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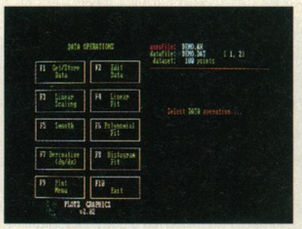

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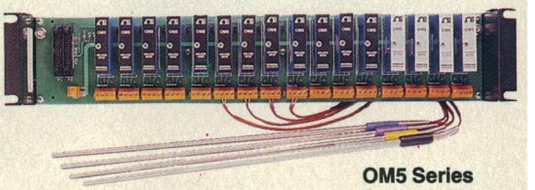

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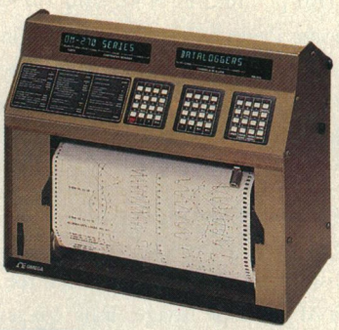

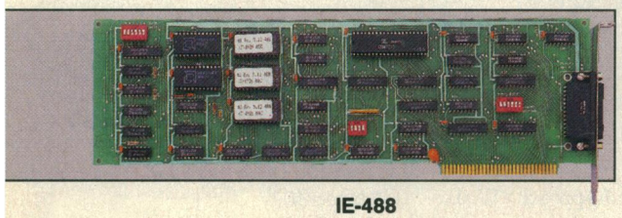

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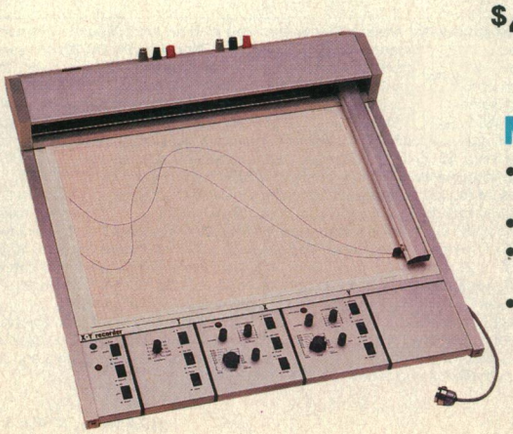

