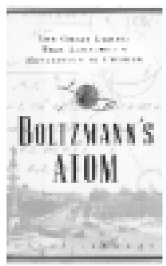
■ ANDREW RUPPEL, Feature Editor, McIntire School of Commerce, University of Virginia

Structure Was the Strategy

Andrew Ruppel, Feature Editor

A sense of structure greatly aids the thought process. Without it, there is a sense of incompleteness. Something seems lacking. When we perceive the presence of structure our confidence rises, uncertainty is reduced. Structure paves the way for others to contribute their work.

Building a structure, intellectually or physically, requires talent and ingenuity. But often elements of luck are involved and so soliciting the grace and goodwill of the gods helps. The tree-topping ceremony observed by builders acknowledges that requirement. Here are some accounts of thinkers and doers who intensely pursued and created structure because they understood its importance in the larger scheme of things.



Boltzmann's Atom

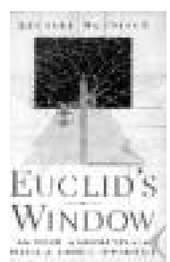
by David Lindely
The Free Press, 2001, 260 pages

www.simonsays.com

Ludwig Boltzmann was a boorish but brilliant physicist teaching and researching at the latter half of the 19th century. His story reflects the polarity of approaches to scientific questions. The empiricists, on the one hand, focus on observations, particularly those stemming from experiments, hoping to uncover immutable laws and clearly demonstrable truths in the process. The theorists, on the other hand, aim to formulate frameworks neatly tying together various phenomena. Logic says that good science should emerge when the two approaches engage in a persistent, but friendly, competition. Ego's often get in the way of logic, however, and the competition becomes less than friendly. This was the case between Boltzmann and Ernst Mach.

Boltzmann argued that heat is the result of motion of particles—the particles being molecules and atoms. "Show me the atoms!" the empiricists shouted. "Here they are, right in this stochastic equation," countered Boltzmann. "Not good enough," replied the empiricists. Making it even harder for Boltzmann to convince the "enemy" and interested bystanders that atoms existed was that his method of predicting atomic movement was probabilistic. Mach argued strongly that science had to begin with observation and measurement, not with theory—mathematical or otherwise. The two would almost follow each other around in prestigious academic posts in central Europe during the course of their debate.

Biographer Lindley, a science editor and physicist himself, makes it easy for us to follow Boltzmann's earnest efforts to make his point and not only ground the field of thermodynamics, but to lay the groundwork for quantum mechanics as well.



Euclid's Window

by Leonard Mlodinow
The Free Press, 2001, 306 pages

www.simonsays.com

Geometry sometimes gets lost in the shuffle of contemporary computation. Yet its impact has been enduring. This account reminds us of the power of this ancient branch of mathematics. Author Mlodinow, from Cal Tech but now with New York City-based Scholastic Inc., covers the work of four 'geometricians' beyond Euclid: Descartes, Gauss, Einstein, and Witten. Descartes accepted Euclid's parallel-lines postulate, arrayed two sets of parallel lines orthogonal to one another and then laid on coordinate system. He thus grafted algebra onto geometry, creating the very useful analytical geometry.

Gauss was cautious about challenging the Euclidean notion that parallel lines

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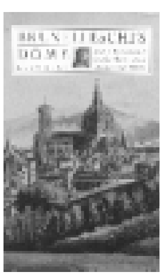
never meet. He let others raise the doubts more publicly—and thereby suffer career-damaging criticism. Gauss's willingness to speculate about non-Euclidean space was, however, to enable his student, Georg Riemann, to develop a version—one in which there were no parallel lines at all and the angles of a triangle summed to more than 180 degrees.

Einstein gave us more than just curved space. He gave us a space whose structure depends upon the observer's speed, particularly as that observer approaches the speed of light. Distance along the direction of motion collapses down to one point. If you are good at thought experiments, then you get the idea.

You may not recognize Witten's contribution unless you're into string theory—theoretical physics' latest approach to a comprehensive description of the structure of all matter. String *per se* does not seem to be a promising material with which to build a structure; particularly, when one is asked to imagine it as one-dimensional and vibrating. But of course, this structure of string is in the mind. The mathematics associated with string theory is extraordinarily difficult. Critics complain that, without empirical verification of its conclusions (currently viewed as very difficult to obtain), it is just an esoteric exercise.

This book itself is a sometimes-cute exercise in stringing together some key developments in mathematical thinking.



Brunelleschi's Dome

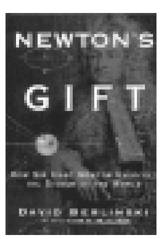
by Ross King
Walker, 2000, 194 pages

www.amazon.com

WHERE WOULD ARCHITECTS BE without the geometric framework developed by Euclid? With their tee-squares they draft parallel lines and with their plastic triangles they turn the angled corners. CAD programs have, of course, have made all this a matter of gliding a mouse and clicking on points. In the early 1400s, there was no CAD, no CalComp plotter to scroll out the plans, sections, and elevations for vaults, naves, and gigantic domes.

This fine little volume chronicles how Fillipo Brunelleschi, a trained goldsmith, came to design and oversee the construction of what remains the world's largest masonry dome. As one of the developers of linear perspective, Brunelleschi was well prepared for the task of designing a dome for Florence's main cathedral. But drawings were not enough; physical models were required to test the ideas, convince the city fathers, and measure actual building progress. Envisioning each construction step was mandatory if one was going to erect a structure that did not fall in of its own weight as it was being built.

