Cookery in cloning

Michael Neuberger

DNA Cloning: A Practical Approach, Vols 1 and 2. Edited by D.M. Glover. *IRL Press:1985. Vol. 1 pp.190; Vol. 2 pp.245. Each volume pbk £14, $25; two-volume set £25, $45.*

SOME years ago, when I was at a station bookstall and just before getting on a train, I bought my first book on cloning. It was entitled *Cloning*, had been written by a biophysicist, David Shear, and was being remaindered for 40 pence. The book was not quite what I had anticipated. It describes how a middle-aged molecular biologist, himself a member of a clone, and his ex-wife Carolyn fight for equal rights for men and androids. It is possibly not surprising that the two volumes edited by David Glover are more convincing as well as being more useful to the run-of-the-mill molecular biologist; however, I also find them better reading.

The techniques of DNA cloning lie at the root of the recent developments in nucleic acid biochemistry. The first isolation of a type II restriction endonuclease in 1970 was shortly followed by the development of plasmid and bacteriophage cloning vectors. However it remains true that molecular cloning into *Escherichia coli* vectors constitutes the hard core of recombinant DNA technology, and it is this field that is the subject of the first volume of *DNA Cloning*.

There are nine chapters, written by different authors, covering various aspects of cloning, manipulating and expressing DNA in gram negative bacteria. Thus, for example, Kaiser and Murray describe phage λ vectors, Hanahan gives a detailed account of DNA transformation into *E. coli* and Fritz writes about oligonucleotide-directed mutagenesis. This volume also includes two chapters on cDNA cloning, the one by Huynh *et al.* being the most detailed guide to date on cloning into phage λgt11. The editor has ensured that a consistent style and presentation is maintained from chapter to chapter, and the extremely detailed protocols are preceded by a helpful discussion of the theoretical background to the techniques and a consideration of the critical parameters.

The second volume deals with the introduction of DNA into organisms other than *E. coli*. Here one can learn the rudiments of cloning into bacilli, streptomycetes, yeast, plants, fruit flies and mammalian cell lines (are transgenic mammals to be included in a subsequent edition?). The range of the subject is clearly vast and the coverage necessarily somewhat eclectic; any individual researcher is unlikely to have more than a passing acquaintance with more than a couple of the members of this zoo. Nevertheless, I found those chapters in my own field to be extremely useful, and enjoyed reading the detailed procedures about cloning into organisms that I have never worked with — much like browsing through travel brochures without having to undergo the inconvenience entailed in the travelling itself.

These two volumes are a strong addition to the IRL *Practical Approach* series. They are essentially cookery books that should be found in the laboratory, as well as the library — they may well merit the occasional monitoring with a Geiger counter. Their popularity has already been clearly demonstrated by the annoying tendency of the review copies to disappear from my desk and resurface a few days later in other laboratories scattered around the building. □

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• Since the completion of this review, Blackwell Scientific have published *Basic Cloning Techniques: A Manual of Experimental Procedures* (price £11.80, $27), a 200-page paperback based on the course on molecular cloning run in the School of Biological Sciences at the University of Leicester. The book (edited by R.H. Pritchard and I.B. Holland) is a compilation of the experimental procedures taught at Leicester, and the format is essentially that of a course manual; it is, I suspect, designed for teaching purposes, although research workers will also find it of value. Within the IRL *Practical Approach* series (of which *DNA Cloning* is a part) there are other volumes that deal with agarose gel electrophoresis and the techniques associated with the study of transcription and translation, so *Basic Cloning Techniques* covers a somewhat larger range of material than *DNA Cloning* but, as might be expected, does so in considerably less depth. However the fact that all of these books cost less than a tube of restriction enzyme means that most laboratories will not need to agonize over which of them to buy. *Michael Neuberger*

What is chaos?

Ian Percival

Chaos. Edited by Hao Bai-Lin. *World Scientific/Wiley: 1985. Pp.576. Hbk £50.80, $63.50; pbk £23.30, $29.*
Universality in Chaos. Edited by Predrag Cvitanović. *Adam Hilger: 1984. Pp.514. Hbk £29.50, $55; pbk £11.95, $19.*

SCIENCE takes ordinary words and puts them to specialist use. The "force" that produces acceleration and the "energy" that is conserved are not the same as the force and energy of non-scientific literature. The same applies to "chaos".

Chaos can refer to static structures, but it is primarily about the motion of dynamical systems. It should be possible to formulate the motion mathematically, so chaos in the scientific sense does not refer to political chaos, for example. Furthermore the study of chaotic motion is mainly concerned with systems of finite order that are not subject to any kind of noisy input. There is no need for an infinite number of degrees of freedom or for external or quantum fluctuations for chaotic motion to take place. Dynamical systems in which future states are determined from the present state by very simple functional relations or differential equations can still be chaotic. How can such simple systems show any kind of motion that can be described as chaotic?

Local exponential divergence with global confinement make chaos, the states of the system being represented by points in the phase space. The divergence produces a local stretching of the phase space, but, because of the confinement, this stretching cannot continue without a folding or chopping. Successive folding and refolding produces such complicated behaviour that it has the appearance of random motion, hence chaos.

For Hamiltonian systems the stretching in one direction is exactly compensated by a shrinking in another direction, so that area in the phase space is conserved, whereas in dissipative systems there is no such compensation. There can be chaotic motion for both, but it differs in detail, and for Hamiltonian systems the motion is sometimes called "irregular" or "stochastic" instead. Chaotic motion may appear to be ordered or regular over long periods of time, but in other cases the apparently random behaviour appears rapidly.

The history of the subject over the past few decades has been one of convergence. Separate studies in widely different fields led to similar conclusions, but only gradually was it realized that they all had features in common — biological populations, simplified models of fluids, chemical reactions, periodically perturbed mechanical structures, the asteroid belts of the Solar System and particles confined to storage rings or toroidal plasmas have all been shown to exhibit chaotic motion. Computers have been invaluable tools for numerical experiments, and the computer-produced illustrations of the behaviour of chaotic dynamical systems can be both illuminating and beautiful. Dynamics is repaying the compliment by providing new insights into approximations for numerical computation.

Chaotic motion has given us a fresh view of the foundations of statistical mechanics, provides us with a timely warning of the dangers of using linear theory as a first approximation in the study of nonlinear systems, and shows that number theory and fractals have impor-