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The crustose lichen Lecanora dispersa. Lichen symbioses, associations between fungi and algae, have originated multiple times during fungal evolution. At least one successful establishment of symbiosis led to the more than 6000 species of the order Lecanorales, represented here by L. dispersa. The white-rimmed cups (between 0.3 and 0.7 millimeter in diameter) emerging from the rock substrate produce the meiotic spores of this fungal symbiont. See page 1492 and the News story on page 1437. [Photo: V. Wirth]
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Punctuated Equilibrium in Scientific Publishing

To many scientists, it was merely a local phenomenon: Dan Koshland stepped down at Science; Floyd Bloom took over. John Maddox announced retirement at Nature; Phil Campbell was named to succeed him. Editorships of journals change hands. That’s life.

But these shifts at the top of the masthead will alter journals that affect a very large number of scientists. And they are only part of a more imposing pattern. Over the past year, eight major scientific publications spanning the spectrum of science and engineering have changed editors. Together, these publications reach about 2 million subscribers and publish papers by 15,000 scientists annually. So it will matter that many of the editors who have stepped down, like Maddox and Koshland, have been institutions in the profession.

Alan Ternes spent over 25 years running Natural History. Over two decades, Don Christiansen turned a dry organ of the Institute of Electrical and Electronics Engineers, IEEE Spectrum, into a publication that competed with Scientific American (SA). Gloria Lubkin led Physics Today for 15 years. Mike Heylin was with Chemical & Engineering News (C&EN) for more than three decades. Robin Fox spent a quarter of a century at The Lancet. And at SA, Jonathan Piel’s departure ended a family dynasty that lasted nearly half a century. Scientific publishing has experienced an extinction event!

It is, of course, too early to see the consequences for readers and authors. But it is clear that a generational change is taking place. In some cases, the differences may seem slight: Bruce Stutz on Natural History is 20 years younger than Alan Ternes but came from Audubon. As IEEE Spectrum and The Lancet, the new leaders are professional editors as the old ones were. But at The Lancet, the age change is marked: Richard Horton, doctor and journalist of 5 years, is only 32.

Age—and experience—are also issues at SA. Jonathan Piel spent a decade mildly moderating a publication whose ads and readership were sharply down when he inherited it. Over Piel’s shoulder was the long shadow of legendary editor Dennis Flanagan, who, with Piel’s father Gerald, had bought the magazine in 1948. In 1986, Flanagan and the elder Piel retired, selling SA to a German publishing conglomerate. Ten years later, the Germans removed the last vestige of familial control—a man in his mid-50s with decades of experience at SA. Installed was John Rennie, bright, confident, 35. Big enterprise in the big leagues of scientific publishing; 5 years. Experience managing people: next to none.

But Horton and Rennie are old hands at scientific publishing compared with the new leader at Physics Today. The American Institute of Physics recently installed a new publisher who elevated long-time editor Lubkin to a nonmanagerial post. He then appointed Stephen Benka, 42, who had worked for the U.S. Post Office for 10 years before getting a mid-life Ph.D. in solar physics at the University of California. After 5 years as a post-doc and researcher, Benka came to Physics Today where he did routine writing and editing for a year before his promotion. Robert Park, a famously crusty observer of the physics community, quipped in his electronic newsletter that the new version of Physics Today "should be lively; Benka . . . has been editing obituaries."

C&EN News also has needed enlivening. Outgoing editor Heylin viewed his charge as chemistry’s Time or Newsweek; his challenge was to maintain some independence from the American Chemical Society (ACS), which owns C&EN News, and from the chemical companies entwined with the ACS. Now comes Madeleine Jacobs, the magazine’s managing editor since 1993. Jacobs wants to reinvigorate the publication. Her qualifications? She began as a chemist, shifted to journalism, then spent 15 years as a Smithsonian public affairs officer. Returning to journalism after years in public relations is, to professional editors, tantamount to a violation of the Second Law of Thermodynamics. But to C&EN News readers, the important question is: Will Jacobs enrich the newsweekly’s journalistic traditions as she enlivens it, or will her public affairs experience make it more of a traditional house organ?

