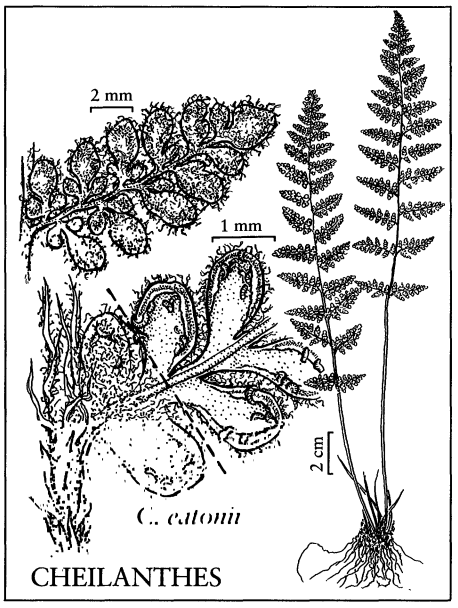
adopted system. There is an overview chapter outlining the Cronquist system, but the 18-page tabular exposition of this system lacks an index to families and thus will frustrate prospective users. Indeed, the index to the first volume is very sketchy; in spite of the attention given to Greene his name does not appear in the index. Clayton, Kalm, Michaux, fire, endemic, Tertiary, and Greenland also are missing from the index, though discussed in various levels of detail in the text.

In a chapter reviewing concepts of species and genera, G. L. Stebbins states that it would be useful if the numerous contributors of taxonomic treatments to *FNA* would work according to the same standards. He warns that "subjective opinions differ so much from one botanist to another as to produce anarchy if every contributor were left to his or her own devices." Wisely, the editors of *FNA* have not attempted to impose a uniform taxonomic philosophy upon contributors to the project and, happily, anarchy is not evident in the taxonomic treatments of volume 2.

The general editors for the pteridophytes, W. H. Wagner and A. R. Smith, discuss the bases and background for taxonomic circumscriptions and policies adopted in this diverse group. They argue for a conservative delineation of the fern genera *Woodwardia* and *Asplenium* but for disassembling *Athyrium*. How they convinced authors of their views is not revealed. They admit that some features of their approach "may prove to be . . . untenable." Gymnosperm editor J. E. Eckenwalder merges the cypress (Cupressaceae) and bald-cypress (Taxodiaceae) families into a single family. Though the arguments for this procedure are convincing, my guess is that tradition will delay its general acceptance for the indefinite future.

The treatment of conifers presented me with a few surprises. The most common montane white fir in California is now *Abies lowiana*, not *A. concolor*. The rare edaphic endemic pygmy cypress of northern California (*Cupressus pigmaea*) is "sunk," that is, relegated to synonymy under the more widespread *C. goveniana*. The federally listed Santa Cruz cypress (*C. abramsiana*) suffers the same taxonomic fate, scarcely with comment. Since the intended audience of *FNA* includes conservationists, a more detailed argument for the non-recognition of these two "sensitive" cypress taxa would have been useful. Indeed, the California Native Plant Society has provisionally agreed to advocate continued protection for several taxa that were not recognized in *The Jepson Manual* (1993), edited by J. C. Hickman; my guess is that it will adopt the same stance for *FNA*. Just how state and federal conservation agencies will handle this issue remains to be seen. These problems might be circumvented if legislative language concerning rare taxa were extended to include evolutionarily significant races or populations of species that are not necessarily accorded formal taxonomic status.



Taxonomic illustration from *Flora of North America North of Mexico*, vol. 2.

The keys and taxonomic descriptions in volume 2 are concise, straightforward, and consistent in format from group to group. Taxonomic treatments are sometimes accompanied by descriptions of breeding systems, chromosome numbers, natural hybridization, economic importance, and other curiosa. I would have welcomed more discussion of geographic variation in morphological and ecological features of the species as well. The format for giving geographic ranges of species risks overgenerosity: *Selaginella eatonii* is said to occur in Florida in habitats that occur widely in that state, yet its distribution map limits it to extreme southern Florida. The maps are often problematical: that showing the geographic range of Bishop pine (*Pinus muricata*) suggests a continuous distribution in California from the Oregon border southward to the Santa Barbara area, yet populations of this species are highly discontinuous, and only a single small population occurs between San Francisco Bay and central Santa Barbara County, a distance of about 300 kilometers.

