chosen because Pollycove was a consultant to the NRC. This was presented so as to marginalize it. Walker did not cite a single piece of evidence for hormesis (benefit), or even use either word, maintaining the fiction that the choices were between minor risk or no risk.

Another token, marginalized-by-context quotation was that of Theodore Rockwell, who complained that his colleagues (presumably including EPA and NRC) in the field of radiation protection failed to recognize the costs of excessive caution. "He suggested that the assumption that exposure to any amount of radiation might cause injury produced 'five different kinds of harm: billions of dollars wasted, ridiculous regulations imposed that degrade the credibility of science and government, destructive fear generated, detrimental health effects created, and environmental degradation accelerated'" (p. 155). Did Walker actually wish he could support this view?

Thus, it is clear to this reviewer that the NRC intends to perpetuate its fanatical defense of the LNT model by citation bias, marginalized quotations, and innuendo, an example of how not to do scientific or historical writing. How many innocent or ignorant readers of this book will be fooled?

JOEL M. KAUFFMAN
Professor of Chemistry Emeritus
University of the Sciences in Philadelphia
600 South 43rd Street
Philadelphia, PA 19104
kauffman@hslc.org

References

Hively, W. (2002). Is Radiation Good for You? *Discover,* Dec., 74–80.

Kauffman, J. M. (2003). Radiation Hormesis: Demonstrated, Deconstructed, Denied, Dismissed, and Some Implications for Public Policy. *Journal of Scientific Exploration 17(3),* 389–408.

Luckey, T. D. (1991). *Radiation Hormesis.* Boca Raton, FL: CRC Press.

The Emperor of Scent: A Story of Perfume, Obsession, and the Last Mystery of the Senses by Chandler Burr. New York: Random House, 2002. 318 pp. $24.95 (cloth). ISBN 0-375-50797-3.

This book is both wonderfully interesting and intensely irritating. Irritating because it is written breathlessly in florid verbiage, and factual accuracy sometimes goes by the board; interesting for its main story, about an iconoclast's battle with the Scientific Establishment. The protagonist, Luca Turin, is clearly more right than wrong, and the central substantive issue is itself fascinating: What is it about a substance, about a given molecular species, that determines its odor?

The conventional wisdom is that molecular shape determines what we smell: odor-producing molecules dock into smell receptors of just the right configuration, as with immune reactions or enzyme-substrate interactions.

Given the vast existing databases of odors and molecular shapes, it should then be possible to predict molecular odors and to design new fragrances at will. But, it turns out, such designing remains a matter of trial and much error—a couple of thousand promising molecules are synthesized for every one or two that are actually useful in the fragrance industries. A given smell may be experienced from molecules of very different shapes, which would seem to cast doubt on the theory. Moreover, we are able to distinguish innumerable different odors, and there cannot possibly be so many uniquely and differently shaped receptors in the nose.

In the late 1930s and again a couple of decades later, it was suggested that molecular vibrations somehow determine odor. This was never widely accepted, chiefly because there seems to be no mechanism by which biological receptors could act as infra-red spectrometers. (Each chemical bond has a characteristic vibrational frequency or set of frequencies—though they can be modified by other bonds in the same molecule. Those frequencies correspond to infra-red light, and each bond absorbs or emits infra-red radiation at those frequencies.) Luca Turin, a biologist who has long made a hobby of perfumery and who has written an acclaimed guide to perfumes, believes the vibrational frequencies could be sensed by inelastic electron tunneling; and he postulates a biological mechanism capable of doing that.

What evidence could one adduce? All thiols (sulfur-hydrogen compounds, for example rotten-egg gas) have a similar odor (or stink) and a characteristic frequency at 2500 cm^{-1}. Turin found a very different molecule with a vibration close to that: decaborane, which people typically avoid smelling because it is classed as highly toxic. But Turin sniffed some and found it sulfurous.

Another test: find molecules of similar shape and different smells. Acetophenone and deuterated acetophenone have virtually identical shapes, since the substitution of deuterium for normal hydrogen changes the bond lengths very little; but the vibrational frequencies are greatly changed because the deuterium is twice as heavy as the normal hydrogen. Turin predicts they will smell different: it turns out that they do. End of the shape theory.

That is to say, the naive, popular image of science would say, "End of theory". But of course this evidence did not win the day. Readers of this *Journal* should laugh heartily at the accounts, which ring so very true, of the double-talk and evasions and illogicalities and self-contradictions delivered by *Nature*'s editors and referees in response to Turin's manuscript (pp. 140–44, 159–63, 170–76, 183). Eventually Turin published in *Chemical Senses* (Turin, 1996; see also Turin, 1997).

Later, a Russian lab prepared for Turin some deuterated decaborane: no sulfur smell. Would *Nature* be interested in publishing a short note about this interesting fact? No (p. 302).

Anomalists will also enjoy, and find entirely familiar, descriptions of Scientific Establishment figures who dismissed Turin's ideas while explicitly refusing to read his article and refusing to enter into discussions of the subject (pp. 228, 230–32). Another point of anomalist interest is Turin's attempt to arrange a test suggested by Rupert Sheldrake to decide between different mechanisms by which homing pigeons may home in (pp. 255–56).