The world of scientific publishing has been shaken by a set of events that, although entirely coincidental, cannot help but affect the scientific and engineering community. Whatever their past pasts, all eight publications play a vital role in scientific information exchange. The scientific community should carefully watch to see whether this new breed invigorates their publications or, by altering their editorial philosophy or practice, endangers them.

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Desert Ants

The Random Sample item "Hot ants" (14 Apr., p. 207) featured a recent article by W. J. Gehring and R. Wehner describing a remarkable thermal adaptation of desert ants (1). It is suggested that these animals may synthesize heat shock proteins (Hsp's) for protection even before leaving their nests to forage in the desert heat, that is, that they prepare "a pre-emptive strike." It is important, however, to distinguish experimentally between the normally abundant and essential heat shock cognate (Hsc) proteins (Hsc70) and the heat inducible Hsp70 family members. Hsc70 is more highly constrained evolutionarily than Hsp70, suggesting that they are functionally distinct (2). An alternative interpretation of the data of Gehring and Wehner is that the ants have unusually high levels of the normal housekeeping protein Hsc70, which appears to be only modestly augmented at high temperatures by inducible Hsp70 in these animals. There must be more to the desert adaptation, as the characteristic in question is shared by another ant species from temperate woodlands. Perhaps desert ants are smart enough to return to the nests before their proteins melt down, and perhaps Hsc70 makes a contribution to their high critical thermal maximums and thermal resistance of protein synthesis reported. Such a response would be less amazing than the mental image of ants turning on their heat shock genes in anticipation of "hotfooting it" across the desert sands, but interesting nonetheless.

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References

Oak Ridge's Strengths

Andrew Lawler's article about the Galvin report, "Report to stress research over close ties to industry" (News & Comment, 27 Jan., p. 446), includes a table describing DOE's multipurpose laboratories. The table indicates that the research focus of Oak Ridge National Laboratory (ORNL) is "nuclear physics, ion-beam, neutron scattering." This description does not reflect the scientific and technical competencies of ORNL as presented to, and used by, the Galvin task force. While ORNL has long-standing and pioneering research activities in the areas listed, it also addresses a wide range of scientific and technical challenges as directed by DOE and other federal agencies. The five broad programmatic themes of ORNL's research activities are energy production and end-use technologies; biological and environmental sciences and technology; advanced materials synthesis, characterization, and processing; neutron-based science and technology; and computational science and advanced computing.

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Performance of Text Retrieval Systems

In his article "Gauging similarity with n-grams: Language-independent categorization of text" (10 Feb., p. 843), Marc Damashek states that his n-gram information retrieval system, Acquaintance, performed "on a par with some of the best existing retrieval systems," on the basis of results of the third Text Retrieval Conference (TREC-3) (1).

The TREC Program Committee objects to this conclusion. On the basis of average precision (the generally accepted measure...
of performance), Acquaintance was ranked 22nd out of 23 systems on the TREC-3 ad hoc task, and 19th out of 21 systems on the TREC-3 routing task. (Some groups presented multiple runs with their systems, and not all groups did both tasks.)

Whereas it is true that Acquaintance did well on a few of the queries, this can be said for most of the participating systems. The nature of information retrieval dictates that any reasonable system will do well on some queries; the best systems do well on most of the queries. The conservative tests of statistical significance presented at the conference clearly show that Acquaintance belongs in the bottom set out of five sets of systems.

While the n-gram approach of Acquaintance may be valuable in some environments, it has not yet been shown that it is even an average system for general information retrieval.