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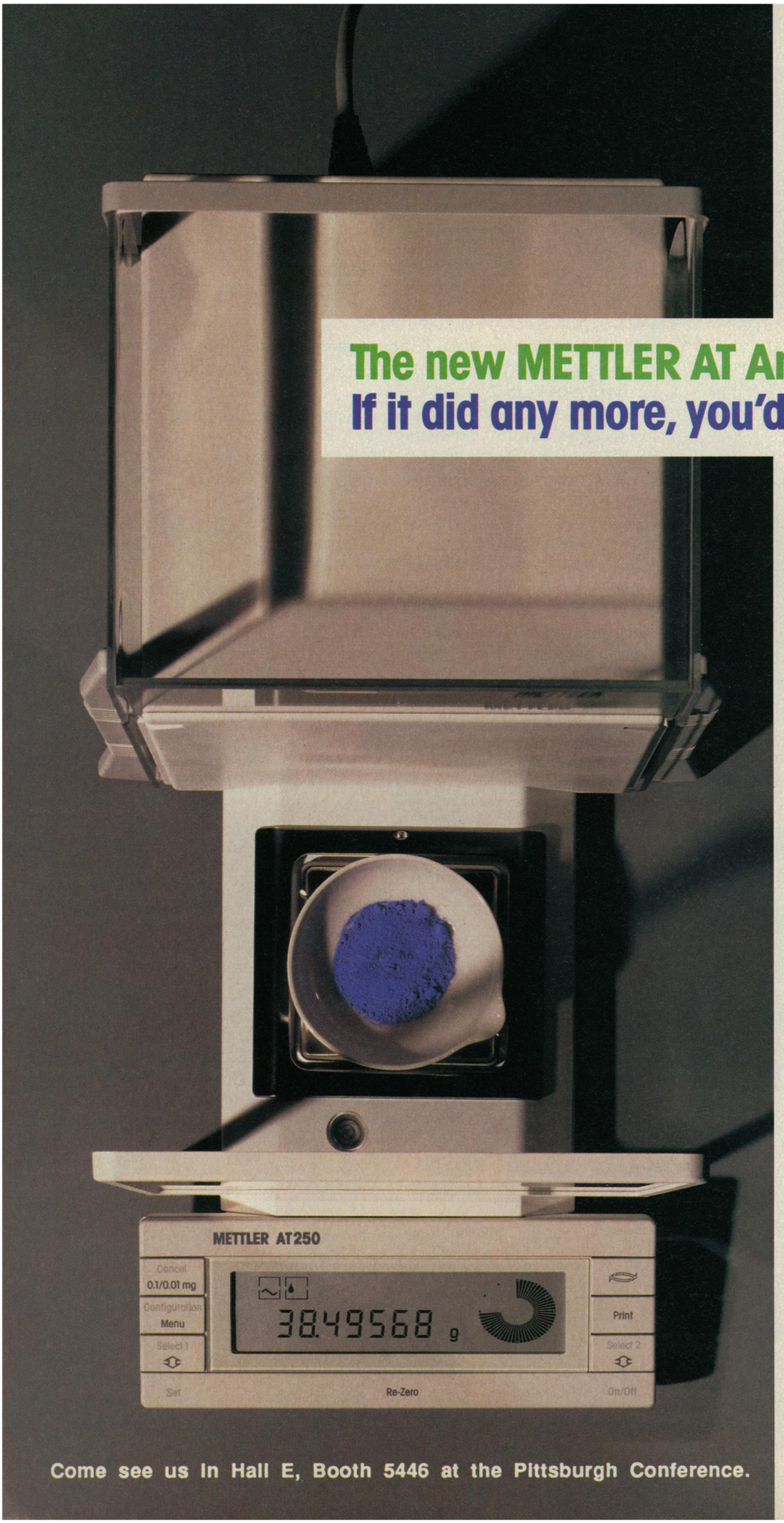
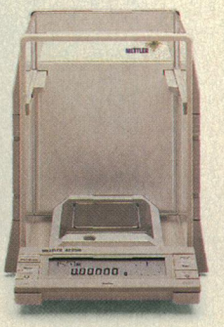
COVER A caterpillar *Nemoria arizonaria* next to the catkins (staminate flowers) of Emory oak. The spring brood of caterpillars develops into mimics of the catkins; the fall brood develops instead into mimics of oak twigs. This developmental polymorphism is triggered by the larval diet. See page 643. [Photo by Erick Greene, Department of Avian Sciences, University of California, Davis, CA 95616]





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This Week in SCIENCE

Coral island survival

WHAT determines whether a coral island survives or drowns during an episode of rapid sea level rise? At a "critical depth" (no more than 30 to 40 meters) below the sea surface, light in the water column and other factors are adequate for supporting coral growth; below that, reefs drown because they are unable to grow to the surface. Using data from the Hawaiian Archipelago, which includes coral atolls, drowned banks, and other edifices that originated over the Hawaiian hotspot, Grigg and Epp show that coral reefs that survived the Holocene sea level rise (a rise of 130 meters or more) are generally those that are built on large and shallow foundations above the critical depth; reefs that drowned were built on smaller deeper foundations that were below the critical depth and were more easily eroded (page 638). Thus, for drowned banks, there is an inverse relation between depth and summit area. There were at least 17 cycles of rising and falling sea level during the Pleistocene and an unknown number during the earlier Pliocene and Miocene epochs; these have contributed to the shaping of the foundations on which Holocene reefs have been growing or drowning during the past 18,000 years.

