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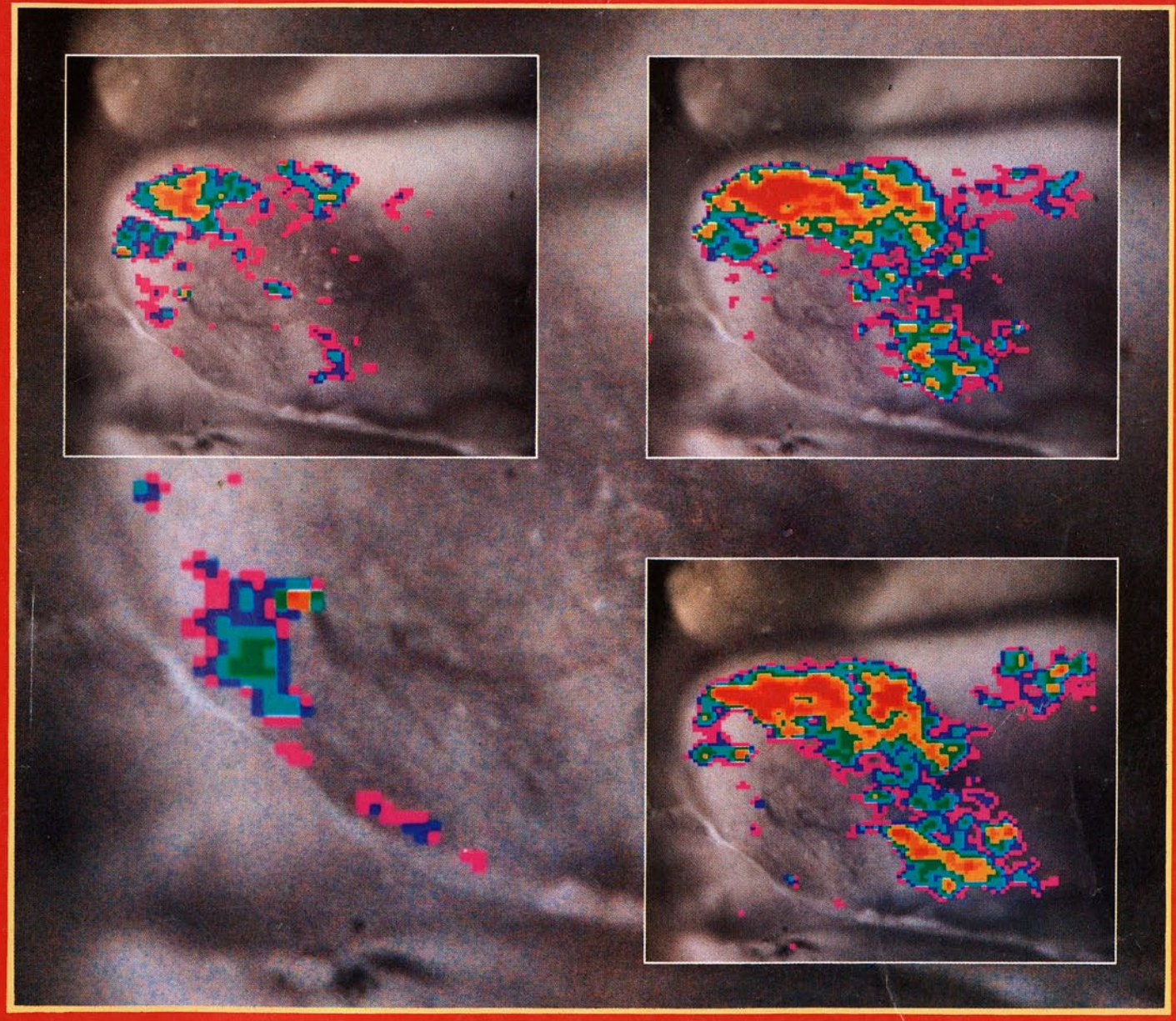

REAL-TIME IMAGING OF NEURAL ACTIVITY

that can only be resolved by carrying through optimization studies.

The first of Lewontin's criticisms is more problematical: for those who spend their lives as biologists because they are filled with awe by the beauty of adaptation it is a tough message to be told that such things are almost impossible because of constraints of history, genetics and development. It is tempting to conclude that the argument that design is hopelessly constrained must be wrong and the facts right. However, a counter-argument to this is that the enthusiastic observer's attention is drawn to the few cases of good design and is blind to the many cases of lack of adaptation. This brings us straight back to optimality modelling as a way of finding out whether or not a particular trait is a design feature.

