Variable stars

Nigel Calder

The Solar System.

By Roman Smoluchowski. Pp.174.

The Discovery of Subatomic Particles.

By Steven Weinberg. Pp.206.

Fossils and the History of Life.

By George Gaylord Simpson. Pp.239.

Human Diversity.

By Richard C. Lewontin. Pp.179.

The Science of Musical Sound.

By John R. Pierce. Pp.242.

Volumes in the Scientific American

Library, published by W.H. Freeman. *

Each book £10.95.

SERIES of books are to be mistrusted because the initial concept can all too easily become a substitute for later thought. I paused when I saw the titles of this batch of five from the Scientific American Library. After the unlikely *Powers of Ten*, the first under this new imprint (reviewed in *Nature* 306, 125; 1983), they seemed too obviously the topics that anyone might jot down on the back of an envelope when proposing a series of popular books on science: planets, atoms, fossils, human genetics — oh, and music to prove you are not philistine. The difference here comes in the quality of the authors, who combine eminence in their fields with proven gifts of exposition.

In the flotilla leader, *Powers of Ten*, Philip and Phyllis Morrison in collaboration with Ray Eames brought full circle the idea of depicting the world at different scales, from the intergalactic to the subatomic. That concept originated in Kees Boeke's book *Cosmic View*, was developed in two movies by Charles Eames, and came back between covers in the new and more vivid book. With the handsome volumes in front of us, and others from such authors as Christian de Duve, James D. Watson and David Hubel coming over the horizon, all of them propelled by the enthusiasm of Gerard Piel of *Scientific American*, what response can there be but immediate surrender to this firepower?

Doubts persist because these beautifully

*In the United States these books are first made available only to members enrolled with the Library (for details write to W. H. Freeman, 41 Madison Avenue, New York, NY 10010). In general, titles are then released to the book trade about one year after their initial appearance. Currently available through the trade are *Powers of Ten* (\$29.95), and *Human Diversity* and *The Discovery of Subatomic Particles* (\$27.95 each). The other titles reviewed here will be released later this year.

In the United Kingdom, Europe, Africa and the Middle East all the above titles are available through the book trade in the usual way. New titles can be obtained through the trade as they are published, at approximately two monthly intervals. *On Size and Life* by Thomas A. McMahon and John Tyler Bonner and *Perception* by Irvin Rock will be available in May, both at £14.50.

printed and illustrated books look very similar. That raises another problem about series: either the authors are forced unhappily into a procrustean bed of editorial devising, or else their idiosyncracies pop out unconformably, which may be confusing to readers who expect one kind of book and get another. Although I am glad that the Scientific American Library (they do not call it a series) veers towards individuality rather than predictability, the standard format carries an implication that the reader who can cope with the fossils should also be happy with the physics. For these reasons, the books must be judged individually, yet also as a variety of solutions to the problem of presenting expert knowledge to a general readership.

The most straightforward exposition is Roman Smoluchowski's *The Solar System*. This is the space-age Solar System, with all the new imagery to draw on (including a composite *Voyager* view of the south pole of Jupiter with a giant Jovian crustacean in the middle, which turns out to be "an artifact of the imaging process"). We also have Venus mapped by radar, and astronauts on the Moon. The book summarizes the latest knowledge about each object in turn, and comments on current riddles — the missing solar neutrinos, Mercury's magnetic field, Venus's retrograde motion, the evidence for the past torrents of water on Mars, and the "astounding" revelations about Saturn's rings. The essay on Jupiter, Saturn and their respective moons is the best in the book, and makes an interesting contrast with the earthbound speculations about Uranus and Neptune; *Voyager 2* will not reach Uranus until 1986. Smoluchowski's afterword on life in the Sun's environment leads to a robust though "disappointing" conclusion that "it is most unlikely that any form of even the most primitive life exists now in the solar system outside the Earth".

