of community, within which conflicting views can be accommodated, such as liking or not liking rain". By introducing meteorological variables — water, light, temperature and pressure — into artificial, built environments, he encourages viewers to reflect on their understanding of the natural world and their relationship to it. Eliasson is intrigued by perception and describes the moment when people pause to consider what they are experiencing as "seeing yourself sensing". But even though all is not as not seems, his aim is to heighten people's awareness of their perception, not to deceive them.

At ground level, visitors can clearly see machines pumping artificial haze into the hall and the bank of mono-frequency lamps that powers the semicircular 'sun'. From above, they can observe that the reflective 'sky' is suspended from the ceiling, both doubling the hall's apparent height and reflecting the half 'sun' to form a whole. **Colin Martin**

The Weather Project *can be seen at Tate Modern in London until 21 March 2004. The work is the subject of an extensively illustrated book,* Olafur Eliasson: The Weather Project*, edited by the installation's curator, Susan May (Tate Publishing, £19.99).*



J. ZIEHE/O. ELIASSON

the only route by which quantities of rare compounds such as eleutherobin or bryostatins can be made available for biological evaluation. Any synthesis, whether of a rare, highly potent natural product or of a more mundane yet equally important intermediate for a prescription drug, requires the careful selection of starting materials and potential synthetic routes.

Synthetic chemists already have a number of information sources, including online search sites such as *Crossfire Beilstein* (www.beilstein.com) and the American Chemical Society's *SciFinder* (www.cas.org). There are also printed reference works such as *Fieser's Reagents for Organic Synthesis* (Wiley), *Comprehensive Organic Synthesis* (Pergamon, now Elsevier) and of course *Organic Syntheses* (Wiley).

*Organic Syntheses* is the 'Mrs Beeton' for synthetic chemists. If you can find a 'recipe' for the reaction or compound you wish to make in these volumes, you can guarantee that the chemistry will work, because each entry is checked for accuracy, safety and reliability. There is a cumulative index for the first 70 volumes, although many libraries do not have either this index or a complete set of 80 volumes. The release of the *Organic Syntheses Database* now provides access to all 80 on your computer screen.

So how does it perform? The user can search for structures and part-structures by importing these from one of their own drawing packages into a display box, and this is probably the most useful function. I tried several structures I wanted to synthesize and others that I knew to be within the volumes of *Organic Syntheses*, and obtained accurate links to the full text for all of them. Much less useful is the search for reaction types and named reactions. An enquiry about the aldol reaction elicited just one response, and no response was returned for queries on the Reformatsky and Heck reactions. Yet the term palladation produced two responses, both referring to syntheses submitted by Heck, and there are many others within the 80 volumes that have clearly been missed by this route.

Searches that use either keywords or author were generally very good, so searching for methodology associated with a key reagent, such as osmium tetroxide or palladium acetate, will elicit a large number of citations although, irritatingly, reaction names (Heck or Mitsunobu, for example) elicit nothing. The utility of the database is extended by the ability to search other Wiley databases, including EROS, the *Encyclopaedia of Reagents for Organic Synthesis* (although my login and password denied me access to explore these possibilities), and access to *Organic Reactions* will follow next spring.

Overall, the database is easy to use and will complement rather than replace the other existing online search tools. The one major advantage of the *Organic Syntheses Database* is that it provides access to an instant recipe that will work, rather than to a list of literature references in which the chemistry may or may not work.

*John Mann is at the School of Chemistry, Queen's University Belfast, Belfast BT9 5AG, UK.*