ogy, in particular the availability of a new, well-tolerated drug.

The chapter on leprosy is interesting, but perhaps premature in comparison with the other stories. It tells of the search for a vaccine; but while much progress has been made over the past decade we are still far from finding a vaccine of proven efficacy for operational use.

The last story, on the fight against smallpox, provides a grand finale in that it fully justifies the title of the British edition of the book. This was a unique achievement, the total eradication of a disease that presented a worldwide challenge. Even though Kuru may disappear, one cannot sign its death certificate with the same confidence as was done for smallpox on 8 May 1980 at the World Health Assembly in Geneva. Although there has been some speculation about the feasibility of completely eradicating other infections "from the face of the Earth" — proposed candidates include measles and poliomyelitis — no other disease presents the combination of features which made possible the difficult task of eradicating smallpox.

Most of the data required for epidemiological surveillance of smallpox could be obtained from fairly simple clinical observations of sick patients, and the examination of scars of healed natural infections or vaccination scars. Laboratory help was required in the identification of the small proportion of atypical cases, and for the differentiation of smallpox from other pox diseases. Most other infections present more formidable problems; the clinical features are usually not sufficiently characteristic to permit differential diagnosis on simple clinical examination, and there are usually no pathognomonic scars to identify those who have had previous infections or are protected by immunization.

Apart from satisfying the demand for exciting accounts of medical discoveries, this book and similar ones draw the public into the debate about investment in the biomedical sciences. On the one hand, at times of economic recession, reduction in the budgets for biomedical research often seems a soft option because the venture does not command a powerful constituency. On the other hand, when threatened by the appearance of such problems as Legionnaire's disease and AIDS, people are anxious to know that something is being done to control the scourge. This book shows that breakthroughs do not leap out on the order of clever scientists. It portrays the path to knowledge as a difficult one, more often crossed by disappointments than by the discoveries that come as the final reward for long-sustained devotion to science and the improvement of human health. □

Adetokunbo O. Lucas is Director of the Special Programme for Research and Training in Tropical Diseases, World Health Organization, 1211 Geneva 27, Switzerland.

Lemons and limes

Joe Collier

Drug Discovery: The Evolution of Modern Medicines. By Walter Sneader. *Wiley: 1985. Pp.392. Pbk £12.95, $21.95.*

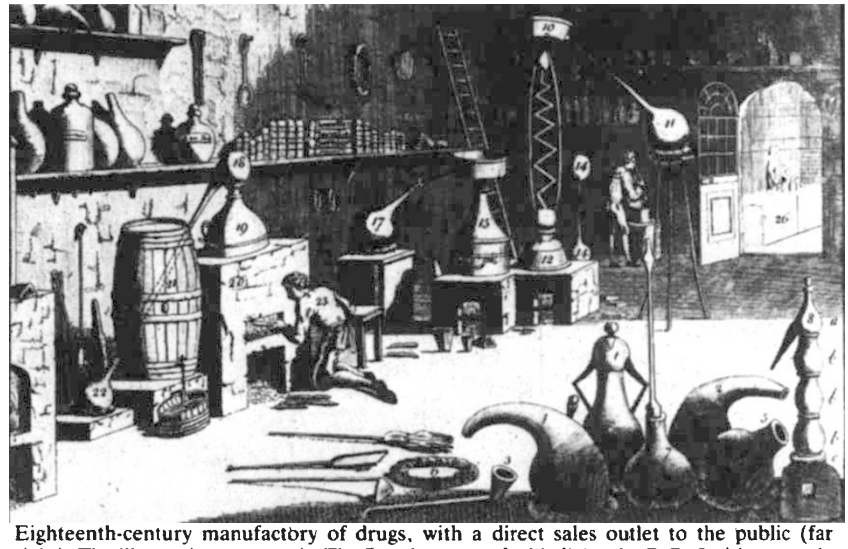
PHARMACOLOGISTS, physicians and legislators alike are now very wary of assuming that a drug is necessarily a medicine. Whereas a drug is any chemical substance that modifies a biological process, a medicine is that rare drug that can be used in patients to treat disease.

