On trans-scientific turf

Owen Gingerich

Beyond Velikovsky: The History of a Public Controversy.

By Henry H. Bauer.

University of Illinois Press/Harper & Row: 1985. Pp.354. \$21.95, £24.25.

"THE thousands of words spilled to refute and condemn his theories gave them a sort of status, even if only that of divinely inspired nonsense." So the London *Times* summed up the controversy surrounding the work of Dr Immanuel Velikovsky when he died in November 1979.

Basically, Velikovsky claimed that in the ages before Christ a large body had been ejected from Jupiter and had gone into orbit around the Sun, eventually to become the planet Venus. On its way, it came close enough to the Earth around 1500 BC to cause the pharonic plagues of *Exodus* and may other miraculous phenomena recorded in the Old Testament, including the day the Sun stood still at Gibeon. Relying on eclectic interpretations of world-wide mythology, Velikovsky amazed his readers with his erudition and dismayed astronomers by his flagrant disregard for Newtonian mechanics.

The hue and cry against Velikovsky's theory came primarily in two waves. When his principal work, *Worlds in Collision*, appeared in 1950, heralded by sensational abridgements in *Harper's*, *Colliers* and the *Reader's Digest*, astronomers stirred up such a tempest that Velikovsky's place in the best-seller list was assured. Having learned that any publicity is good publicity, the scientists quickly lapsed into indignant silence, hoping that the interest in Velikovsky's theories would atrophy under their careful lack of attention. Their scheme may well have worked except that Velikovsky was "rediscovered" by the anti-establishment generation of the 1960s, for whom he became something of a folk hero. The scornful attacks of the early 1950s, and especially tales of a threatened textbook boycott against his publisher, Macmillan, helped build up an image of a scientific martyr, a modern-day Galileo alternately jeered and ignored by the entrenched scientific establishment.

Thus, by 1974, several of us agreed that a forum should be provided for Velikovsky to meet his scientific critics, and for the scientists to put on the record a clear statement of their objections. The actual encounter, at a meeting of the American Association for the Advancement of Science in San Francisco, proved to be a memorable non-meeting of minds, with a highly polarized audience full of partisans unlikely to be swayed by arguments or counter-arguments from either opposing camp. Scientists who had advocated silence

on the matter went away with an "I told you so" attitude. Nevertheless, this second wave of criticism was harder for Velikovsky's supporters to cope with, and Velikovsky felt particularly stung by the witty and articulate attack made by Carl Sagan. In colourful terms, Sagan described such things as the "fly ablation problem", that is, the difficulty of flies originating on the Venus-comet in entering our atmosphere just in time to cause the pharonic plague of pests.

Today, although Velikovsky's catastrophism is rapidly being forgotten, the fierce controversy that swirled for three decades can still teach us something about the nature of science and trans-scientific

Unreal Science

SIR,—As a qualified and practising scientist I wish to dissociate myself from your editorial of April 12. You allude to Geller and Velikovsky with terms like "nonsenses", "beliefs beyond science", and "pseudo-scientific ideas", and contrast these with "real science" and "science based on conventional ideas about the way a scientific investigation should proceed", and you declare that "scientists want to fight this distressing drift from the scientific way of thinking".

History is littered with ideas shown to be false by people bold enough to question their contemporary conventional science, often in the face of personal ridicule and even persecution.

Presumably you class Einstein's

Passions run high — a letter in Nature, 28 June 1974, in response to an editorial on Velikovsky.

challenges. It is such questions that Henry H. Bauer, Dean of the College of Arts and Sciences at the Virginia Polytechnic Institute, has explored. A personal and somewhat idiosyncratic account, *Beyond Velikovsky* contains material to infuriate or at least exasperate everybody. Nevertheless, it is the most balanced and informative analysis yet to emerge from the whole affair.

Bauer argues that science does not find absolute truth, but only a high degree of probability. This prevents scientists from claiming that any particular sequence (such as Velikovsky's) is impossible, only that it is staggeringly unlikely. However, Velikovsky never claimed that his scenario was probable, only that it happened. Hence, counter-arguments that it was improbable completely missed the point. Velikovsky was staking his claims on an entirely different turf — "trans-scientific" in Bauer's terminology — and so the normal type of scientific argument lost its force against Velikovsky and his supporters. In their frustration, scientists were frequently reduced to appeals to authority (their own, of course), which went directly counter to their own claims of how science worked.

Velikovsky, too, was frustrated by the resistance from the scientific community, so he consulted his neighbour at Princeton, Albert Einstein, about the status of his theory. Einstein assured him that it would be better if the theory could *predict* something. Thereafter Velikovsky searched his writings and came up with a series of "advance claims" that he had made, ranging from high temperatures on Venus to radio noise from Jupiter. Unfortunately, Einstein had not made it clear to him (and thus to Velikovsky's followers) that predictions have to be made for the right sorts of reasons to be persuasive. The principles must fit with the coherence of scientific understanding, and they should not be single *ad hoc* instances incapable of supporting further, related predictions.

Bauer analyses both Velikovsky's physical reasoning and his advance claims, and both are found wanting. Although Velikovsky's scenario cannot be denied outright, it is relatively easy to show that his understanding of physical principles was hopelessly faulty. "There is rarely a certain way of identifying a crank", Bauer cautiously asserts, and only after 150 pages does he label Velikovsky one in the sense of a person "enthusiastically possessed by a particular crotchet or hobby". But in a devastating chapter entitled "A Nontechnical Case against Velikovsky" he leaves no doubt that the enthusiastic Dr Velikovsky was also a crank in the more pejorative sense of the word.

