thetic taxonomy ought to be about. Yet I take issue with them on some conclusions; in particular, the biogeographic assertion that "there is no reason whatever to suppose that there were any legumes in Australia prior to the Miocene" is highly arguable. Inferred phylogenetic patterns and distribution suggest that "*Acacia* subgenus *Heterophyllum*" (a good genus by any reasonable criteria), *Castanospermum, Bossiaeeae* (both of its disparate moieties), *Mirbelieae*, and perhaps *Barklya* were in Australia long before the Miocene influx of odds and ends of other legume groups, all with close relations in Asia.

Part 1 of the work presents discussions of all subfamilies and tribes as recognized by the various authors, with enumerations of all genera (500 or more). Part 2 consists of 30 chapters on special topics. Among them are a fine chapter on cytology by Goldblatt and accounts of many aspects of phytochemistry, of varying value but none useless. Also treated are root nodules (Corby, Sprent), wood anatomy (Baretta-Kuipers), and petal sculpturing (Stirton), the last representing a new field that will help us understand in adaptive terms why some flowers are glossy, some velvety, and so on. Several chapters are devoted to the taxonomically and adaptively important albeit sometimes obscure subject of pollen morphology and fine structure, with a superb introductory chapter by Guinet that has significance for all flowering-plant families. Among the other chapters are ones on breeding systems (Arroyo) and defenses against herbivores large and small (Janzen), one of the best things in the book. Some of the chapters not mentioned here are equally good, though a few are rather formalistic (for example, Dudik on pod classification) or report work as yet too sketchy to have much synthetic value (for example, Weder on protease inhibitors). All are of some use, even if only in leading us to think of future elements in the phylogenetic-dynamic synthesis that justifies systematic study.

Editorial flaws in the book are few; among them are: "*Nemicia*" for *Nemcia* and "Dipteryxeae" throughout for a new tribe that must on etymological and grammatical grounds (and therefore under the International Code of Botanical Nomenclature) be corrected to Dipterygeae (Greek: *pteryx, pterygos*).

The systematic value of understanding of inflorescence structure is sadly neglected overall; the few attempts at such analysis in limited groups are intriguing but imperfect.

Illogical and sometimes indefensible systematic placements are too many, though they are few in proportion and the evidence for correcting them is in the book. To mention only a few: *Parkia* and *Pentaclethra* have only superficial and symplesiomorphic features in common and should be separated; Swartzieae and especially Sophoreae are messes of diverse elements; *Erythrina* (as Raven points out) should be in a tribe by itself; *Glycyrrhiza* is out of place in Galegeae and belongs in or near Psoraleae; *Pickeringia* does not belong in Thermopsideae, nor *Anarthrophyllum* and *Sellocharis* in Crotalarieae, nor I suspect *Lupinus* in Genisteae; and certainly the Australian pseudotribe Bossiaeeae (this spelling is correct under the Code) must be a mixture with two diverse origins. Such foulups in an otherwise phylogenetically reasonable system reflect the immanent curse of taxonomy, excessive respect for the past.

Admirable are the words of Irwin and Barneby in their chapter on the Cassieae: "We have encountered a prejudicial belief that a tribe is by nature extensive and that the proliferation of tribes within a family must inevitably devalue tribal status. We hold, to the contrary, that this must depend entirely on the nature of the taxa under review. . . . The hallmark of any taxon should be quality, not mass." But even they have partly yielded: "We should have accorded tribal rank to the five subtribes if not dissuaded by others!"

But the most striking deficiency in this grand work is that it almost ignores cladistics. I could not find a mention of this term until p. 620, hidden in a chapter on phytoalexins. Certainly Polhill, Raven, and Stirton put forward a reasonable phylogenetic scenario of the family as a whole and summarize abundant evidence that convinces even this reviewer that the legumes are best treated as a single family, not three. This view is founded on a mass of evidence and the absence of marked extinction gaps in the array of contemporary genera arranged for convenience in three fuzzy subfamilies, one of them (Caesalpinioideae) including relict groups not too different from the ancestors of all legumes as well as lines just as "advanced" as the other two subfamilies.

Throughout the book, probable phylogeny is fascinatingly illuminated, but no consistent methods of phylogenetic analysis are employed (except in some chemical chapters, where the data are limited and the suggested detailed phylogenies rather incompatible with those derivable from other or broader databases).