What will be the shelf life of *FNA*? Wagner and Smith point out that "approximately 75 species [of pteridophytes] in the flora have undergone a name change" since the 1985 treatment of the group in *A Field Manual of the Ferns and Fern-Allies of the United States and Canada* by D. B. Lellinger. In addition, 58 taxa have been added to the pteridophyte flora, some newly described, others as a result of revised circumscriptions or range extensions. Thus, differences between the treatments in Lellinger's book and in *FNA*, separated by less than a decade, involve about 30 percent of the pteridophyte flora of the region. Perhaps the pteridophytes have received an unusual amount of systematic study in the past decade, but this magnitude of difference suggests that by the time the final volume of *FNA* appears the earlier ones will already be out of date to one degree or another. A database for *FNA* is maintained at the Missouri Botanical Garden; although the mechanics and details of its long-term financial support are not described, this database is expected to be continually updated and will be made accessible to the public, the botanical community, and various agencies. This continuing upgrading and free accessibility to a broad constituency should instill a form of immortality for *FNA*.

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Plasmid Transfer

Bacterial Conjugation. DON B. CLEWELL, Ed. Plenum, New York, 1993. xvi, 413 pp., illus. $89.50.

Bacterial conjugation and phage studies were the two pillars of molecular genetics at its inception. Basic concepts such as intercellular DNA transfer, autonomous replication and infectious spread of genetic elements, genetic and molecular circularity, and cytoplasmic regulatory proteins arose largely out of the pioneering efforts by Lederberg, Hayes, Wollman, and Jacob to understand and utilize conjugation. Together with transposable elements and temperate bacteriophage, F and other bacterial plasmids brought us a revolution in thinking about the fundamental mechanisms of genetic change. In particular, they led to the picture we now have of a fluid genome subject to natural genetic engineering, an idea that allows us to make sense of all the evolutionary surprises that greet us as we wander through sequence databases.

Because bacterial conjugation has disappeared from the radar screens of most biologists, the appearance of a book summarizing recent work on the subject is especially welcome. Reading the chapters in Don Clewell's compilation is like sitting down to two smorgasbords at once. One set of delights comprises all the intricate details of

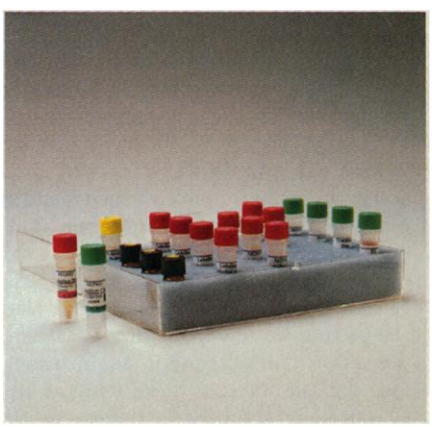
DNA processing that we have learned from studies of plasmid transfer and replication in a few model systems, mostly based on F and drug-resistance plasmids analyzed in *Escherichia coli*. There are chapters on genetic and molecular analysis of F and its close relatives (Willets, Ippen-Ihler and Skurray, Dempsey) as well as on other Gram-negative plasmids (Guiney, Wilkins and Lanka, Reimmann and Haas, Frost, Kittell and Helinski). The various complex molecular systems involved in plasmid transfer and replication and chromosome mobilization provide some of our best illustrations of how cells can manipulate DNA in virtually any conceivable fashion. The prokaryotic molecular toolbox includes proteins that bind, kink, wrap, nick, attach, release, join, and transport specific polydeoxyribonucleotide sequences in a breathtaking display of natural high technology. Case studies like the ones presented in *Bacterial Conjugation* make it difficult to avoid the conclusion that realistic theories of genome structure and function must incorporate knowledge of the biochemical virtuosity with which cells mobilize and recombine DNA molecules; classical assumptions about restricted possibilities for information flow between proteins and nucleic acids are simply outmoded.