It is this distinction that occupies regulatory authorities (such as the Committee on Safety of Medicines, and the Food and Drug Administration) when licensing drugs for medical use; equally, it is the gap that the pharmaceutical industry strives to bridge so that new products can be marketed. Accordingly, as advances in fields such as biochemistry, genetics, immunology and pharmacology have led to the production of evermore sophisticated drugs, legislators have demanded increasingly detailed information about them before they will consider granting a licence. This balance now dominates the development of new therapeutic agents, and it is to this end that industry labours to discover how new drugs are absorbed, metabolized and excreted, how they should be formulated to be delivered to best advantage, how the dosage frequency should be adjusted to offer the greatest chance of efficacy, and, in longer term trials, the details of safety and efficacy.

Walter Sneader seems to be almost oblivious of these issues which are so central to the title of his book. They neither seem to be a consideration from which he might view the past, nor have they proved worthy of mention as a topic in their own right (and one so admirably dealt with by R.D. Mann in *Modern Drug Use: An Enquiry on Historical Principles*, published last year by MTP Press).

Instead, Sneader has filled the book with classical information. Each chapter (there are 16 in all) is devoted to a single broad therapeutic category, such as antibiotics, cardiovascular drugs, psychopharmacological agents, and in each the group is traced from the earliest reference to a seminal substance (penicillin, digoxin, Rauwolfia) through to drugs developed in recent history (the date seems to depend on Sneader's interests; inotropic agents stop with digoxin in 1933). The material is mostly in story form, in which the full names and addresses of each and every worker are listed, as are the movements of compounds and ideas between departments, companies and continents. There is an abundance of anecdotal information, clearly written and easy to follow — it is fascinating, for instance, to learn that scurvy returned as a threat to sailors when the trusty lemon juice was replaced by lime; lime juice, which was introduced for reasons of economy, has, we are told, about one-quarter of the ascorbutic activity of lemon juice.

Two good reasons for publishing a new history book are that either it reveals fresh information or it analyses history from a



Eighteenth-century manufactory of drugs, with a direct sales outlet to the public (far right). The illustration appears in *The Development of a Medicine*, by R.B. Smith, recently published by Macmillan, London (hbk £30; pbk £12.95)/Stockton, New York (hbk $60).

● Without fuss or pretension Smith's short book (160 pages) describes the development of medicines from their discovery (by serendipity or search), through their manufacture, their assessment both in the laboratory and the clinic, and on to the procedures involved in their marketing as licensed products. It gives a simple and straightforward account of contemporary practice in Britain, written by someone obviously familiar with the industry — when discussing drug company activity the book gives some rare glimpses of commercial philosophy in the pharmaceutical business. The book suffers from apparently being compiled in a hurry (tables illegible, legends wanting) but these should be corrected for the second edition that will surely come. *Joe Collier*

novel point of view. Unfortunately, *Drug Discovery* does neither. The author's statements are always left open to question because no references are given in the text, so leaving the reader to search the rather poor and imprecise chapter bibliography at the end of the book. Interestingly, this sacrifice was made so that the text, which was written to convey "drama and excitement", should not be disrupted. However without references to contemporary information, the book has lost much scientific credibility.

Perhaps more annoying, there seems to be no benefit of hindsight. The ethical issues that have emerged so forcefully over the past 30 years and now engulf medicine seem to have left no impression. For its easy pace and the stories it relates I would expect the book to have its devotees; but as a serious historical account it falls short of what should be expected. □

Joe Collier is Senior Lecturer and Honorary Consultant in Clinical Pharmacology at St George's Hospital Medical School, Cranmer Terrace, London SW17 0RE, UK.

Marking the path

Peter Laing

The Biotechnology Business: A Strategic Analysis. By Peter Daly. *Frances Pinter, London/Rowman & Allanheld, Totowa, New Jersey: 1985. Pp. 155. £16.50, $25.*

THE emergence of an international industry based on molecular biology and immunology is a striking example of the potential economic benefits of government funding of basic research. Equally, however, the commercialization of biotechnology well-illustrates the familiar pattern of technological innovation being avidly and rapidly exploited in the United States and only belatedly in Europe.

In the United States, the availability of venture capital and an entrepreneurial business climate have led to the formation of numerous specialist biotechnology companies. These have been able to attract many of the brightest academic scientists (who would not normally have considered an industrial career) and concentrate upon the problems of developing marketable products. The large, established American companies, aware of the many studies that have shown that technical innovation most often stems from small, flexible and highly-specialized firms, have generally encouraged this process by the provision of research contracts (and even equity finance) for start-up companies, obtaining in exchange the commercial rights to future products.