Entirely different in approach is Steven Weinberg's *The Discovery of Subatomic Particles*. From a recent Nobel prize-winner, readers might well expect a stop-press report on charmed quarks, W particles and the like. If so, they will be disappointed: this is prehistory, centred on events at the Cavendish Laboratory between 1897 and 1932, with only a brief postscript about mesons, strange particles and quarks. While Weinberg indulges his evident pleasure in the story, he uses "flashbacks" to explain the classical physics underpinning the subatomic discoveries. For example he starts off with J.J. Thomson identifying the electron, but immediately interrupts himself with 15 pages of historical disquisition on electricity, discharges in vacuum and Newton's laws of motion, while poor J.J. is waiting to switch on his apparatus. I do not believe this is how non-physicists want to hear about it. Weinberg's crypto-mathematical approach also makes the progress of physics early in this century seem logical and robot-like, rather than the roller

coaster that it really was, and we are denied the intellectual climax to the story because the quantum theory falls outside his self-imposed syllabus.

A book from George Gaylord Simpson, the guru of American palaeontology, is all the more welcome because he defied illness to complete *Fossils and the History of Life*, which is packed with authoritative information. It is also conservative in its treatment of current controversies in palaeontology. Even continental drift comes as a postscript to the traditional biogeography of waif dispersal and land bridges. The Eldredge-Gould critique of phyletic

Illustration Library-style — the picture, of Robert Wadlow who was 8 feet 10¾ inches tall at the age of 20, is reproduced from *On Size and Life*. See the footnote on this page for publication details.

gradualism is described as an attack on a straw man. Other heresies get shorter shrift: the neutral theory of molecular evolution, the evidence for a cosmic impact terminating the Mesozoic and the banishment of *Ramapithecus* from the human lineage. That may be a pity because if these ideas prevail, as some now seem likely to do, Simpson's dismissal of them may diminish the long-term value of the book. Moreover, when his treatment of evolutionary mechanisms becomes argumentative, the author's use of language slips from vivid explanation into the denser terminology of the seminar.

Like Smoluchowski's *The Solar System*, Richard Lewontin's *Human Diversity* is a wonderfully updated exposition of an old theme. Yet for every hundred people who have seen spectacular spacecraft images of the planets, I doubt if one is familiar with the discovery by Lewontin and Harry Harris of the wholesale molecular polymorphisms. They illuminate the genetic similarities and differences between indivi-

duals and between populations, and also reflect the migrations of identifiable human groups that kept acquiring differences and then re-stirring the genetic pot. The biochemistry does not entail genetic determinism. Lewontin stresses the plasticity of the human endowment, and the interaction of genotype and environment in producing adult variations. "The heritability of MN blood type is 100%, and the heritability of the ability to pronounce *rue* like a Frenchman is zero". *Human Diversity* is a book that non-biologists will have to read carefully, because of a spattering of jargon and the subtleties of the subject, but the effort will be well rewarded.

While Lewontin's takes pride of place on my shelf as arguably the most important book of the five, it is Pierce's that finishes up at my bedside — also on my record player, because two disks come with *The Science of Musical Sound*. This is a personal and practical exploration of the subject by a distinguished electronics engineer who, besides being a pioneer of computer-generated music, also writes science fiction as J.J. Coupling. From a deceptively elementary start with the behaviour of stretched strings, the reader soon finds himself among the paradoxes and illusions that flower in the no man's land between physics, perception and art. Whether Pierce is dealing with scales, harmony, loudness or timbre, or with misadventures in architectural acoustics, he combines a lucid and lively presentation of the facts with shrewd discussion of the mysteries. His message is that the computer transcends all the limitations of previous musical instruments and offers many novel effects; these await only the supply of new genius that is not overpowered by the genius of the past. Although *The Science of Musical Sound* is entirely different in content and style from *Powers of Ten*, which I mentioned at the outset, they share an enthusiasm and delight which are muted in the other books.

From this batch of books, what should we conclude about the merits and problems of series-like publication of science for a general readership? The authors all have star quality, but inevitably they appear with variable magnitudes in this constellation. My guess is that the best of the books (Smoluchowski, Lewontin and Pierce) would have appeared willy nilly, from authors already full of their ideas. If the Scientific American Library is to take well-deserved credit for giving them a ride in its gleaming vehicle, then equally a question hangs over others that have an air of coming aboard to oblige the driver. These, I must stress, are in the minority. Quality control in the production of popular science, as with all books, is nevertheless a matter of making quite sure that every author has a fresh and exciting story to tell.

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Grand organization in mind

Stuart Sutherland

Frames of Mind: The Theory of Multiple Intelligences.

