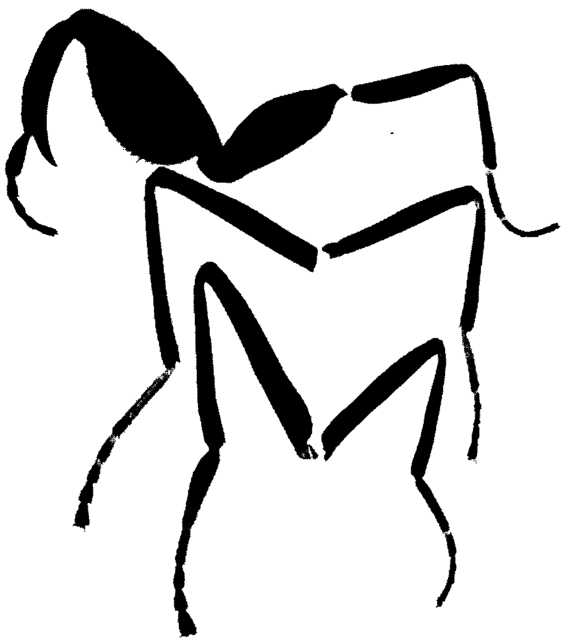
"The legs of two related flies. On the left a predatory species and, on the right, the equivalent legs of a peaceful relative." [From *The Making of a Fly*]



leave the reader with that impression.

Lawrence says the book is styled after Ptashne's *A Genetic Switch*. But whereas Ptashne's book constantly asks, how do we know what we know?, Lawrence's is more of a collection of stories about what is known. We know what we know about *Drosophila* embryos because of the nitty-gritty of molecular biology and genetics, but Lawrence's interest is primarily at the level of the cell and the group of cells. Consequently the descriptions of molecular and genetic experiments that define what is known about early embryogenesis sometimes come across rather flat and do not highlight why these experiments are truly exciting.

In contrast, the final three chapters on intrasegmental polarity, bristle spacing, and eye development give the best descriptions of these topics I have come across. Perhaps because the take-home lessons here are cellular rather than molecular, Lawrence's descriptions are at just the right level of analysis to capture the essence of these processes.

It is possible to publish a book like this in 1992 because the pace of progress in *Drosophila* developmental biology has slowed enough that the facts did not change fundamentally between the time of writing and the time of publication. I think this fact and Lawrence's presentation conspire to create the unfortunate feeling that the fly is made and we can all go home or go work on zebrafish now. There are a few topics that Lawrence points out as areas for future research, but these all sound like filling in the details, normal science after the revolution. Indeed we are living in a time of transition: now that many genes important in *Drosophila* development have been cloned, we need to think hard about how we can use what we have learned in order to address new problems, move to new levels of analysis, and apply the lessons from *Drosophila* to other organisms. I hope that students will not come away from this book with the sense that it's all over but will use it as a starting point for their own ideas that will take us into the new millennium of developmental biology.

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Reversal of Fate

Transdifferentiation. Flexibility in Cell Differentiation. T. S. OKADA. Clarendon (Oxford University Press), New York, 1991. x, 238 pp., illus. $98.

Prior to overt differentiation when they express recognizable phenotypes, cells in developing organisms are thought to pass through a state of determination in which the decision regarding their future fate is made. Although the outcome of these processes is generally assumed to be fixed, there are numerous examples in which differentiated cells can partially or totally switch their fate. This has led to the idea that perpetuation of the differentiated state may require active maintenance. The term "transdifferentiation" refers to the flexibility of cell differentiation, perhaps a consequence of "reprogramming" of already differentiated cells. The book *Transdifferentiation* by T. S. Okada provides a unique and thorough description of this important topic, knowledge of which is essential for a comprehensive understanding of the factors that control development.

The phenomenon of cell-type switching has been noted repeatedly over the last two centuries. The most common examples are associated with human pathological conditions, in which differentiated cell types arise in unexpected sites, or occur during regeneration of primitive organisms such as Hydra, in which an entire organism is recreated from a few adult cells. Until recently, however, there was controversy regarding the ability of specialized cells to switch their differentiated state during normal development. This stems largely from the difficulty of identifying and following the "transdifferentiating cell" within the organism over time, as a consequence of which it was impossible to distinguish phenotypic switching from differentiation of new cells from undifferentiated precursors. The advent of modern cell-culture and cell-marking techniques has obviated many of these problems, making it possible to verify a switch in cell phenotype in numerous cases. Because most cell types retain their full genomic complement of information long after differentiation, some dormant genes may be activated under appropriate conditions. Recent descriptions of tissue-specific gene expression suggest that one set of gene products is replaced by another, a phenomenon consistent with the possibility that transdifferentiation involves changes at the transcriptional level. The future challenge will be to unravel the molecular mechanisms underlying this flexibility and to compare them with the events of normal differentiation.

As a leader in this field, Okada is intensely aware of both the complexity and the importance of the concepts of transdifferentiation. Consequently, he unfolds the problem in a logical progression. The monograph first sets out to define the terminology, with the goal of eliminating unnecessary jargon and reconciling confusing terms such as "differentiation," "determination," and "commitment." The author then embarks on describing the process of transdifferentiation in numerous systems ranging from plants and *Drosophila* imaginal discs to mammalian neurons. Beginning with a straightforward examination of the relatively simple question of whether dormant genes can be activated by nuclear transplantation or the creation of heterokaryons, he proceeds to more complicated examples of transdifferentiation between apparently different cell types such as lens cells and neurons. Because transdifferentiation of adult cells can lead to cancer, Okada includes a cogent discussion of metaplasia in adult cells. Also discussed is the transdifferentiation that occurs during regeneration, where cells in lower vertebrates have the ability to grow new limbs, tails, and eyes after loss of these structures. Finally, the author reviews some of the possible factors and mechanisms influencing transdifferentiation. These include, but are not limited to, the number of mitotic cycles, the loss of the pre-existing phenotype, and the disruption of cell-cell contacts. The mechanism underlying transdifferentiation may vary depending upon the cell types and organisms involved.