Given that adaptation is worth trying to understand — after all, without the concept of function, biology would be just a mass of descriptive detail (imagine a list of the components of the mammalian immune system with no attempt to say what the system does) — optimality models have a role to play as research tools. The book does not come to a consensus about this role. At the very least optimality models have forced biologists to think about the epistemological status of the concept of design; at the most, they may provide us with a coherent general framework for the study of adaptation. □

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Indian wisdom

Robert Temple

History of Science and Technology in Ancient India: The Beginnings. By Debiprasad Chattopadhyaya with appendices by various colleagues. *Firma KLM Private Ltd, 257-B B.B. Ganguly Street, Calcutta 700-012, India: 1986. Pp. 556. Rs 325.*

THE history of Indian science has not been well documented and this fascinating book does much to remedy the situation. It deals largely with what happened before 500 BC, and its contents will be highly unexpected to most readers. The book is primarily written for an Indian audience and the author bravely attacks "Hindu revivalism" and the obscurantist doctrines of the religious fanatics of India, pointing out that even many modern Indian scientists are tainted by it. This has resulted in a widespread unwillingness among devout Hindus to acknowledge indebtedness to the Indus Valley civilization, which preceded the Aryan invasion of India and which collapsed about 1500 BC. Chattopadhyaya takes this bull firmly by the horns, demonstrating conclusively that the mathematics and geometry preserved in the Hindu Sulvasutras can only be Harappan (Indus Valley civilization) in origin.

The book will be tough going for those with no background in Indian studies, as the references to the Vedas and countless other matters taken for granted by an Indian readership will be obscure or even incomprehensible. But this volume is nevertheless a masterly contribution to the history of science.

It is, for example, astonishing what the author reveals of the complexity of the brick technology of the Indus Valley civilization. One of the mathematical preoccupations of that civilization was to make widely varying constructions of bricks — of great size — having identical areas and volumes. The Indus people were thus concerned with attempting to square the circle, knew the Pythagorean theorem (as the Babylonians also did), had an accurate value of the square root of 2 to five decimal places, and indeed worked with the decimal system. They were fond of problems such as "construct a square whose area is three times the area of a given square" or "transform a square into a rectangle of the same area" or "construct a triangle whose area is equal to that of a given square". This information was preserved by the later Hindus for superstitious reasons connected with the awe in which they held baked bricks (which they were incapable of making) and to which they attributed a mystical or divine power.

Indus Valley astronomy is less fully treated because less evidence survives, but it was fairly advanced, and ingenious analysis of one datum has yielded a precise date of 2357 BC for an observation. Failure of scholars to decipher the Indus script makes various speculations on Indus astronomy controversial, though many surviving short inscriptions seem to refer to stars (represented by a fish sign).

For 1,000 years, between 1500 and 500 BC, India had no form of writing. Most science disappeared. But it was during this period that the early Hindus developed linguistic science to its highest pitch in world history, a story also told in the book. The motivation was the need to preserve immensely long texts orally without so much as a syllable out of place. Stemming from this extraordinary feat of linguistics came the foundation of phonetics, etymology, semantics, and the most complicated grammar in the world, that of classical Sanskrit. Also discussed at length is the ancient Hindu concept of *ṛta*, which seems to be the world's earliest formulation of the principle of natural law, and which in the Vedic period in India transcended all wishes of the gods.

A sequel volume by another author dealing with the history of Indian science of subsequent epochs will appear in due course. We can hope it will match Chattopadhyaya's book, which will be a fundamental reference work for decades to come. □

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Rubber economy

AFTER 74 years of publication, the *CRC Handbook of Chemistry and Physics* (the 'Rubber' book) appears in every technical library worth its salt, and is an essential facility in chemistry and physics laboratories. Now the first softcover edition of this 'bible' has been published*: though with 1,800 pages it is slightly slimmed down from the hardback classic, at $29.95 it probably gives more scientific information per unit price than any other book in print, and is aimed at a mass student market. Although the mathematics section has been pruned to a few pages, those on elements and inorganic compounds and organic chemistry retain comprehensive coverage along with sections on general chemical and physical constants. The philosophy has been to present core data that will require revision every three or four years.

The *Handbook* remains the best source of elementary data (melting point, boiling point etc.) on chemical compounds but it has been slow to incorporate the new spectroscopic fingerprints of chemistry — indeed CRC publish another specialist handbook in these areas. Remarkably, the softcover edition omits such limited IR and NMR information that appears in the main handbook. Ultraviolet data are sparse and Mössbauer parameters do not appear, though X-ray and atomic line spectra of elements retain wide coverage. The recently revised *Tables of Physical and Chemical Constants* (the old Kaye and Laby) published by Longman is more informative in these areas and more imaginative in presentation of data, though of course much less comprehensive on thermodynamic matters. Surprisingly there are two separate and not totally consistent tables of elemental binding energies without cross reference, while chemical shifts in binding energies get no mention. Group theory tables are another notable omission.

For all its great strengths, the full edition of the *CRC Handbook* is a curiously unbalanced data selection for the *overall* reference needs of contemporary chemistry and physics students. For this reason the new edition fulfils a more limited role than its title might suggest. J.A.D. Matthew

* *CRC Handbook of Chemistry and Physics*, Student Edition, published by CRC Press price $29.95. Available in Europe, from 5 April, from Wolfe Publishing, London, price £19.95.