

ticated. He cites but then slights Ichizo Kobayashi's elegant selfish-element theory to explain restriction modification systems, and misses out completely on Rosemary Redfield's data on transformation that show that bacteria care most about the food value of foreign DNA.

Similarly, the final chapter summarizes Bushman's earlier generalities about the differences between prokaryotes and eukaryotes with regard to the mechanism, frequency and impact of LGT, and other people's ideas

about the role of LGT in the evolution of introns, sex and life. The bold new unifying theory I had hoped to see simply isn't here, and in particular there is no attempt to bridge the gap to population genetics: this is a molecular biologist's book. But then I could do no better myself, and Bushman's book does provide, in one place, the best review of the many pathways and processes of LGT now available. I'm glad it's on my shelf. ■

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### More on gene transfer Mobile DNA II

edited by Nancy L. Craig, Robert Craigie, Martin Gellert & Alan M. Lambowitz  
ASM Press, \$169.95

### Horizontal Gene Transfer, 2nd Edition

edited by Michael Syvanen & Clarence I. Kado  
Academic Press, \$99.95

## Science in culture

### Algorithmic architecture

The Serpentine Gallery Pavilion by Toyo Ito and Cecil Balmond.

*Martin Kemp*

The most spatially ambitious buildings have invariably extended the potential of engineered structures into new realms. We need only think of the soaring Gothic cathedrals, the ultimate high-tech of their day. Mathematical principles are integral to this quest, even when the methods have been more empirical than theoretical.

At key moments — as with Antoni Gaudí, architect of the church of the Sagrada Família in Barcelona, and Richard Buckminster Fuller, who invented the geodesic dome — the mathematics of structure has been consciously embedded in the broader context of the generation of form within nature. Rather than the literal imitation of natural structures, this ambition exploits design processes that are analogous to nature's organizational principles.

For like-minded contemporary architects, designers and engineers, the advent of the computer has released radical new potentiality, as witnessed in the joyous pavilion erected outside the Serpentine Gallery in London's Hyde Park by the Japanese architect Toyo Ito and the London-based engineer Cecil Balmond of Ove Arup. To describe them respectively as architect and engineer is inadequate. Both are visionaries who blend structural insight, innovative processes of form generation, aesthetic adventure and wide cultural reference. They are forging new modes of building that subvert the dominant box of modernist architecture.



Ito's personal vision is to transmute traditional buildings, viewed as 'bodies', into entities adapted to the electronic age. He argues that the "virtual body of electron flow is drastically changing the mode of communication in family and community, while the primitive body in which water and air flow still craves for beautiful light and wind. The biggest challenge for us is how we can integrate these two types of body."

Balmond, for his part, is fascinated by proportion and number theory, and has published a tale of numerology, *Number 9: The Search for the Sigma Code* (Prestel, 1998). He delves into pythagorean harmonics, sacred geometry, Islamic tiling, tantric numbers, the mathematics of symmetry and asymmetry, chaos theory and fractals for interlocking insights into the magic of form and number.

It is perhaps surprising to find that the underlying form of the pavilion is so simple. It is a cubic structure, 17 metres square and 4.5 metres high. But this is where the simplicity ends. The floor and walls dissolve into an intricate web of interpenetrating squares, triangles and irregular polygons generated by an algorithm. From the mid-point of one side of a square, a line is drawn to a point two-thirds along an adjacent side. The procedure is then repeated to produce an internally 'suspended' square which is rotated

on the diagonal axis. Through iteration and extension of this linear construct, a flat sheet is generated, which folds perpendicularly to produce the walls.

The not inconsiderable load of the roof glides above our heads, like a flight of tethered kites. The angular music of the design, with its alternating sets of opaque and open panels, generates a visual dynamism that subverts architectural convention. The net impetus is up and across rather than static, as in the classic post-and-lintel system.

Building a temporary structure of this kind, as part of the Serpentine Gallery's annual programme, has proved liberating for Ito: "One need not be so strict about function nor worry about how it will age. And, it seems to me, it just might offer the clearest expression of the concepts I habitually imagine." The pavilion serves, in effect, as a laboratory for a structural aesthetic which would have been inconceivable in an earlier era.

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Visualizations: *The Nature Book of Art and Science is a collection of essays edited by Martin Kemp (published by Oxford University Press and the University of California Press; £20, £35).*