There are chapters, notably one by Watson, that feature phenetic analyses. This technique should be sufficiently discredited by now on logical and practical grounds, so far as taxonomy above the interbreeding level is concerned. Of course, phenetics will tend to show some correspondence with cladistic analysis—the messages of that part of the basic data that represents synapomorphic character states are not always drowned out by the noise inherent in the phenetic input and the effects of analyses unrelated to any biological model. But to have included phenetic analyses while ignoring sensible (as opposed to doctrinaire) cladistics is a major blemish on this fine work. The data are there for cladistic analysis, tempered by functional interpretation as so well treated in this symposium. How one would love to do it on such a glorious family, and one of such ecological and phytogeographic importance, to say nothing of its vital role in the past, present, and future of the human species' encroachment on the biosphere.

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Cellular Regulation

Calcium and cAMP as Synarchic Messengers. HOWARD RASMUSSEN. Wiley-Interscience, New York, 1981. xiv, 370 pp., illus. $39.50.

The theme of Rasmussen's monograph is the relationship to cell homeostasis and to one another of the two most clearly established biological "second messengers," calcium and cyclic AMP. Rasmussen was one of the first to call attention to the relationships between these second messengers in an important review appearing over ten years ago (*Science* **170**, 404 [1970]). This monograph serves to illustrate how experimentation during the '70's has added substantially to our knowledge of this topic.

Historically, our appreciation of the biological importance of calcium dates back almost a hundred years to Ringer's original observation that muscle contraction requires calcium. Only in the last 20 years, however, has the general role of calcium as a mediator of other cellular responses (such as secretion and metabolism) come to be fully realized. The discovery in the 1950's by Sutherland of cyclic AMP and its role as a mediator of hormone action in the liver subsequently spawned a considerable quantity of re-

search indicating a ubiquitous role for cyclic AMP as a mediator of cellular responses.

From his own experimental work and from his appraisal of the reported results of others, Rasmussen concludes that the nature of neither the stimulus (hormone, voltage change, neurotransmitter) nor the cellular response (contraction, secretion, ion flux) has predictive value in determining the nature of the second messenger. In fact, it would appear that in most (if not all) instances, both calcium and cyclic AMP play roles, often interacting to fine-tune or modulate the final expression of cell function.

That calcium and cyclic AMP act together in most stimulus-response pathways is well supported by the available data. However, there appears to be considerable variability in the mode of interaction, ranging from cooperative or coordinate roles (as in *Calliphora* salivary gland, for example) to complete antagonism (as in smooth muscle contraction, for example). To describe this phenomenon of dual messengers acting almost universally together but in a variety of ways, Rasmussen suggests the term "synarchy." The word is derived from the Greek "syn," meaning together, and "archon." The archons were a special class of heralds who, because of the importance of their messages, were often dispatched in pairs carrying either the same message or parts of a total message.

The book begins with a historical review of the development of our understanding of second messengers. The regulation of calcium metabolism in cells is reviewed, with particular emphasis on calcium in subcellular organelles. A number of ancillary topics of current interest in cellular regulation are addressed, including phospholipids (methylation and phosphoinositide metabolism) and calcium-binding regulatory proteins (troponin, calmodulin, and leiotonin). Rasmussen then attempts to categorize the steps involved in a general stimulus-response coupling sequence in much the same way in which the steps in synaptic transmission, an extracellular communication process, have been categorized before. This is followed by a general discussion of the principles of synarchic regulation. The sections on general principles of second messengers and synarchic regulation make up about one-half of the monograph. The second half contains discussions of specific cellular control systems in the context of the general principles developed. These are subdivided on the basis of general modes of calcium–cyclic AMP interaction into chapters on coordinate control, hierarchal control, redundant control, antagonistic control, and sequential control.

The discussions of specific systems are developed in ways that reinforce the general concepts already developed. Rasmussen permits himself considerable speculation in attempting to synthesize holistic models for which, in some systems, sufficient data are not available at present. Thus, there are some statements and theories that may be at odds with currently favored views. One can predict that some of Rasmussen's speculations may prove to be prophetic; others, I believe, may eventually be proved wrong. It is for this reason that *Calcium and cAMP as Synarchic Messengers* is probably not useful specifically as a reference for factual information, nor would it appear to be the author's intent that it should be. It should be extremely valuable to biologists interested in the roles of these second messengers in cellular regulation by a variety of receptor types in a variety of cell types. The one lesson the book well teaches is the usefulness of a broad perspective on universal control mechanisms. The book makes clear that scientists interested in mast cells have much to learn from understanding smooth muscle; the mechanisms involved in controlling hepatic glucose production may tell us much about the puzzling hormonal controls of intestinal absorption and secretion.

Rasmussen's book convincingly demonstrates that synarchic regulation is the general mode of response regulation in most systems. The development of this concept adds a new dimension to our understanding of cell function and adds new challenges to the task of characterizing detailed mechanisms of stimulus-response coupling.

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