Caterpillars: they are what they eat

ALL *Nemoria arizonaria* caterpillars look alike at hatching whether they hatch in the spring or in the summer; yet as they develop, these caterpillars begin to look either like the food they are eating or the place where they are eating (page 643). Those of the spring brood feed on oak catkins (spiky, scaly staminate flower clusters) and ultimately look like catkins; those from the summer brood feed on leaves (the catkins have dropped from the tree by this time) and soon resemble twigs. Each type, when placed on the food it mimics, remains still; each type moves away from the other food. The expression of such mimicry (cover) appears to be associated with the tannin content of the diet: catkins are low in tannins, leaves are high, but when a catkin diet is supplemented with tannins the caterpillars resemble twigs. Greene speculates on how this developmental polymorphism may have evolved and how it may operate, pointing out that the camouflage conferred by food mimicry provides an enormous survival advantage in the face of predators that search visually for their prey. Catkin diets, though ephemeral, are "superior," producing heartier, more fecund, and faster developing individuals; on the other hand, there is a "numbers" advantage for populations that can produce two broods within a year.

Hepatitis delta virus

THE hepatitis delta virus (HDV) is smaller than other known mammalian viruses and is similar in certain respects to plant viroids and related small infectious RNAs. HDV is a defective virus that has only been found in association with its "helper," the hepatitis B virus; the hepatitis B virus provides its surface antigen to HDV. HDV is associated with chronic and active hepatitis and cirrhosis and is a growing problem in hemophiliacs (who are dependent on pooled blood products) and in intravenous drug users. Wu and Lai report that the RNA of HDV can cleave itself and then rejoin the fragments and that the two reactions are dependent on local magnesium ion concentrations (page 652). Magnesium drives cleavage and its removal drives religation. The fast-acting cation-dependent ribozymes appear to be a new class of RNA enzymes. New structural parallels between the RNA of HDV and the RNA of plant viroids have been identified by Branch *et al.* (page 649). Two noncontiguous regions of the RNA were covalently cross-linked with ultraviolet light. The cross-linking site is a novel tertiary element and one of three features—the others are a region of highly conserved sequence and the ribozyme cleavage activity site—that together define a viroid-like domain in HDV RNA.

Collagenase induction

THERE is extensive damage to collagen in the joints of persons with inflammatory and proliferative rheumatoid arthritis. The enzyme collagenase is responsible for the breakdown of this most abundant of body proteins, and the source of the collagenase is fibroblasts that line the joint cavities. How these cells are induced to produce and secrete collagenase has been assessed in rabbit synovial fibroblasts grown in vitro (page 655). Cells were found to produce and secrete two proteins—one that was similar to serum amyloid A and the other that resembled β_2 microglobulin. These two proteins then went on to induce, in the same fibroblastic cells, the synthesis and secretion of collagenase. Neither of the two inducer proteins was previously known to have this effect. Brinckerhoff *et al.* point out that the self-induction of collagenase in fibroblasts by other fibroblast proteins may be central to balancing or deregulating supply and demand of this enzyme under normal conditions and during inflammation and disease.

Defective channels in cystic fibrosis

IT has been difficult to get a handle on the molecular defect in cystic fibrosis, in part because the defect involves malfunctioning chloride channels in somewhat inaccessible epithelial cells that line the airways. Now, however, Chen *et al.* show that the same defect is present in chloride channels of lymphocytic cells from cystic fibrosis patients: the chloride channels in both epithelial cells and B lymphocyte lines are refractory to activation by adenosine monophosphate–dependent protein kinase (page 657). This discovery will be a boon to both molecular and genetic studies of cystic fibrosis because lymphocytes are easy to collect and propagate; in addition, defects in immune functioning in cystic fibrosis can be investigated with these cells. Lymphocytes may prove useful for prenatal screening for this disease and for the identification of carriers.

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Blank Check Laws

In certain types of laws, a worthy ideal is enacted with deliberately vague wording in the hope that authorities will administer it wisely. Like a blank check, in which the writer hopes that his agent will fill in the numbers correctly, there is great danger as well as some utility in such a procedure. Three laws—California's Proposition 65, the Delaney clause to the Food, Drug, and Cosmetic Act, and vagrancy laws in general—illustrate the potential power and abuse of this legislative approach.