The second smorgasbord offered by *Bacterial Conjugation* is a cornucopia of evolutionary relationships. Some of these are apparent in the chapters on less well studied conjugation systems, including *Agrobacterium* (Kado, Farrand), *Streptomyces* (Hopwood and Kieser), and other Gram-positive bacteria (Macrina and Archer, Clewell and Flannagan). What I found particularly fascinating was the way in which DNA transfer systems seem to have been put together in a Lego-like manner out of a general toolbox containing different kinds of interchangeable molecular components. One frequently cited example is the close functional and sequence relationship that has emerged between the system that *Agrobacterium* uses to bring transfer T-DNA to the plant nucleus during tumor formation and the systems used by certain broad–host-range plasmids during transfer between bacterial cells. Another illustration of cut-and-splice evolution comes out of the recognition of several classes of core operations on DNA molecules—replication, transfer, insertion/excision. Determinants permitting these operations can be found in all imaginable combinations: nontransmissible or transmissible plasmids, autonomous or integrating replicons, conjugative or nonconjugative transposons. Clearly, evolution of these genetic elements has been far more than a process of accumulating point mutations, and the relevant evolutionary considerations extend far beyond bacteria. (For example, several chapters draw parallels between prokaryotic plasmid systems and eukaryotic viruses.)

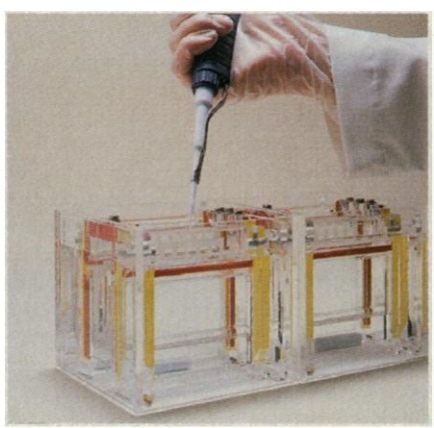
Another fascinating aspect to the bacterial conjugation story is the cell (or, perhaps more accurately, intercell) biology of DNA transfer. Although this subject is touched on in several chapters here, it unfortunately remains the weak point of the entire conjugation field. For example, the genetic analysis of extracellular organelles in bacteria began with the sex pilus of F, but we currently know little about F-pilus construction and far more about the biogenesis of other bacterial structures, such as flagella and pili involved in tissue adhesion. Moreover, the formation of the conjugal DNA transport pore between donor and recipient cells is still a black box, and the long-standing question of whether the sex pilus plays a direct role in carrying DNA remains unanswered. This book should stimulate a renewal of interest in the interactive nature of bacterial DNA transfer. There are many rewarding areas yet to explore, including new subjects like intercellular communication by agglutination pheromones in *Enterococcus* and autoinducer molecules in *Agrobacterium* Ti (tumor-inducing) plasmid conjugation.

In short, this is a fascinating collection of molecular genetic treasures. The book will not be an easy read for many people, and a strong background in DNA biochemistry and plasmid biology is a prerequisite. Nonetheless, it will prove a valuable re-

Carbohydrate Analysis



Step 1. Start with your purified glycoprotein or isolated oligosaccharide. Hydrolyze the glycoprotein or oligosaccharide into monosaccharides, or release N-linked oligosaccharides from the glycoprotein. Glycan releasing time is just two hours instead of overnight.



Step 2. Label the mixture of monosaccharides or oligosaccharides with a patented fluorescent tag. Three hours is all you need.

Step 3. Separate the labeled carbohydrates on a high-resolution polyacrylamide gel. Electrophoresis lasts just 60-120 minutes. You can run up to 32 samples at the same time—for high productivity and accurate, side-by-side comparisons. Setup is a snap. No fluid connections or messy wires. It's a gel rig anyone can run.

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source to specialists, a useful reference for teachers who wish to give students a sense of the natural technological wonders revealed by molecular genetics, and a reminder that long-established fields always remain capable of providing us with fresh insights.

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The Dyslexic Brain

Dyslexia and Development. Neurobiological Aspects of Extra-Ordinary Brains. ALBERT M. GALABURDA, Ed. Harvard University Press, Cambridge, MA, 1993. xxii, 378 pp., illus. $45 or £35.95. Based on a conference, Barcelona.

