

Geothermal Energy's Future

I would like to comment on the Briefing of 22 November (p. 1113) concerning the outlook for geothermal energy in California. The Briefing's somewhat gloomy outlook is due largely to a confusion of the geothermal *resource* estimates made by the U.S. Geological Survey (USGS) in 1979 (contrary to the assertion in the Briefing, the 1979 inventory is the most recent USGS inventory) with the geothermal *reserve* estimates made by Ebasco Services in 1991. By definition, reserves represent only that fraction of the resource that can be exploited profitably with current technology. With an understanding of this difference, one can see that there is no actual conflict between the 1979 USGS study and the 1991 Ebasco report.

Although production at The Geysers has dropped significantly [to 1380 megawatts-electric (MWe) from the installed capacity of 2000 MWe], much of this drop can be attributed to overoptimism and overexploitation by the field developers. (The 1979 USGS study estimated a 1610 MWe capacity for The Geysers.) With new technological developments such as fluid injection, jointly researched by industry and government, it should be possible to recapture some of the lost generating capacity.

California's geology (and that in neighboring states) still promises an abundance of economical, environmentally acceptable geothermal energy. Supporting studies for the National Energy Strategy indicate that under reasonable assumptions approximately 11,000 MWe from hydrothermal resources can be on-line nationally by 2010, and 22,000 MWe by 2030. In addition, more advanced geothermal resources (hot dry rock, geopressured geothermal systems, and magma) can potentially play a significant role in satisfying America's long-term energy needs. Geothermal energy truly has a bright future in helping to satisfy America's energy needs.

JOHN E. MOCK
Geothermal Division,
Conservation and Renewable Energy,
Department of Energy,
Washington, DC 20585

Response: Contrary to the comment by Mock, we find no methodological differences between the 1979 inventory by the U.S. Geological Survey (USGS) and the 1991 report by Ebasco Services, both of which estimate California's geothermal re-

sources. According to Patrick Muffler of the USGS, who supervised the 1979 inventory, the terms "reserves" and "resources" were inconsistently applied in the Ebasco report, but the methods used were the same in the two studies. Muffler cannot vouch for the application of those methods in the "gloomy" Ebasco report, but finds it appropriate to directly compare the two studies.—EDS.

Bellcore Basic Research

Contrary to the impression created by the ScienceScope item "Bellcore basic researchers out of work" (10 Jan., p. 147), Bellcore is *not* "phasing out its basic research effort and closing down facilities." We have made a small reduction in the size of our effort in physical sciences and materials research and we are increasing our research in software and information technologies, but these changes are modest and do not involve the large-scale "retrenching" indicated in the ScienceScope piece. Only a handful of people were involved in our work with superconductivity, not the "20 to 25" mentioned in the ScienceScope piece. That is the number of *all* the affected people in physical sciences research. Several of our physical science researchers have been placed elsewhere in our research efforts, a few have chosen to retire, and ten have indicated they want to continue in their specific fields of research elsewhere.

The shifts we have made in our overall program, while significant to the individuals involved, are small and are the normal ones to be expected from time to time as technological progress is made. It should not be necessary to state that Bellcore intends to continue being a leader in those areas of research important to our owners and to the telecommunications industry, including materials and device research.

GEORGE H. HEILMEIER
President,
Bellcore,
290 West Mt. Pleasant Avenue,
Livingston, NJ 07039-0486

Fullerene Superconductivity and the Dynamic Jahn-Teller Effect

C. M. Varma *et al.* (Reports, 15 Nov., p. 989) attribute superconductivity in the fullerenes to electron-phonon coupling of H_g vibrational modes of the component C_{60} molecules induced by the dynamic Jahn-Teller effect of partially occupied degenerate $t_{1u}(p\pi)$ molecular orbitals. Superconductiv-

ity theory based on dynamic Jahn-Teller vibronic coupling of degenerate molecular orbitals was applied to organic superconductors in 1983 (1), to high-transition temperature oxides in 1987 (2), and to superconductive fullerenes in May 1991 (3). Indeed, dynamic Jahn-Teller coupling may provide a unifying quantum-chemical basis for high-transition temperature superconductivity in ceramics, organics, and fullerenes (4).

