Vignettes: Embarrassment

With embarrassment goes blushing. Why do we blush?. . .

Darwin wanted to see how blushing was related to embarrassment in women, who blush more than men. As he regarded it as a social signal, he was interested to discover whether the blushing occurs in places normally hidden by clothes. But being too embarrassed to try the experiment himself, he got his doctor friends "who necessarily had frequent opportunities for observation" to see how far the blush spread down below the neckline. It generally didn't. Whether this was because the visibility-limit was set thousands of years ago by the dress style of cave ladies, or whether it was set by individual experience to conform to their Victorian neckline, is an unanswered question. . . .

One can be embarrassed not only by oneself but by others, especially as a child by one's parents. My father was an astronomer, Director of an observatory, nothing embarrassing in that. But he was decidedly eccentric. . . . At an international Astronomical Convention (note the word!) . . . my father took his clothes off and swam in the national shrine of Napoleon's Carp Pond at the Palace of Fontainebleau. He was surprised to be arrested. . . . There were small headlines commenting on foreign professors. . . .

There is no doubt we try to avoid embarrassments. . . . This extends to editing ourselves. If we are embarrassed by some kinds of ignorance, we edit the text of "what really matters." . . . Very common is the attitude to science that says it is no disgrace to be ignorant of how the universe ticks, and how technologies work. So most people are not embarrassed by scientific solecisms, even so extreme they pass over into being funny which, funnily enough, is just what happens with extreme embarrassment, no doubt as a divine protection.

The bottom line is that as embarrassment is multiplied by increases of social sophistication, which in this country is waning, it is now increased by the new expectations of literacy in languages and science. So—life will go on being blush-making.

—*Richard L. Gregory*, in *Even Odder Perceptions* (Routledge)

tain the moral polarity of the narrative. In an early National Science Foundation annual report, O'Neill finds something sinister in a flat, uninspired sentence about the need for a healthy partnership between science and government; he fails to mention that the sentence appears in an argument against political tests and loyalty investigations of scientists doing unclassified basic research. And in a scattershot windup, he hints at a CIA conspiracy in the death of one of his protagonists following an automobile accident.

In a book with so many literary pyrotechnics, some duds should be expected. *The Firecracker Boys* remains an exciting, generally reliable account of a dismal but significant chapter in the recent history of science and society.

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Fractal Colonies

Fractal Modelling. Growth and Form in Biology. JAAP A. KAANDORP. Springer-Verlag, New York, 1994. xiv, 208 pp., illus. $39.95 or DM78.

The recent discovery of a geometry of structures with non-integer dimension—fractals—has been a momentous event in one of the oldest fields of mathematics. This was not just the discovery of a new type of geometric object, but rather a realization that the field of geometry was immensely bigger than anyone had guessed. The integers are but a small archipelago of infinitesimal islands in the sea of non-integers. Since almost all numbers are not integers, almost all geometric forms must be fractals.

The field took off in the 1960s, when Mandelbrot began showing that fractals both are easy to produce and can closely resemble many real structures that could not be modeled well by Euclidean geometry. This latter possibility has been a mixed blessing. The ease with which "biological-looking" structures can be created with fractal-building algorithms has led some to uncritically "model" everything from morphology to phylogeny by constructing similar-looking fractals. Biologists seeing this could be forgiven for concluding that the entire subject is an exercise in curve-fitting.

Forgiven, but not allowed to continue with such a misconception. The language of fractals provides us with one of the best ways to discuss complex forms. In order to say something interesting, though, we must be able to relate the rules by which fractal structures are generated to the processes by which biological structures develop. A model of biological growth must do more than simply mimic the adult phenotype, it must construct that form in a way that is related to the actual processes by which the organism develops. This is why most organic-looking fractals are not useful to biologists.

Most current work on fractals involves only a few ways to construct them. Many of these are based on iterative processes in which discrete parts of structures are either added or replaced. We might therefore look for organisms whose growth involves the repeated addition of discrete units to a growing core. This is exactly what Jaap Kaandorp does in *Fractal Modelling: Growth and Form in Biology*.