Preventing hazards from toxic chemicals is the laudable goal of Proposition 65 (News & Comment, 20 Jan., p. 306), which stipulated that business must warn the public if it knowingly exposes them to a substance that poses a significant risk of cancer or birth defects. If a company is sued for releasing a chemical without proper warning it must assume the burden of proof that the compound is safe. The law failed to define "significant risk," and left no guidelines as to how one could prove that a chemical is safe. Guidelines are now being drawn, but it is too early to say whether they will solve the problems of vague wording in the legislation itself.

The Delaney clause, whose purpose was to protect the consumer from carcinogens, included a requirement that no chemical should be introduced into food at detectable levels if it caused cancer in experimental animals. Because analytical techniques improve continuously, in some cases this requirement imposes a limit of a few molecules of substances that have been shown to require many grams to cause cancer as deduced from experiments in animals. In the administration of the Delaney clause, the authorities have wisely winked at provisions that would, for example, have prevented addition of antispoilage chemicals to foodstuffs on supermarket shelves. Failure to do so would have caused many more deaths from food poisoning than could possibly have been prevented from cancer. In general, the Delaney clause has been administered well, because it has been used when needed and ignored when chemical benefits outweigh risks.

Vagrancy laws have a long history in this country, including abuse in the 1930s when individuals were harassed for no reason other than lack of money or job. Currently, some nebulous vagrancy laws are being eyed with interest because it is recognized that many of the homeless either are incapable of taking care of themselves or represent a danger to others. A vague law, which would give authorities the power to assign individuals to shelters, mental hospitals, or release on their own recognizance, would make great sense in some ways, but would pose serious civil liberties problems in others.

These three blank check laws arouse curiously polarized, and often simplistic, responses. Ardent civil libertarians, some of whom view business with suspicion, dislike the blank check provision of vagrancy laws but admire the same vagueness in Proposition 65. Supporters of business, some of whom view the homeless with distaste, think Proposition 65 is a disaster but approve the ambiguity of vagrancy laws.

A good argument can be made for giving authorities some discretion. There is not going to be some absolute level of risk in toxic substances, so a caveat emptor approach makes sense. And, because scientific data are continuously altering the assessment of risk, standards need constant revision. In the case of the homeless the line may be vague between those who are likely to be violent and those who simply cannot cope, and no law can define that difference clearly. There is therefore a justification for some degree of latitude in the law. On the other hand, vaguely worded statutes are an invitation for expensive and inappropriate legal battles as well as bureaucratic abuse. It is also unfair to force responsible civil servants to wink at provisions in the law to make it workable. If diverse administrators, judges, and juries are all interpreting the law differently there is a good chance for chaos, in which businesses cannot make coherent plans and individuals cannot protect their rights.

Perhaps such laws should be modified to resemble the standard procedure used in writing a blank check for completion by an individual in whom one has partial but not absolute trust. In that case, leaving some leeway by allowing a 10% markup or markdown would provide room for judgment without gross uncertainty. If we have to live with vaguely worded laws in our complex society, they should be drafted to allow some latitude, but should define with great care the outer limits that will ensure orderly procedures and civil rights. In the long run it is as unwise for society as it is for individuals to write blank checks.—DANIEL E. KOSHLAND, JR.