Experimental evidence for this mechanism in fullerene C_{60} can be found in the unusual electron-spin-resonance spectrum (5), which shows temperature-dependent line width and highly shifted g value, well-established signatures of the dynamic Jahn-Teller effect (6). Raman spectra for superconductive fullerenes show only the lowest frequency H_g vibrational mode (7), consistent with the dynamic Jahn-Teller scenario of (3). A recently reported carbon isotope shift exponent of $\alpha = 0.37 \pm 0.05$ for the transition temperature of superconducting Rb_3C_{60} (8) is close to the value predicted from the dynamic Jahn-Teller mechanism in (3).

KEITH H. JOHNSON
Department of Materials Science,
Massachusetts Institute of Technology,
Cambridge, MA 02139
DENNIS P. CLOUGHERTY
Department of Physics,
University of California,
Santa Barbara, CA 93108
MICHAEL E. MCHENRY
Department of Materials Science,
Carnegie-Mellon University,
Pittsburgh, PA 15213

REFERENCES

1. K. H. Johnson and R. P. Messmer, *Synth. Metals* **5**, 193 (1983).
2. K. H. Johnson *et al.*, in *Novel Superconductivity*, S. A. Wolf and W. Z. Kresin, Eds. (Plenum, New York, 1987), p. 563.
3. K. H. Johnson, M. E. McHenry, D. P. Clougherty, *Physica C* **183**, 319 (1991).
4. K. H. Johnson, D. P. Clougherty, M. E. McHenry, in *Electronic Structure and Mechanisms for High- T_c Superconductivity*, J. Ashkenazi and G. Vezzoli, Eds. (Plenum, New York, in press).
5. P. M. Alleman *et al.*, *J. Am. Chem. Soc.* **113**, 2780 (1991).
6. I. B. Bersuker, *The Jahn-Teller Effect and Vibronic Interactions in Modern Chemistry* (Plenum, New York, 1984), p. 103; — and V. Z. Polinger, *Vibronic Interactions in Molecules and Crystals* (Springer-Verlag, New York, 1989), p. 281.
7. S. J. Duclos *et al.*, *Science* **254**, 1625 (1991).
8. A. P. Ramirez *et al.*, *Phys. Rev. Lett.* **68**, 1058 (1992).

Response: We are happy to note that Johnson *et al.* have also thought of the intramolecular vibrations in metallic fullerenes as responsible for effective electron-electron attraction in the fullerenes. We would like to point out that there are essential differences between our results and theirs. (i) Johnson *et al.* consider the prob-

lems in terms of "real-space pairing," where the partners of a Cooper-pair reside on a given ball. This requires Cooper-pair binding energy larger than the electronic bandwidth. Superconductivity then occurs by the coherent hopping of this pair from ball to ball. Our calculations show that even though the interactions are intramolecular, superconductivity is of the conventional BCS variety. (ii) Johnson *et al.* suggest that low frequency vibrations with frequencies of approximately 100 cm^{-1} are responsible for the pairing. Our calculations show that the vibration modes with the dominant coupling to electrons have frequencies over 1500 cm^{-1} . Finally, we do not believe that the physics of superconductivity in the fullerenes is relevant to the physics of high-temperature superconductivity in the copper oxide-based materials.

C. M. VARMA
J. ZAAENEN

AT&T Bell Laboratories,
600 Mountain Avenue,
Murray Hill, NJ 07974-0636

Physical Activity and Cancer

A reduction of risk of sex hormone-sensitive cancers in women in association with regular physical activity, as suggested in the review article by Brian Henderson *et al.*, "Toward the primary prevention of cancer" (22 Nov., p. 1131), has already been documented (1). A study of more than 5000 American women college alumnae showed that former college athletes had significantly less breast cancer and cancers of the reproductive system than their sedentary classmates (1). More than 80% of the former athletes began their regular, moderate physical activity in high school or earlier, which underscores the recommendation of Henderson *et al.* that this lifestyle be adopted early.