The TREC Program Committee: Donna Harman, Chair, National Institute of Standards and Technology, Gaithersburg, MD 20899, USA; Chris Buckley, 18 Dickinson Court, Plainsboro, NJ 08536, USA; Jamie Callan, Department of Computer Science, University of Massachusetts, Amherst, MA 01003–4610, USA; Susan Dumais, Bellcore Laboratories, Morristown, NJ 07974–0636, USA; David Lewis, AT&T Bell Laboratories, Murray Hill, NJ 07974–0636, USA; Steve Robertson, Department of Information Science, City University, London E1LV OHB, United Kingdom; Alan Smeaton, Dublin City University, Glasnevin, Dublin 9, Ireland; Karen Sparck Jones, New Museum Site, Computer Laboratory, Cambridge University, United Kingdom; Richard Tong, Verity, Inc., 1500 Plymouth Street, Mountain View, CA 94043, USA.

The content analysis of stored texts and documents represents a crucial component in automated document retrieval and question-answering systems. In principle, such a content analysis ought to be based on sophisticated syntactic and semantic methodologies leading to a complete understanding of the respective text content. Unfortunately, complete linguistic text understanding systems are too brittle to be usable in open-ended text environments with unrestricted subject coverage. For this reason, word- or phrase-based analysis methods are used in operational retrieval systems where each text item and each search request is represented by sets of possibly weighted terms (words and word phrases) that collectively characterize text content (1).

Damashek proposes to simplify the text analysis step further by giving up word and phrase recognition and using instead sets of overlapping strings of n characters (n-grams) derived from the existing document texts for the representation of text content. Although a decomposition of running texts into overlapping n-grams is in principle trivial, such a representation is too rough and too ambiguous to be usable for most purposes. Necessarily, a decomposition of text words such as HOWL into HOW and OWL raises the ambiguity of the text representation and lowers retrieval effectiveness. Damashek shows that the n-gram characterization is good enough for certain rough classification tasks. But for more demanding tasks, such as information retrieval, the n-gram analysis can lead to disaster.

The results obtained with Damashek's Acquaintance system in the TREC studies (where many different retrieval approaches compete against each other in an objective retrieval evaluation environment) are sufficient proof of the inadequacy of the n-gram text representation method (2). For ad

### References


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hoc retrieval, where individual user queries are processed against existing text collections, Damashek states that “Out of 50 queries considered, the measured precision [of the n-gram Acquaintance system] exceeded the median (across 34 participating systems) only twice.” He goes on to say that his system does, however, perform “on a par with some of the best existing retrieval systems” in the routing task, where certain relevant items are identified a priori, and the task consists in retrieving new items similar to the previously known relevant ones.

Actually, Damashek’s system scored below the median for 22 queries out of 50, and for an additional 18 queries out of 50, the system scored only as well as half the other participating systems. A reasonable performance was obtained by Damashek for only 10 queries out of 50. Overall, Acquaintance was ranked near the bottom (28th out of 34 systems participating in the TREC studies) with an average precision performance of 0.2641, compared with a precision performance of 0.4068 for the best performing system.

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References

Response: I sincerely regret any offense occasioned by my characterization of Acquaintance’s performance on the TREC routing task in my article and offer my specific apologies to any participant so offended. TREC is a state-of-the-art showcase of retrieval methods. Using the performance data available at the time my article was written (the data presented in the article), I interpreted the performance cup as being “half full.” I viewed a presentable showing as an indicator of above-average performance in the world at large. This ultimately led me to the unfortunate choice of words, “on a par with some of the best existing retrieval systems,” which made no explicit mention of the world at large. There is no question that certain systems participating in TREC consistently exhibit superior performance and, at TREC-3, Acquaintance was not one of them. My statement could easily have been perceived as suggesting performance comparable to that of the best systems participating in TREC, a claim that would have been ludicrous in view of the evidence presented in the article itself.