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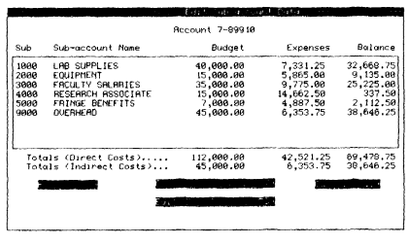

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4000	RESEARCH ASSOCIATE	15,000.00	14,662.50	337.50
5000	FRINGE BENEFITS	7,000.00	4,887.50	2,112.50
9000	OVERHEAD	45,000.00	6,353.75	38,646.25
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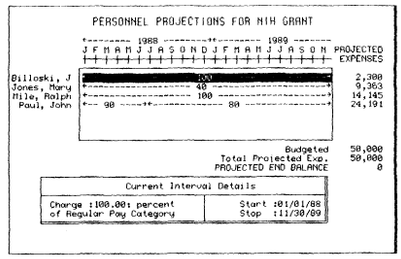

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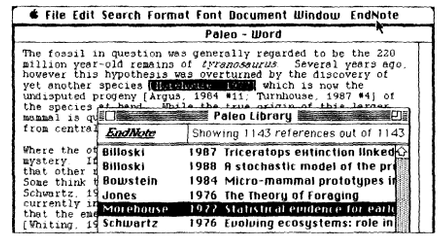

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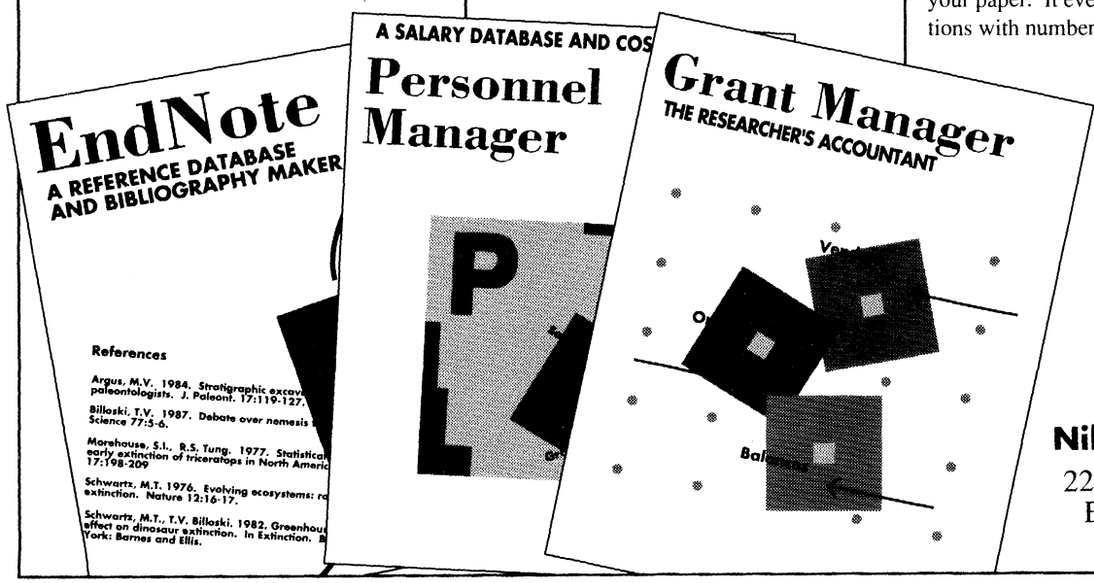

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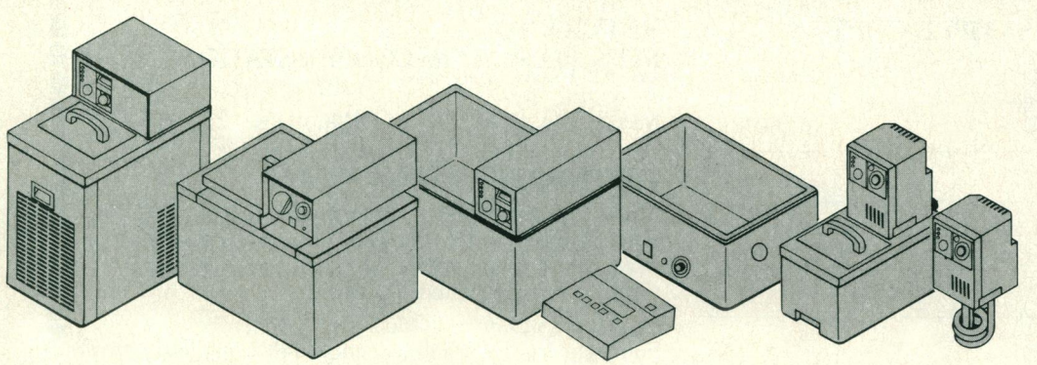