Despite the title, which recalls d'Arcy Thompson's wide-ranging meditation on geometry in biology, Kaandorp focuses almost exclusively on a single type of growth: growth of colonies by accretion at the tips of branches. Even then, he restricts his attention further to branching sponges and corals. There is good biological reason for this; most seemingly fractal-like organisms, such as vascular plants, display a number of developmental processes, such as apical dominance, that coordinate growth in different areas, making models based on iterative addition unrealistic. By choosing to study those organisms whose growth really does look most like the iterative addition of basic elements, Kaandorp is able to draw conclusions from the behavior of his models that he can then test against growth experiments carried out on the actual organisms.

The book describes the actual algorithms in great detail, often inserting page-long segments of code into the text. Though this sometimes makes for awkward reading, it means that those interested in doing similar research can follow along closely, seeing where potential pitfalls arise.

Fractal geometry is clearly a much bigger subject than can be seen by means of the simple construction rules so far studied. Ad-

vances in both developmental biology and mathematics will surely increase the number of organisms whose form can be rigorously studied. There is a lot of geometry out there, most of it unexplored. Seeing a piece of it carefully studied reminds us that there must be more.

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Optical Properties

Modern Nonlinear Optics. MYRON EVANS and STANISŁAW KIELICH, Eds. Wiley, New York, 1994. In three parts. Part 1, xii, 628 pp., illus. $150 or £124. Part 2, xii, 835 pp., illus. $195 or £161. Part 3, xiv, 823 pp., illus. $195 or £161. Advances in Chemical Physics, vol. 85.

Given the current interest in nonlinear optics in the fields of physics, chemistry, and materials science, it is timely that a volume of Advances in Chemical Physics should be devoted to the subject. The three parts that make up the volume contain 36 papers by 60 authors.

Part 1 comprises 13 papers by the Poznań school in Poland. This school was founded in the 1950s by A. Piekara, who made notable discoveries concerning the nonlinear dielectric polarization of liquids and solutions; Stanisław Kielich's contributions to the theory of nonlinear phenomena enhanced the reputation of the school. Alas, Kielich died in October 1993. This volume is a fitting and lasting memorial to a very productive scientist.

When confronted with such a large collection of papers a reviewer must concentrate on a selection that reflects personal preferences. The two reviews by Kielich *et al.* on squeezed states of light are timely and informative, as is his chapter with Lalanne and Buchert on fast molecular reorientation in liquid crystals probed by nonlinear optical techniques.

The chapter in part 2 by Akhlesh Lakhtakia on the continuum electromagnetic properties of a gas of scattering centers provides a firm and stylish mathematical foundation for this viewpoint. The Heaviside-Lorentz conceptualization of continua is reviewed and generalized. The scattering by a gas, which can be considered to comprise either small pieces of continua or molecules, is discussed and related to scattering by a continuum. A continuum can always be subdivided into smaller pieces, each retaining the same properties as the original. Also in part 2, Jeffrey Williams contributes a useful review of the Kerr and Cotton-Mouton effects and the optical Kerr effect, discussing the utility of optical Kerr and Cotton-Mouton measurements as probes of ionic solutions and touching upon the possibility that low-frequency electromagnetic fields could be harmful to health. David Andrews presents a scholarly theoretical account of second harmonic generation, but it contains little in the way of a practical guide to help in the choice of a particular nonlinear optical material.

In part 3 Laurence Nafie and Diping Che provide a timely account of both theory and experiment in the differential Raman scattering of right and left circularly polarized light and related chiral phenomena. Teresa Freedman and Nafie review the theory of vibrational circular dichroism. But one may ask if these interesting subjects actually lie within the field of nonlinear optics! The chapters on hyper-Rayleigh and hyper-Raman scattering by Koen Clays *et al.* and by T. Bancewicz and Z. Ożgo (the latter in part 1) are, however, clearly within the bounds.

Part 3 also includes a long chapter with 547 references by Sheng-Bai Zhu, Surjit Singh, and Wilse Robinson on field-perturbed water. It is concerned with computer simulations of liquid water and ends with some provocative questions: "Has anything not previously known to experimentalists actually been predicted? . . . Have any old questions been settled?" The authors admit that the answers are at best only very weakly in the affirmative.