What I find intensely irritating in the book is not only its overblown verbiage but also its flagrant and quite unnecessary errors about basic matters of science. It is surely a nice image, to describe for lay people how electrons hold atoms together in lasso-like fashion; but there is no reason to say that it is a single electron, rather than a pair, that constitutes each molecular bond-lasso. Again, to draw an analogy between ions and isotopes is more misleading than helpful. And there is much more along those lines.

With those caveats, I recommend the book for its many points of interest, not least of which is a truly heart-warming account of Turin's part in curing a Scottish lady of cacosmia, a rare disorder that causes *everything* to carry an unbearably repulsive odor; albeit Turin's inspired suggestion is really irrelevant to the validity of his theory (pp. 153–57).

This book gives only the one side of the scientific story, which makes support for Turin's theory seem more straightforward and the evidence more decisive than is actually the case. In an Author's Note inserted between Chapters V and VI, Burr acknowledges this; his explanation is that proponents of the mainstream theory, opponents of Turin's idea, simply refused to talk with Burr about it. One illustration of their technique (Rossiter, 1996) is to point out that 3 out of 20 examples present problems for Turin's theory *while neglecting to acknowledge that the other 17 contradict the mainstream "shape" theory and lend support to Turin's* (pp. 243–44).

I found the matter sufficiently interesting that I wanted to look into the scientific aspects more directly. Turin's ideas are described in his initial paper (Turin, 1996) and in some more recent ones (Turin, 1997, 2002; Turin and Yoshii, 2003), all of them available on-line at http://flexitral.com (which, however and annoyingly, requires downloading of Shockwave). In these articles, Turin expresses his views less arrogantly, insufferably, and dogmatically than his behaviour as described in the book. To make the theory useful, to substitute informed design of odorants for trial-and-error methods, it remains to devise a satisfactory way of calculating inelastic-tunnelling vibration-frequencies and intensities *since these are not the same as those measured by infra-red spectroscopy*; this is discussed most clearly in Turin (2002).

Henry H. Bauer
Professor Emeritus of Chemistry & Science Studies
Dean Emeritus of Arts & Sciences
Virginia Polytechnic Institute & State University
hhbauer@vt.edu
www.henryhbauer.homestead.com

References

Rossiter, K. J. (1996). Structure-odor relationships. *Chemical Reviews, 96,* 3201–3240.
Turin, L. (1996). A spectroscopic mechanism for primary olfactory reception. *Chemical Senses, 21:* 773–791.
Turin, L. (1997). The nose as spectroscopist. *Chemistry and Industry, 3 November,* 866–870.
Turin, L. (2002). A method for the calculation of odor character from molecular structure. *Journal of Theoretical Biology, 216* (July), 367–385.
Turin, L., & Yoshii, F. (2003). "Structure-odor relations: a modern perspective." In Doty, R., ed. *Handbook of Olfaction and Gustation*, 2nd ed. New York: Marcel Dekker.

Prematurity in Scientific Discovery: On Resistance and Neglect edited by Ernest B. Hook. Berkeley: University of California Press, 2002. xx + 378 pp. $80.00 (cloth). ISBN 0-520-23106-6.

Science enthusiastically seeks out and welcomes novelties, the more novel the better, so it is still commonly believed. Still believed, that is to say, within the scientific community and among the general public and by some self-appointed pundits. Proponents of unorthodox scientific claims have known differently for a couple of centuries. Academic observers of science were awakened by Barber (1961), Kuhn (1962/70), and Stent (1972a,b) to the fact that genuine novelties are typically resisted.

While Kuhn's discussion of scientific revolutions has been much discussed and much cited, the seminal articles by Barber and Stent were largely ignored by students of science, even though scientists themselves welcomed them as insightful. At long last, the book here reviewed makes a determined effort to tease out characteristics of what Stent recognized as "premature discoveries". In doing so, it deals as much with resistance to new discovery as with prematurity.

The editor's comprehensive introductory remarks about resistance and prematurity are followed by a re-printing of the relevant portion[1] of Stent's original articles. Part 2 of the book comprises "Observer and Participant Accounts": Glenn Seaborg on transuranium elements; Charles Townes about masers, lasers, and radio astronomy; Norton Zinder about bacterial gene transfers; and Oliver Sacks on scotoma. Part 3, "Historical Perspectives", has two sections: "Relatively Unproblematic Examples" and "Disputable Cases". The first includes scurvy, expanding-universe theories, recognition of nuclear fission, and several cases from the earth sciences—global warming, continental drift, and dinosaur extinction by extraterrestrial impact. The disputable cases feature Polanyi's theory of adsorption, prescient ideas concerning human genetics, McClintock's ideas about transposable genetic elements, and historian Frederic Holmes's insightful comments about Avery and Mendel as purported instances of premature discovery. Part 4 of the book has two articles on Darwin's theory of natural selection. Part 5 features social science: a piece on prematurity in political science, a sociological view of what makes for