Like other Renaissance artists, Brunelleschi had an interest in mathematics and science. And he was highly cogniscent of the properties of materials and readily put his hands ' in the mud.' It was these traits that led to his success in erecting a dome one foot larger in diameter than that of Rome's Pantheon. His basic approach was to create two domes—one for the interior and one for the exterior. And he utilized a herringbone pattern to allow the brick courses to better support one another as the dome arced ever more toward the horizontal as it rose in height. The book includes a number of not-always-helpful illustrations that, nevertheless, increase the reader's appreciation of the magnitude of the cathedral's construction challenge and Brunelleschi's mechanical ingenuity and ability to work out the structural details. While the central character of Ayn Rand's *The Fountainhead* might be seen as an architectural hero, in terms of straight-out skill and amazing accomplishment, it would be hard to beat Brunelleschi.



Newton's Gift

by David Berlinski
The Free Press, 2000, 217 pages

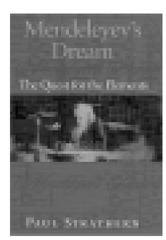
www.simonsays.com

TALK ABOUT A GRAND STRUCTURE. Here's the story of the man who not only shed light on the structure of the universe, but also shed light on the structure of light itself. And not only did Newton demolish counterfeit theories about the solar system, but he also demolished counterfeiters of the King's coin. Upon turning 60, Newton was put in charge of the British Mint, where he exhibited extraordinary and zealously applied skill in enforcing currency laws. It would have been interesting if Newton had gotten involved in monetary policy and used his calculus to address such questions as the velocity of money. But, of course, others would step in later to try their hands at that.

Both Euclid and Descartes were inspirations for Newton, while Hooke and Leibnitz were to hound him about who deserved the real credit for key intellectual discoveries. Newton was not gracious in his dealings with either of those scientists. Kindness was not apparently one of Newton's traits. As Warden of the Mint, he had one William Chaloner, a counterfeiter and scoundrel of the first order, not only hanged, but also drawn and quartered as well.

Newton's principal work, the *Principia*, reflects the format of Euclidean geometry, with its axioms and postulates. Movement of a body in a straight line is natural, unless acted upon by a force, and so on. Time and space were assumed to be absolute. Gravity is identified as the pervasive force running the "System of the World." But what is gravity itself? Is there a further irreducible? We know its effect, but not its makeup. Questions that contemporary physicists ponder over. (Interested readers may wish to check physicist Lee Smolin's *Three Roads to Quantum Gravity*. He says gravity could be "grainy.")

Berlinski's book has an extended appendix covering the notation of the calculus and basic equations of Newtonian physics, along with a useful chronology of Newton's career. Berlinski's style tends to be overly romantic. Of the several books reviewed here, this is among this reviewer's least favorite in terms of style, consistent though it was, and as informative were its contents.



Mendeleyev's Dream

by Paul Strathern
St. Martins Press, 2001, 309 pages.

www. stmartins.com

IN THE NEWTONIAN WORLD there is a spirit of imposing structure, almost in a normative sense. But progress also comes from discovering structure and similarity for the shear clarity of description. This certainly was the case in chemistry. Spend enough time in the lab trying to isolate compounds and elements and one begins to sense some similarities. But how to portray them? De Chancourtois tried using a spiral plot on a cylinder, which he termed a "telluric screw" and which seems astonishingly like the DNA helix. The journal in which he published his findings neglected to include the screw's picture, so few understood what he was getting at. John Newlands later proposed a law of octaves to account for the recurrent similarities in chemical properties that become apparent when looking at the elements arrayed by weight. But there were unexplained gaps and so critics were unconvinced that Newlands' law had answered the question of the structure of the chemical elements. That question had, of course, absorbed the attention of Russian chemist, Dmitri Mendeleyev.

Having written the first organic chemistry textbook (in the amazing period of 60 days), Mendeleyev decided to write one in inorganic chemistry—because none existed. He needed to have a chapter outline. He needed to have a structure for the book. Chemistry needed a structure. Mendeleyev was to dreamily discover, in 1869, that structure: the *periodic table*. This book gives an account not only of Mendeleyev's work to find a structure amongst the elements, but also recounts the efforts of others to bring coherence to the field. Indeed, only two of the fourteen chapters focus on Mendeleyev. Among the other chemists, and alchemists, who are covered are Paracelsus, Cavendish, Davy, Priestley, and Lavosier. The book is like a tour through the labs of chemistry's greats. There are the usual problems of priority of discovery and the problems created by unusual personalities. The book will help the reader not only better understand the structure of the elements, but the history of science as well. ■

Proposed Changes to Section 2 and Section 3(a) of the Institute's Bylaw 9

The Institute's Board of Directors' establishment of the *Decision Sciences Journal of Innovative Education* (*DSJIE*) necessitates that changes be made to the Institute's Bylaw 9, Sections 2 and 3. The current wording is stated below. The proposed revised wording to reflect the changes is underscored in bold type.

BYLAW 9: Publications

Section 2. The Institute's Journals and Official News Publication

The journal**s** of the Institute shall be *Decision Sciences* and ***Decision Sciences Journal of Innovative Education***. The Institute's Official News Publication shall be *Decision Line.*

Section 3. Editors

(a) The Publications Committee shall nominate and the Board of Directors shall appoint an editor for the journal**s** and for the official News Publication of the Institute.

A form is provided below on which to indicate your wish to request that a written ballot for voting on the proposed changes be submitted to the Members. Please return the form only if you are requesting that a vote by the membership be taken on the proposed changes. **The form should be returned by no later than December 31, 2001, to:**

Carol J. Latta, Decision Sciences Institute, Georgia State University, 35 Broad Street, #816, Atlanta, GA 30303

______ Check here if you wish to have a written ballot submitted to the Institute's members for voting on the proposed changes to Bylaw 9, Sections 2 and 3, as stated above.

Name ______________________________

Address ______________________________

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Signature ______________________________

Date______________________