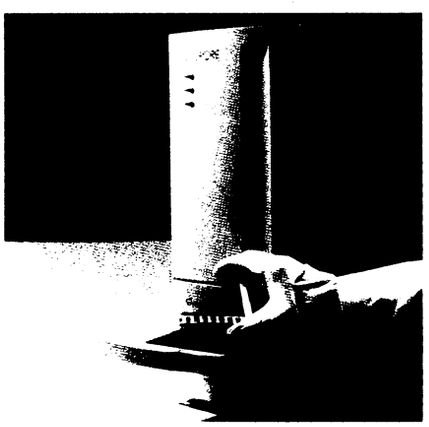
Developmental dyslexia is a widespread disorder, affecting some 5 to 10 percent of all children, adolescents, and adults. More boys than girls are affected, and there is convincing evidence that genetic and neurodevelopmental factors are involved. Dyslexia and other severe learning disorders may be associated with other developmental disorders such as language disturbance and attention deficit hyperactivity disorder, as well as disorders that implicate dysfunction of the immune system. They seem to occur more often in left-handed individuals.

Although dyslexia had always been presumed to be due to neurological dysfunction, evidence was circumstantial until Albert Galaburda published his postmortem studies of the brains of dyslexics, which provided convincing evidence of cytoarchitectural developmental abnormalities. *Dyslexia and Development*, containing contributions from representatives of the fields of neuroscience, neurology, neuropsychology, and genetics, goes far toward integrating the diverse literature exploring the neurobiological basis of this disorder.

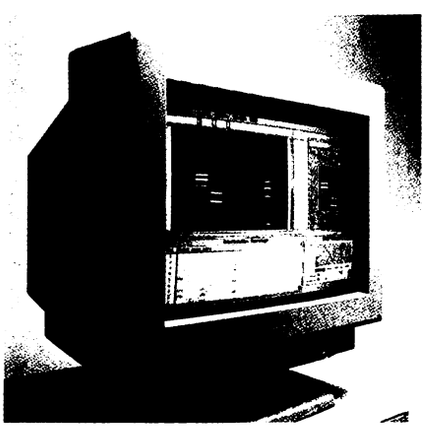
As Barraquer-Bordas points out in the foreword, there has always been interest in comparisons of developmental dyslexia and acquired reading disorders of brain-injured adults. Although many of the symptoms are similar—such as the paralexias, or speech errors—dyslexia in children is not typically due to acquired brain damage. The first few chapters of this book explore the many neurobiological complexities that contribute to the developmental brain abnormalities first observed by Galaburda. As discussed by Finlay and Miller in the first chapter, experimental manipulations of the developing cortex in laboratory animals have improved our understanding of normal neurodevelopmental processes as well as likely patterns of brain reorganization after early brain insult.

Short of overt brain damage, however, what kind of early neurobiological environment might result in the brain anomalies that ultimately manifest themselves as dyslexia? In a very clearly written chapter Kelley discusses the possible role of the hormonal milieu during fetal development—in particular, testosterone, which influences the masculinization of tissues during critical neurodevelopmental periods. Androgen steroids may affect, both directly and indirectly, the commitment, proliferation, migration, differentiation, and survival of neurons. Kelley's hypothesis is that androgens' effects on brain cell number may lead to abnormal patterns of brain asymmetry in the language cortex, which might explain why males seem at greater risk than females for a variety of developmental disorders, including dyslexia. There is also evidence that histopathological alterations due to asphyxia may produce leptomeningeal heterotopias, which have also been observed in the brains of dyslexics and may play a role in development of the disorder, as discussed by Marín-Padilla. Rosen *et al.* point out that the brains of dyslexics are characterized by neuronal ectopias and symmetry of the region of the planum temporale. Drawing on the seminal conceptual work of Norman Geschwind, they argue that even focalized areas of cortical microdysgenesis can have widespread effects

For The Do-It-Yourselfer.



Step 4. Take a picture of the band pattern. Simply slide the gel cassette into the imager.



Step 5. In less than one minute, a high-resolution image is displayed on the screen. Easy-to-use, Windows® driven software lets you quickly determine the number of bands and perform quantitative as well as qualitative analysis of your data.

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