By contrast, in Europe the start-up company as an engine of technological change has until very recently been a rarity. The brunt of commercialization of new technology has been borne largely by the established industrial companies, in which new ideas have a depressing tendency to be stifled or restrained by corporate inertia and the "Not Invented Here" syndrome. This situation has been compounded by a general lack of contact between industry and academia, particularly in the biological sciences, with the result that the more enterprising scientists have either remained in universities or left for North America.

In Japan, a strong sense of national purpose and a cultural preference for consensus solutions have engendered active cooperation between Government, industry and academia with the aim of establishing national priorities for the exploitation of new ideas and identifying the means of bringing them about. Even so, the vehicle for commercialization in Japan has invariably been the established company — indeed, companies in moribund or declining industries have often been selected for revitalization by the injection of funds for biotechnology projects.

The Biotechnology Business is a comprehensive and readable guidebook to the commercial side of the biotechnology industry. As acknowledged by the author, it leans heavily on the excellent Office of Technology Assessment report *Commercial Biotechnology*, published in 1984, but is less nationalistic in its approach (and also weighs only a quarter of the OTA report's daunting 1.2kg).

Daly's emphasis on strategic analysis, made explicit in his sub-title, has resulted in many interesting case studies. Among them is a timely comment on the American company Genex, warning of the dangers of the company's heavy reliance on a single manufacturing contract for L-phenylalanine with G.D. Searle. This contract was terminated a few weeks after the book was published, plunging Genex into a financial crisis.

The source material for the book appears to have been culled largely from articles in specialist biotechnology magazines. These have tended to concentrate on the newsworthy start-up companies, and there is in consequence an under-representation of the strategies which are being adopted by the large chemical and pharmaceutical firms; now that the basic technology is more widely disseminated, such companies are beginning to make real inroads into the market. The likely impact of these moves on the start-up companies suggests not only a volatile employment market for the scientists involved, but, as Peter Daly points out, the development of an even more fruitful area for strategic analysis than the biotechnology industry has provided to date. □

Peter Laing is an Assistant Director of N.M. Rothschild Asset Management Ltd, New Court, St Swithin's Lane, London EC4P 4DU, UK, which acts as investment adviser to Biotechnology Investments Ltd.

A stir in the primeval soup

Jacques Ninio

Seven Clues to the Origin of Life: A Scientific Detective Story. By A.G. Cairns-Smith. *Cambridge University Press: 1985. Pp. 123. £9.95, $17.95.*

WE ALL admire the high technology feats that the simplest cells achieve in duplicating chromosomes, translating genes into proteins and adjusting their enzyme activities to their immediate needs. All such pathways are interdependent, each relying on all the others, as in an arch that would collapse if any one of its stones were missing. How did the first cells arise, if life requires, at a minimum, a translation apparatus to make proteins to replicate DNA?

The usual answer is that some 4×10^9yr ago the Earth was a gigantic organic reactor producing masses of small molecules, amongst which were amino acids, sugars and nucleotides. Spontaneous polymerizations occurred, leading to nucleic acids that could replicate without the help of enzymes. Some of these "naked genes" acquired control over their environment. The coupling between nucleic acid replication and peptide synthesis became tighter and tighter until it became a strict coding relationship.

Cairns-Smith objects to this view; he believes that primitive organic reactors were more likely to produce tars and sludges than fine biochemical products, and that nucleotides are complex molecules that require sophisticated mechanisms for their production. Also, if a low-technology machine is to work, it must avoid the mutual dependency of its parts that is characteristic of more complicated machines. But, he says, the very existence of a primitive life-form made the synthesis of well-defined organic molecules possible. Amongst these, fancy polysaccharides, with no genetic use, might initially have been precursors of DNA or RNA. According to Cairns-Smith, new genes and the machineries they controlled gradually took over from the older forms of life: "None of the fibres in a rope has to stretch from one end to the other . . . new 'gene fibres' may be added and others subtracted without breaking the overall continuity".

These ideas are well known among scientists in general but are rarely discussed openly. In the origins-of-life research community, people seek a comfortable corner where they are least likely to interact with competitors. Yet, consider the fundamental issue: is nucleic acid replication conceivable in a prebiotic world? We are flooded with so-called theoretical treatments which generate models of the evolution of prebiotic self-replicating nuc-