do communicate to their readers the excitement and enthusiasm which have been such characteristics of their work. Here, brought together for the first time, is a really authoritative and up-to-date account of the Fox hypothesis. It is illustrated with a magnificent set of micrographs, including time-lapse series, which, although many have been published before, are good to have collected together.

Four shorter chapters, on optical activity, on protein sequence, on fossils, and on extraterrestrial problems, conclude the volume. These chapters are useful in that in places the authors can bring cogent criticism to bear on the work of others, but, like the first three chapters, they lack the authority and the immediacy which are such characteristics of the central core of their work. And their enthusiasm is infectious. A special bonus comes in the last three pages. Here, in an appendix, is a recipe for home-made protocells! Readers are encouraged not only to make them for themselves, but also to feed them and watch them grow and divide!

The book is certain to be criticized, for it is much prejudiced in favour of the theories that the authors themselves have so often championed in their experiments. But there are, to my knowledge, at least four other comprehensive books on the origins of life at the moment in press, and we should very soon be able to range against each other all the rival models. Perhaps, in their enthusiasm, Fox and Dose are in danger of creating the mistaken impression that their protocells are almost already "alive". The student who defines life in functional terms may be perplexed, for in the laboratory these protocells absorb food from the environment, grow and multiply by fission. Is this not life? The answer is, of course, very firmly in the negative, for these activities are not spontaneous, they are induced by environmental changes, by (for example) increasing the pH. And in morphological and chemical terms, the differences are even greater. The membranes of protocells are chemically quite distinct from any living cell membrane, and we still await experiments in which protocells have been persuaded to incorporate nucleic acids.

Despite this danger of over-enthusiasm, the protocell hypothesis is such a vital element in the present debate on the origin of life, and it is set out so well, that the volume must surely become compulsory reading for everyone interested in the topic. The book does the publishers credit: it is well produced and reasonably priced. And it is quite the most exciting account that we yet have of what must surely be the most exciting event in the whole history of the Universe.

P. C. SYLVESTER-BRADLEY

Boundary Erosion

Meaning and Control: Essays in Social Aspects of Science and Technology. Edited by D. O. Edge and J. N. Wolfe. Pp. x+274. (Tavistock: London, February 1973.) £4.

ARTHUR KOESTLER, I suppose, might have it that making a book of the papers presented at an international conference is like trying to provide a call girl service by post. Personal contact not being transmissible by the Gutenberg technology, how much point is there in what remains?

If the quality of individual contributions were all that mattered, this volume would pass muster without question. One is entitled, however, to look for more: the coherent development of a theme. The editors suggest that metaphor, and the social context of its use and abuse, form such a theme; but I doubt whether many readers will perceive it as such, once past the first two papers, in which first D. C. Bloor and then Edge deal explicitly with it.

Perhaps the strongest recurrent thread is the attempt to erode boundaries between science and other aspects of human endeavour. Bloor makes the point plainly in his transparently lucid attack on Oxford linguistic philosophers: it is for "boundary maintenance"—for trying to see different spheres of competence as autonomous—that he berates them. Harry Kay points out that, though in general the medium of technology is "more penetrating than any of its hardware", it has not effectively permeated our educational structure; most new machines are not being well integrated into teaching. Eric Trist traces to the dialectic between the "scientific" and the "human relations" approaches to management the newer attempts to organize the technology-people interface; "only the socio-technical whole could be effectively optimized", and principles for job design should explicitly take this into account. Frank Bechhofer's problem regarding shop-floor behaviour is similar, and F. R. Bradbury makes matters specific with regard to the chemical industry.

W. H. G. Armytage wittily traces technocracy through a century and a half. Lewis Gunn analyses the way in which MinTech, "lean and purposeful" in 1965 and concerned with the planned promotion of selected research and development (R and D) programmes, rapidly grew by accretion to become a broadly based sponsoring department for industry. Edwin Mansfield gives a useful summary of his research findings on R and D management, and Wolfe adds a note on cost escalation. R. W. Davies shows how in Soviet Russia, as in the West, there have been attempts to bring R and D closer to users. A brief but cogent paper by

Christopher Freeman deals with R and D for less developed countries.

Although it is hardly possible to deny that issues arising from the science-society relationship form just about the most important group of problems facing mankind, the point still needs making in academic circles, and it is good to see it made in a volume of such high calibre. Some of the papers have suffered from the three-year lag between conference and publication, and some of the newer areas of frontier activity like environment, pollution and conservation are barely mentioned.

F. R. JEVONS

Prime Number Problems

The Distribution of Prime Numbers: Large Sieves and Zero-Density Theorems. By M. N. Huxley. Pp x+128. (Clarendon Press: Oxford; Oxford University Press: London, 1972.) £6.50.

ORIGINALLY, a large sieve was a result expressing in quantitative form the fact that a sufficiently dense integer sequence is well distributed in most arithmetic progressions modulo most (small enough) primes. Nowadays the name covers also a class of allied inequalities for averages of trigonometric and character sums; such inequalities have assumed in recent years increasingly sharp and comprehensive forms, and have led to significant progress in the notoriously difficult study of prime numbers. In 1967 there appeared *Multiplicative Number Theory* (Markham, Chicago) in which the late Professor H. Davenport described the early stages of these developments by ending an exposition of classical prime number theory with a simplified account of Bombieri's now well-known result on the distribution of primes in arithmetic progressions. More recently (1971) H. L. Montgomery's *Lectures on Multiplicative Number Theory* (Springer) have traced the important developments since then (most of these, incidentally, due to himself); and now Huxley's monograph takes the story almost up to the present. Dr Huxley tends to follow Davenport (to whose memory the book is dedicated) in the organization and choice of material; but he is able, of course, to give an account of much more powerful large sieve techniques and of superior results about the zeroes of ζ- and L-functions. He concludes with an account of Vinogradov's famous three primes theorem, based on Montgomery's treatment of the associated trigonometric sums, and with his own result for gaps between consecutive primes, which refines a technique of Montgomery and is currently the "world record", after many years of very slow progress. Huxley is a leading expert in the field, and he shows this in many ways in the course of the book. One of