By Howard Gardner.

William Heinemann/Basic Books: 1984.

Pp. 438. £18, \$23.50.

UNTIL about forty years ago, the fashionable psychologist rose to fame by proposing majestic theories that were *une grande mélange de tout*. William James, Ivan Pavlov, J. B. Watson and the Gestalt psychologists took the whole of human behaviour into their purview. The last in this romantic line was Donald Hebb: I remember the excitement generated in 1949 by the publication of his book, *The Organisation of Behaviour* — a typically modest title. Unfortunately, most of the theorizing in such books was as vague as the scope was broad, and psychologists came to work in more restricted domains. They felt it better to provide rigorous explanations for such fascinating phenomena as the movement evinced by a stationary point of light in a dark room or the faster learning of nonsense syllables at the beginning and end of a serial list than of those in the middle. Now, after a gap of 35 years, Howard Gardner has reverted to the grand tradition. No one can challenge the scope of *Frames of Mind*: it remains only to debate its rigour.

Gardner puts forward a faculty psychology. The idea that the human mind contains discrete and autonomous faculties is of course not new. It gave rise to phrenology and was subsequently defended by such practitioners of mental testing as L.L. Thurstone and J.P. Guilford. They attempted to uncover the different faculties by giving subjects an array of tests and performing a factor analysis on the results in order to extract a small number of hypothetical factors that would account for the correlations between the individual tests. As Gardner rightly points out, the enterprise foundered because there is no one solution to a factor analysis and because the tests given were arbitrary.

Gardner's originality lies in the composition of the seven faculties into which he claims human intelligence can be divided, and in proposing seven "unmistakable marks, by which you may know, wheresoever you go, the warranted, genuine" faculty. He describes his faculties as "intelligencies", but I shall keep to the old-fashioned word "faculty" since intelligence is not a count noun and to use it as one is a mockery of Gardner's first faculty, that for language. The other faculties he proposes are musical, logical-mathematical, spatial, bodily-kinaesthetic, and intra- and extrapersonal. Spatial ability is the capacity to manipulate the world in the imagination: it is required for map-

reading, for much of science, and for all painting; bodily-kinaesthetic ability is required both for moving the body and for manipulating the external world and is, according to Gardner, a prerequisite for dancers and inventors. The intrapersonal faculty is used to understand oneself, while the interpersonal one is for understanding others: Gardner seems in some doubt whether to classify these as two separate faculties or as different aspects of the same one.

Some may feel a sneaking suspicion that Gardner chose his seven faculties through common sense and then looked for supporting evidence by the use of his criteria, but that is a perfectly legitimate way to proceed. The criteria he has devised are as follows. First, each faculty should depend on a set of core operations that differ from one faculty to another. Many of the computations needed to use or understand language are clearly different from those needed by the spatial or bodily-kinaesthetic faculties. To understand language, however, it is surely necessary to make use of all the remaining faculties (though which is needed at any instant will depend on the topic of discourse), a point which Gardner does not adequately consider. Second, the existence of a particular faculty may be inferred if there are brain lesions that damage its operation while leaving the others unimpaired: showing that the computations underlying each proposed faculty are carried out in different parts of the brain is presumptive evidence that the computations themselves are different. This criterion works moderately well for most of the faculties, but it seems doubtful if personal intelligence can be impaired by brain damage without deterioration in many of the others.

A third and novel criterion is the existence of a heightened form of a single faculty in *idiots savants*, whose other abilities are severely impaired. They may attempt to compensate for a general loss in intelligence by developing to their utmost any faculty that has been spared. Some *idiots savants* have shown remarkable ability at such tasks as calculating the day of the week on which a particular calendar date falls, though it should be noted that none have become great or even good mathematicians. It is in fact open to question whether rapid calculations and real mathematical ability have much to do with one another.

Among the other criteria that Gardner uses are a distinctive evolutionary and developmental history for a given faculty. Neither of these is very compelling. We know little about the evolutionary history of most of the faculties he identifies, and it may be that in the individual the development of one faculty is tied to progress in another: thus, a child can hardly begin to enumerate objects (logical-mathematical) before having the concept of an object (spatial) and without some spatial knowledge it could not display much in the way of