Salton raises several points that demand close scrutiny. As it pertains to document content analysis, the contention that an exhaustive list of n-grams is “too ambiguous to be usable for most purposes” can be shown to be untenable. By construction, every n-gram in a document shares n - 1 characters with each of its immediate neighbors. For n > 1, this redundancy of the n-gram representation makes it possible to unambiguously reconstruct a significant fraction of the document’s text, implying that much of the information conveyed by the document remains intact. Given no more than a list of the n-grams in the document, one can easily show, by automatically identifying and concatenating those n-grams that can be uniquely paired with a predecessor or successor, that on average approximately 60% of a typical narrative English document can be reconstructed for n = 5 (with low variance across documents). This figure rises to 70% for n = 6 and 80% for n = 7. The argument can be applied to the example cited by Salton, showing that the trigrams HOW and OWL uniquely specify the four-character

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and the organ of Corti is demonstrated to possess wider band width, and it becomes substantially greater than the intracellular receptor potential at mid- to high frequencies. However, as this voltage gradient appears across the motor-bearing basolateral membrane of passive (nonexcited) hair cells, it will be less than the receptor potential produced by a solitary hair cell, and its magnitude is inversely related to m. This means that, for a favorable case of \( n >> m \), the driving voltage to the motors of a passive cell approaches the hitherto assumed single cell response, while the driving voltage to the motors of an active cell becomes small. In general, the ratio of driving voltages in passive and active cells has a horizontal asymptote at low frequencies; the ratio rises in the mid-frequencies and approaches \( n/m \) at high frequencies.

The consequences of these findings are several. Voltage drops produced in passive hair cells by extracellular potentials resulting from a group of active cells will be attenuated at high frequencies with unity slope. Thus, these voltages would be unlikely to produce motility at ultrasonic frequencies, as we assumed. However, these voltages are greater at high frequencies than the intracellular receptor potentials in the active hair cells by a ratio of \( n/m \). This means that, at least in the approximate frequency range of 5 to 20 kilohertz, there is a potential of induced electromotility in hair cells that are removed from the region of peak excitation. The mediator for this motility is the extracellular potential gradient generated by hair cells in the region of maximum excitation \( (n) \). Induced electromotility apical to the peak excitation cannot feed back to the vibration of the basilar membrane because of the low-pass filtering of the traveling wave. Electrical potentials spreading basally, however, can produce feedback from OHCs in a limited spatial extent \( (m) \). This displacement of the feedback region from the peak of the traveling wave is as postulated by modelers of the cochlear amplifier \( (4) \). The displacement also helps explain high-side two-tone suppression phenomena. Finally, the reactive voltage divider feature of epithelial cells subjected to external voltage commands, as in current injection experiments with the cochlea \( (5) \), studying isolated cells in the microchannel \( (6) \), or in situ in electroreceptors \( (7) \), permits high-frequency stimulation, as we suggested.

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References
3. J. Santos-Sacchi, ibid., p. 1906.

Corrections and Clarifications
In the Table of Contents of the issue of 19 May (p. 950), the Policy Forum "Environmental implications of electric cars" by L. B. Lave et al. should have been listed as appearing on page 993, not page 995.

In the report "Crystal structure of DCoH, a bifunctional, protein-binding transcriptional coactivator," by J. A. Endrizzi et al. (28 Apr., p. 556), figures 2A and 2C on page 557 were inadvertently transposed.

In Daniel E. Koshyland Jr.'s editorial of 28 April, "Notall seeks new horizons" (p. 479), it was incorrectly suggested that the world's human population is 4.2 billion. It currently exceeds 5.6 billion.
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extinctions clearly occurred by the end of the Triassic Period, but exactly when, or how many major extinction events occurred, is still open to vigorous discussion. This is exemplified in chapters by Simms et al. and by Benton and in a well-reasoned summary by Padian. At issue are the number of extinction events—one or two—at the end of the Triassic, whether marine extinction coincides with extinction in the terrestrial realm, and even the possibility of an extra-terrestrial cause for terminal Triassic extinctions. This is good stuff. And out of that time—somehow—springs the major tetrapod groups of our modern world.