There are two papers by Myron Evans in part 2. The first is entitled "Laser and pulsed laser NMR spectroscopy" and presents Evans's contentious views of this infant subject. Its figure 4, showing an apparent shift in a methoxy resonance caused by a circularly polarized laser beam, is not to be found in the paper that is cited as its source. The second paper, "Some properties of longitudinal fields and photons," runs to 213 pages. Evans proposes that a circularly polarized beam is associated with a static magnetic field in the direction of propagation and that this field is of opposite sign for right and left circular polarization. However, such a proposal requires that rotating positive or negative charges radiate circularly polarized light having opposite magnetic fields; that is, there would be two distinct types of right (and left) circularly polarized light, contrary to experience. The paper contains lengthy and probably unrefereed criticisms of L. D. Barron's comments on a related paper by Evans and is seriously out of place in this volume.

This three-part work contains some useful papers, but it is rather idiosyncratic and lacks contributions from the stars of nonlinear optics.

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Reprints of Books Previously Reviewed

Children in Time and Place. Developmental and Historical Insights. Glen H. Elder, Jr., John Modell, and Ross D. Parke, Eds. Cambridge University Press, New York, 1994. Paper, $16.95 or £16.95. *Reviewed* **264**, 1013 (1994).

Dynamics of the Standard Model. John F. Donoghue, Eugene Golowich, and Barry R. Holstein. Cambridge University Press, New York, 1994. Paper, $39.95 or £25. *Reviewed* **260**, 107 (1993).

Fossil Horses. Systematics, Paleobiology, and Evolution of the Family Equidae. Bruce J. McFadden. Cambridge University Press, New York, 1994. Paper, $29.95 or £15.95. *Reviewed* **260**, 1156 (1993).

Wrinkles in Time. George Smoot and Keay Davidson. Avon, New York, 1994. Paper, $12.50. *Reviewed* **263**, 1455 (1994).

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Books Received

Age and Structural Lag. Society's Failure to Provide Meaningful Opportunities in Work, Family, and Leisure. Matilda White Riley, Robert L. Kahn, and Annette Foner, Eds. Wiley, New York, 1994. xiv, 290 pp., illus. $39.95.

Agricultural Field Experiments. Design and Analysis. Roger G. Peterson. Dekker, New York, 1994. xii, 409 pp., illus. $150. Books in Soils, Plants, and the Environment.

Airway Secretion. Physiological Bases for the Control of Mucous Hypersecretion. Tamotsu Takishima and Sanae Shimura, Eds. Dekker, New York, 1994. xx, 714 pp., illus. $195. Lung Biology in Health and Disease, vol. 72.

Asteroids, Comets, Meteors 1993. A. Milani, M. Di Martino, and A. Cellino, Eds. Published for the International Astronomical Union by Kluwer, Norwell, MA, 1994. xxxiv, 503 pp., illus. $147.50 or £100 or Dfl.250. From a symposium, Belgirate, Italy, June 1993.

Astronomy for All Ages. Discovering the Universe Through Activities for Children and Adults. Philip Harrington and Edward Pascuzzi. Globe Pequot, Old Saybrook, CT, 1994. xii, 208 pp., illus. Paper, $17.95.

Biomembranes. Structural and Functional Aspects. Meir Shinitzky, Ed. VCH, New York, 1994. viii, 383 p., illus. $135. Biomembranes, vol. 2.

Bioprocessing.. G. Stephanopoulos, Ed. VCH, New York, 1994. xvi, 816 pp., illus. $320. Biotechnology, vol. 3. 2nd ed.

The Birds of South America. Vol. 2, The Suboscine Passerines. Ovenbirds and Woodcreepers, Typical and Ground Antbirds, Gnateaters and Tapaculos, Tyrant Flycatchers, Cotingas and Manakins. Robert S. Ridgely and Guy Tudor in association with The Academy of Natural Sciences of Philadelphia. University of Texas Press, Austin, 1994. xii, 814 pp., illus., + plates. $85.

Chemical Analysis by Nuclear Methods. Z. B. Alfassi, Ed. Wiley, New York, 1994. xx, 556 pp., illus. $150.

Chemical Engineering Dynamics. Modelling with PC Simulation. John Ingham *et al.* VCH, New York, 1994. xx, 701 pp., illus. + diskette. $160.

Chemical Safety. International Reference Manual. Mervyn Richardson, Ed. VCH, New York, 1994. xviii, 613 pp., illus. $145.

Chemistry. An Experimental Science. 2nd ed. George M. Bodner and Harry L. Pardue. Wiley, New