ROSE E. FRISCH
GRACE WYSHAK

Center for Population Studies,
Harvard School of Public Health,
9 Bow Street, Cambridge, MA 02138

TENLEY E. ALBRIGHT
Institute for Clinical Applications, Inc.,
126 Brookline Avenue,
Boston, MA 02215

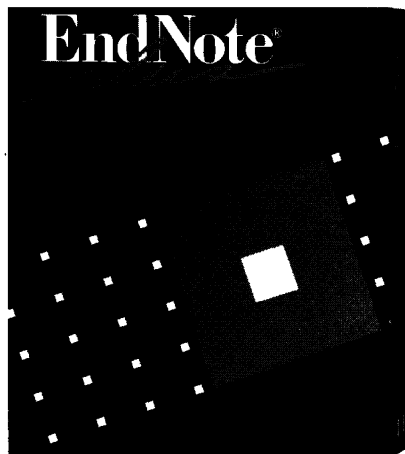
NILE L. ALBRIGHT
Advanced Medical Research Foundation,
333 Longwood Avenue,
Boston, MA 02115

REFERENCES

1. R. E. Frisch *et al.*, *Br. J. Cancer* 52, 885 (1985).

20 MARCH 1992

NEW!



**EndNote Plus
for the IBM PC
is shipping!
Upgrade
your old
Bibliographic
Software now!**

Good News for DOS and Windows users!

EndNote Plus on the PC is shipping! If you're using Microsoft Word for Windows, WordPerfect, or WordPerfect for Windows, EndNote Plus can save you hours of work! You want to cite a paper? Simply switch to EndNote Plus, select the reference and paste it into any of these word processors! When you're ready to submit your paper, select a bibliographic style and EndNote Plus will format both the bibliography and the in-text citations according to the selected style.

Why is EndNote Plus Better? "It's all in the details."

Most bibliographic software packages include basic features like the ability to search for references and output them in different formats. But as one of our users told us recently: "It's all in the details". The differences emerge when you ask yourself questions like these:

- Can my records include expressions like α or ^{14}C and diacritical marks like \acute{e} or \ddot{u} ?
- Does my software reformat just the bibliography or also the in-text citations?
- Does it work directly with Windows word processors? with WordPerfect?
- Does it support different reference types? (e.g. journal articles, books, theses, etc.)
- Does it output the bibliography in my word processor or just as an ASCII file?
- Will it take me less than 5 minutes to teach a student how to enter data?
- Can it output authors with full names or initials? with or without periods? with or without spaces? with or without commas?
- Does it have a TSR? If so, does it allow me to add, edit and search references?
- Can it output the first author's name as J. Smith and the second author as Johns, G.?
- Will it find records quickly and easily?
- Can I share data with Mac users without losing Greek characters and diacriticals?
- Can I easily create my own style?
- Is it completely free of copy-protection?
- Was it updated in the last 12 months?

- Can I easily move between fields even if I'm not finished entering one?
- Can I add fields for my own use? Are there fields for abstracts and notes?

If you answered "yes" to all these questions, you're using EndNote Plus.

Unbiased Opinion:

Obviously, we're a little biased, so here's what the press has said about our products: "the clear winner in the bibliographic database management race." —*MacGuide*
"[it does] practically everything except type in the data" —*Personal Computer World*
"The results we got from EndNote Plus were outstanding." —*MacWeek*
"EndNote Plus is a terrific bargain." —*Information Today*

Import from Other Programs

We realize that you may have thousands of records in your old program, so we made it easier for you to switch. We have instructions on transferring data from several bibliographic programs into EndNote Plus. Call us to see if these instructions cover the software you currently use.

Upgrade Now for \$169

If you upgrade before 5/30/92, you'll pay just \$169 instead of \$249. Send a photocopy of the first page of the manual of any bibliographic software (PC or Mac). Attach it to your check or fax it with your university purchase order to (510) 649-8179. If you're not 100% happy with EndNote Plus, simply return it within 30 days and we will refund your money.

NA Niles & Associates, Inc.
2000 Hearst Ave. #200
Berkeley, CA 94709
Phone: (510) 649-8176 Fax: (510) 649-8179

Purchase orders accepted only from universities in the U.S. All trademarks acknowledged.