In a humorous mutation of the parable of the blind men and the elephant, Padian compares the investigation of Late Triassic vertebrate-bearing terrestrial sediments to an attempt to understand the workings of an internal-combustion engine by using blueprints of six different kinds of engines torn into jigsaw puzzles and with some pieces missing. I am not much of a grease monkey myself, but I appreciate the Earth as an engine that works. As a manual to begin investigating the workings of the Late Triassic and Early Jurassic world, this is a good book. —Louis L. Jacobs

Shuler Museum of Paleontology
and Department of Geological Sciences,
Southern Methodist University,
Dallas, TX 75275, USA

Vignettes: Sea Changes

Some inspired pack of rhipidistians or Dipnoi came ashore for the first time in the late Devonian, either looking for a meal or trying to avoid becoming one. Maybe they were pursuing the as yet unknowable vertebrate dream of a future filled with cheeseburgers, pizza, Caesar salads, decent wine, homes of their own, and a new car every two years.

—Brad Matsen, in Planet Ocean: A Story of Life, the Sea, and Dancing to the Fossil Record (Ten Speed Press)

Cruise the aisles of a grocery store and it's hard to find many products without algae and algae byproducts. Alginates help keep beer foam from collapsing when it comes in contact with lipstick. The same alginates keep pimentos firm in green olives, stabilize pulp in juice concentrates, thicken instant soups, and substitute for oil and eggs in no-fat mayonnaise. Carrageenan is used as a stabilizer in air freshener gels, anti-icers, breads, infant formula, liquid cleanser, and pumpkin pie. Betacarotene pigment provides a natural yellow-orange food coloring for cheese, butter, beverages, pastries, and popcorn. Agar is found in canned meats, jellies, and marshmallows. And in the foreign food aisle you might find dried algae.


Chemical Paperwork


Chemical structures have to be understood in three dimensions, yet books and blackboards are in two, so chemistry classrooms and labs are often decorated with molecular models made of plastic, styrofoam, and the like. Many students purchase modeling kits that allow structures with "standard" bond lengths and angles to be constructed. Trickier structures, such as ones with fivefold symmetry or unusual bond lengths, can be difficult to construct, and the nuances of different structures are lost in an effort to ease the task of construction.

Hanson takes an approach that requires more patience and dexterity but likely yields a more satisfying learning experience. He has developed a workbook for constructing paper models of molecules, which he calls "molecular origami." Each structural type is introduced within the framework of molecular orbital theory, but Hanson emphasizes that the models, which reproduce the known bond lengths and angles, make no assumptions about bond orders or unpaired electrons. Instead, theory must be used to understand why the structures result. Thus the student can make models of NH3, NF3, and PF3 and interpret the changes in bond lengths and angles. A series of questions are included with the simpler structures, and an answer guide is provided. More than 70 structures are explored, including coordination compounds such as iron carbonyl [Fe2(CO)9], network solids such as silicates, and even the highly complex shapes of C60 and the boron hydrides.

Clear instructions are given for the actual cutting, folding, and taping of the models; making some of the "inside" folds on the more complicated shapes is facilitated by putting a straight edge (ruler or business card) under the paper. The examples should prove useful in teaching chemical bonding concepts not only in high school and freshman chemistry classes but also in undergraduate inorganic chemistry. The models could also aid physical chemists looking for structural models to illustrate symmetry concepts in the application of group theory.

Phillip D. Sczuroni

Books Received

Adult T Cell Leukemia and Related Diseases. Takashi Uchiyama and Junji Yodori. Landes, Austin, TX and Springer-Verlag, New York, 1995 (distributor, CRC Press, Boca Raton, FL), vi, 139 pp., illus. $59. Medical Intelligence Unit.


Birth Control Vaccines. G. P. Talwar and Raj Raghupathy. Landes, Austin, TX, 1995 (distributor, CRC Press, Boca Raton, FL), xii, 171 pp., illus. $79. Medical Intelligence Unit.


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