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gap junctions, their possible involvement in development and differentiation has been a frequent target of experimentation and speculation. Some of the latest episodes in this long story are presented in the final group of papers. With the exception of the lead-off paper on developing vertebrate limb, the various studies support the developmental importance of junctional communication. Evidence for communication compartments is reviewed for quite divergent species and related to developmental boundaries. Modulation of junctional selectivity as a function of developmental stage in insects and its possible mediation by L-glutamate is especially intriguing and brings one story at least closer to an understanding of mechanisms. In regenerating hydra, junctional involvement is strongly suggested by the effects of antibody blockade of junctional transfer, a method of "perturbation analysis" that is likely to appear more commonly in future investigations.

In all, the book provides the specialist a useful summary of most of the current themes in the gap junction field. For the generalist, the thoughtful introductions to each section give appropriate perspective to the specific experiments and models, the resolved conflicts and unanswered questions. Throughout, the impact of new technologies and approaches is evident and the prospects for exciting future discoveries are tantalizing.

At an earlier meeting, Lewis Wolpert stressed the "need" for gap junctions to answer the problems of limb patterning. Although his paper in the current book arrives at a less sanguine outlook for establishing a critical role for gap junctions in his own system, he once again sets the stage for the future when he says, "But it is early days, and exciting times are still to come." The contributors to this book would certainly agree.

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Chaos in Living Systems

From Clocks to Chaos. The Rhythms of Life. LEON GLASS and MICHAEL C. MACKEY. Princeton University Press, Princeton, NJ, 1988. xviii, 248 pp., illus. $45; paper, $13.95.

During the past several years a number of excellent books have been published on chaos and nonlinear dynamics. In most, some mention is made of applications in the life sciences, but for the most part the development is in terms of physical applications. This is hardly surprising. Physicists and chemists are generally able to carry out their experiments under cleaner conditions than their biological counterparts, and they can often amass considerably larger quantities of data. Thus the most convincing experimental evidence for chaos comes from physical systems—fluid dynamics, lasers, and chemical reactions such as the Belousov-Zhabotinskii system. At the same time, it has been remarked (A. Mandell, personal communication) that it is in biology that nonlinear science may ultimately find its most important applications. For it is in living systems that one sees overwhelming evidence of the complex behaviors—both temporal and spatial—that are grist for the dynamicist's mill. Indeed, one might argue that it is dynamical complexity that operationally distinguishes animate from inanimate matter.

From Clocks to Chaos provides a much-needed introductioin to complex dynamics from a biological point of view. Its authors, Leon Glass and Michael Mackey, have been major contributors to the field of biological dynamics for more than a decade. This book gives us an opportunity to view the role of chaos in biology through the eyes of pioneers.

Here are some specifics: The book is divided into nine chapters, of which the first provides an overall introduction. Chapter 2 develops some of the underlying mathematics—differential equations exhibiting stable equilibria and limit cycles; stability concepts; and period-doubling to chaos in the logistic map. Chapter 3 introduces the important problem of distinguishing noise from chaos. The authors point out that successive iterates of some chaotic difference equations have exponential probability distributions. Hence the observation of such a distribution cannot by itself be taken as evidence for a Poisson process. Here and throughout the book, biological observations provide the motivation, in this case data for miniature end-plate potentials in neuromuscular junctions. A second example of the "noise *vs.* chaos" problem is provided by cell cycle studies. Here, the authors argue that observations traditionally explained by models involving random transitions can be fit just as easily by deterministic models that generate chaos. The chapter concludes with a discussion of techniques, among them Poincaré maps, Lyapunov numbers, and fractal dimensions, for diagnosing chaotic