In this book Okada gives a balanced view of transdifferentiation in many systems, presenting all sides of the argument in areas where discrepancies exist and providing useful historical perspectives. Given the large amount of information presented in a concise format, the sheer load of data is sometimes daunting. Because so little is known about changes in gene expression that accompany the process of transdifferentiation, this area is ripe for molecular analysis. The wide scope and potential significance of the underlying molecular mechanisms make Okada's monograph a review that should hold the attention of developmental, cell, and molecular biologists alike.

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Priorities for Plants

Genetics and Conservation of Rare Plants. DONALD A. FALK and KENT E. HOLSINGER, Eds. Oxford University Press, New York, 1991. xviii, 283 pp., illus. $49.95. Based on a conference, St. Louis, MO, March 1989.

No contemporary biologist is oblivious to the gathering cloud of extinctions that threatens to engulf our planet in a biological holocaust. If we are to forestall these losses, our efforts must be guided by both general principles and information specific to individual species. Falk and Holsinger have tidily assembled a distinguished set of population biologists to ponder and discuss the role of genetics in rare-plant conservation. To what degree should we concern ourselves with genetic factors? How does the distribution of genetic variation within and among populations affect population vulnerability? How can we best sample existing genetic variation for off-site preservation? What are the hazards of such *ex situ* conservation efforts?

The contributors differ widely in perspective and address a diversity of issues. Nevertheless, the chapters are of consistently high quality and will interest plant conservation biologists and those seeking genetic sophistication in their reintroduction or restoration efforts. Apart from their interest for conservation, many chapters stand alone as summaries of great value to population biologists interested in the causes and consequences of rarity. The editors and publisher have also succeeded in producing a useful book by providing a complete index and a comprehensive bibliography (850 references). Though the book is predictably parochial in focusing primarily on North American plants, the principles discussed are general and one chapter (Bawa and Ashton) is concerned with tropical plants.

Considerable consensus emerges on many scientific issues, including the variable (and often minor) role genetic diversity plays in population persistence, the advantage of making genetic surveys before designing sampling or protection schemes, and the differential sensitivity of populations and species to the damaging effects of genetic impoverishment. Such consensus, however, does not obscure controversy elsewhere: Should we always use locally adapted source material when restoring populations? When is it appropriate intentionally to amalgamate (or inbreed) captive stock?

The sharpest debate dividing contributors to the book concerns the wisdom of "off-site" preservation. Should biologists try to conserve rare species and their genetic variation through careful sampling and cryogenic storage or repeated propagation? Three chapters deal with how best to sample, assess, and maintain genetic material from plants, implicitly assuming that such *ex situ* programs will be needed to compensate for our growing failure with *in situ* conservation. Other chapters caution us against such measures, noting that captive-bred stock will be subject to reduced genetic variability and unpredictable levels of artificial selection. Some might wonder further whether *ex situ* preservation might serve as an excuse to allow further losses among natural populations.

Readers seeking discussions of how ecological variation affects the partitioning of genetic variation within and among populations will find them in the chapters by Hamrick *et al.*, Karron, and Millar and Libby. Those wanting a comprehensive review of ideas and data regarding the ecological importance of this variation should read Huenneke's stimulating chapter. Cladistics enthusiasts will be pleased to find discussions of how isozymes (Barrett and Kohn, Karron) and particularly analyses of cDNA and mtDNA variation (Schaal *et al.*) can be used to infer population bottlenecks. There are also up-to-date discussions about how such bottlenecks may actually release quantitative genetic variation. Several authors describe in some detail the hazards of combining genetic contributions from different areas ("outbreeding depression").

Barrett and Kohn emphasize the importance of population history and note a surprising persistence of inbreeding depression in many populations seemingly already inbred or otherwise depauperate in genetic variability. Studies of isozyme, DNA, and quantitative genetic variation frequently generate contrasting results, as reviewed by Schaal *et al.* and Millar and Libby. Brown and Briggs use the neutral theory and quantitative genetics to predict that rare alleles will be both scarce and of limited utility for captive breeding programs, favoring small samples for such efforts. Ironically, given the focus of the book, genetic factors only occasionally precipitate plant population declines. Most authors concede the preeminence of other factors, primarily habitat loss and degradation, in species conservation. Menges stresses these non-genetic concerns, injecting ecological common sense in his chapter on assessing minimum viable populations.

Neither ecology nor genetics appears to matter for some species needing protection. *Oryctes nevadensis* exists in only a few sites in California, is threatened by cattle trampling, and constitutes the only member of its genus in an economically important family, the Solanaceae. Yet the California Fish and Game Commission has twice failed to grant this "weedy looking" plant protection, perhaps in part because this species lacked the foresight to avoid growing on lands now owned by the Los Angeles Department of Water and Power. Holsinger and Gottlieb, however, also fault the conservation community in this instance for failing to rank rare species according to taxonomic uniqueness and the economic value of their relatives.

Falk agrees that priorities should be set and ambitiously attempts to link the diminishing returns for sampling allelic variation within populations to economic models based on setting of priorities in a world of limited resources. Conservation biologists, however, will hardly need to be reminded to allocate resources carefully and are unlikely to be enlightened by this superficial economic analysis. Even assuming conser-