Nor do Velikovsky's opponents escape Bauer's criticism. "In retrospect", he writes, "it seems clear that Velikovsky's critics did not grasp the magnitude — or perhaps even the nature — of the task of discrediting Velikovsky in the eyes of the public at large". Bauer charges them with errors of commission — arguing *ex cathedra*, with ridicule, *ad hominem* — as well as with errors of omission. In the latter category is, primarily, the failure to capitalize on the unoriginal character of Velikovsky's scheme.

There is, however, one logical path that, curiously enough, Bauer has not explored. Although science cannot prove that a Velikovskian scenario is impossible, it might well prove that it did not happen. At the San Francisco confrontation, Peter Huber provided evidence from Babylonian records that Venus in 1600 BC behaved just as it did in the centuries immediately before our own era. I remarked at the time that if Huber was right (as I certainly believe), Velikovsky's scenario was finished. Velikovsky tossed one of his *ad hominem* barbs at Huber, labelling him a self-confessed amateur in Babylonian. Huber, who is one of the world's leading statisticians and a redoubtable cuneiformist on the side, quickly proved on the stage how ignorant Velikovsky himself was of cuneiform languages. The Velikovskites were naturally reluctant to admit defeat by a single stroke, so they have since worked hard to discredit the Babylonian data,

which were unavoidably contaminated with copyists' errors (and hence Huber's statistical approach). Ambiguous data often characterize the cutting edge of science, and discussion of the point would have added another dimension to Bauer's analysis.

With the decline of interest in Velikovsky, another, surprisingly similar, challenge is facing the scientific establishment: so-called "Creation Science" whose extreme form calls for a 6,000-year-old Earth geologically shaped by Noah's flood. Fossil footprints of a giant humanoid beside indisputably genuine dinosaur prints in the rocks of the Paluxy Creek, Texas, are taken quite seriously by many of these fundamentalist, Biblically-literalistic people. Bauer's closing chapters on "Means of Persuasion" and "Some Realities about Science" offer sound advice about pitfalls to be avoided in these "trans-scientific" debates, where probabilities, values and desirability are at stake. How successfully his analysis can be brought to

bear upon this new challenge remains to be seen. But arguing that the creationist ideas have been heard before does not seem to be a cogent strategy. Rather, we must argue that even if science is "never completely final, always subject to question and doubt" (as Einstein put it), nevertheless it is of a piece, not easily shredded, and the process of building this coherent tapestry is what science is all about.

Beyond Velikovsky is awkwardly repetitive, not as complete as it might appear at first glance and in its own way rather too polemical. Its system of references, numbered but unattributed in the text itself, is seriously distracting. Nevertheless, the account is detailed, thought provoking, and the best yet written on a bizarre episode that continues to smoulder in the annals of science. □

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Continental epic

Robert M. Hazen

Landprints: On the Magnificent American Landscape.

By Walter Sullivan.

Times Books, New York: 1984. Pp.384. \$22.50.

"THERE is no epic tale to compare with the account of how the North American continent came to be." So begins *Landprints*, one of the finest popular earth science books to appear in decades. In this recounting of the 3,500-million-year evolution of the mountains and valleys, rivers and deserts of North America, Walter Sullivan, the science editor of the *New York Times*, has achieved a masterly blend of geomorphology, historical geology, geophysics, structural geology, palaeontology and geodynamics.

The book consists of 37 short, self-contained essays on the principal features of the American landscape. Inspiration for this geological feast came from the author's frequent transcontinental flights; as Sullivan observes, many of the continent's landforms are best viewed from the air. The first two dozen chapters, therefore, focus on striking geomorphological features — parallel ridge systems, meandering rivers, volcanic craters and cones. The White Mountains, Wyoming basins, Hawaiian Islands and the Grenville Province are among the many areas which are examined first in terms of their distinctive aerial appearance, but then also from the standpoint of their underlying geological structure and history. In this way Sullivan gradually introduces current views on plate tectonics, continental subduction, and the regional folding and faulting that

are associated with mountain building.

The last third of the book emphasizes the dramatic alterations of the Earth's surface imposed by man. Farms and mines, cities and suburbia have all left their distinctive imprint on North America, and Sullivan discusses both their geological and environmental significance. He explains why East Coast cities grew up along a former continental shelf margin (the "fall line"); he shows how rock erosion influences soil chemistry, which in turn controls the predominant crops of American farms. From aerial observations of the distinctive patterns caused by centre-pivot irrigation, hydroelectric dams and strip mining, Sullivan proceeds finally to consider the possible consequences of man's actions on his environment.

Landprints is graced by a magnificent collection of photographs and other illustrations. Aerial and Landsat photos — more than 150 of them — display the variety and splendour of North American topography, both natural and man-made. Views of ancient craters, barrier islands, dune fields and the crazy-quilt of America's farms, photographs of road-cuts, regional maps and schematic diagrams of geological processes, all enrich the presentation.

This is a beautifully produced book, too, with clear typography, a felicitous layout and sturdy binding. The writing is stylish and informative, in the best tradition of popular scientific literature; Sullivan brings to his subject an infectious sense of wonder and enthusiasm — he entertains as he teaches. Anyone interested in science, particularly those who travel frequently by air, will be well rewarded in reading this continental epic. □

Robert M. Hazen is at the Carnegie Institution of Washington's Geophysical Laboratory, Washington, DC.

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