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graph paper. In acoustics, electronics, chemistry, and other fields, logarithmic scales have proved to be invaluable—the decibel scale, for example, or *p*H. Some years ago I presented many unanswerable arguments for using a logarithmic scale [*J. Opt. Soc. Am.* **32**, 229 (1942)]. With the equipment described in that paper, many millions of spectral curves have been plotted—with logarithm-of-frequency used as abscissa—and have had a variety of applications.

WILLIAM A. SHURCLIFF
Cambridge Electron Accelerator,
Harvard University,
Cambridge, Massachusetts

Toward Innovation

In his editorial "Barriers to innovation" (15 Oct., p. 295), Wolfle points out that "In new and undeveloped areas such as space exploration, only cost, ingenuity, and technological feasibility place limits on innovation. But innovation in civilian industry encounters a number of other barriers." There is no question that innovation is primarily controlled by political considerations—economic, social, managerial, fiscal, regulatory. Technological knowledge is an impotent force unless political consensus creates a climate conducive to its application. Such consensus requires fresh attitudes by those who control the resources for innovation—government, industry, labor, and the professions. The problem is how best to gain such new attitudes.

I suggest that we would do well to experiment with new institutional relations between these power groups in order to make them aware of the mutuality of enlightened self-interest in innovation. Such awareness can lead to progressive attitudes and to actions that are complementary instead of antagonistic. The School Construction Systems Development project in California (set up by Educational Facilities Laboratories, 477 Madison Avenue, New York 10022) is one example of a successful experiment where new institutional relations helped create an improved climate for innovation—in this case, in building technology. Plans are now being considered by other groups to conduct similar experiments in other parts of the country on other functional needs of society, for example, transportation and education. . . .

My recent experiences in government and in industry make me as hopeful as Wolfle that increasing attention is being paid to the nontechnical barriers to innovation. As yet, however, we are for the most part still talking singly. Let us experiment together.

MICHAEL MICHAELIS
1735 Eye Street, NW,
Washington, D.C. 20006

How the Spider Got into the Psalm

In 40 years of Old Testament study I have never come across a spider in the Psalms. Frank Allen (Letters, 29 Oct., p. 554) claims he sees one in Psalm 90:9—

> *Ki kal yomenu panu b'ebrascha,*
> *Kilinu shanenu k'mo hegeh,*

the second line of which he translates, "We spend our years like a spider," adding "—spinning our webs of life."

Beautiful poetic imagery, but not a translation of the Hebrew text.

Psalm 90 was written about 550 to 450 B.C. It was incorporated into the final edition of the Psalter circa 100 B.C. The whole of the Hebrew Bible (Law, Prophets, and Hagiographa) was canonized at Jamnia, Palestine, in 93 Christian Era. Then came the translations: Western Aramaic (Targum), Greek (Septuagint), Latin (Vulgate), Arabic (Saadya Gaon), German (Luther), and English (Coverdale, 1535; King James, 1611; Protestant American Standard Version, 1901; Jewish Publication Society, 1917; New American Catholic Edition, 1952; Protestant Revised Standard, 1952). Not one hints of a spider in Psalm 90.

In the University of Chicago's *An American Translation* (1931), J. M. Powis Smith renders Psalm 90:9—

> For all our years vanish in Thy wrath,
> We come to an end; our years are like a cobweb wiped away.

I find no more textual basis for Smith's cobweb than for Allen's spider. The literal translation, the English for every Hebrew word, is:

> For all our days we have faced Thy wrath,
> We end our years as in a sigh.

The Psalms are Hebrew poems. Biblical Hebrew poetry is characterized by parallelism; the words or clauses of the alpha half of a verse parallel those of the beta half. Thus *yomenu* ("our days")

in Psalm 90:9 alpha parallels *shanenu* ("our years") in beta. *Kal . . . panu* ("all . . . we have faced") parallels *kilinu* ("we end") in beta. This leaves us *b'ebrascha* ("thy wrath") demanding a matching term. *K'mo hegeh* ("as in a sigh") is given.

The spider appears but twice in the Hebrew Bible: Job 8:14—"And the web of the spider is his trust," and Isaiah 59:5—"And they shall weave a spider's web." The Hebrew for spider is *akkabis*; for web, *kur*.

How did Smith and his disciple Allen get entangled in spinneret silk? Whence the "cobweb?" They somehow extract it from the phrase *k'mo hegeh* ("as in a sigh"). Some translators render the two words, "as a tale that is told." The noun *hegeh* derives from the verb *hagah*, meaning to point, to pierce, to reason, argue, pronounce, recite, spell, murmur a charm. *Hegeh*, the noun, is found three times in the Old Testament: our Psalm 90:9; Job 37:2—"And the *sound* that goeth out of His mouth"; and Ezekiel 2:10—"And there was written therein lamentations, and *moaning*, and woe." There is neither spider nor web associated with *hegeh* in these verses.

Smith knew post-Biblical Hebrew literature (Talmud and Midrash), wherein the spider symbolizes bad luck. In the Babylonian Talmud, for example, we find, "The evil inclination is at first like the thread of a spider. . . ." The evil inclination is the fuel kindling God's wrath. Thus Smith rounds out the parallelism in concept, forging a gossamer link between *hegeh* and "cobweb." Allen must have reasoned: where there is a web there must be a spider.

ELY E. PILCHIK
Congregation B'nai Jeshurun,
457 South Centre Street,
South Orange, New Jersey 07079

Erratum: Wrong Man

In my letter in the issue of 24 December ("Looking ahead," p. 1667), I erroneously made Klement Gottwald, instead of Walter Ulbricht, the protagonist of "a story popular in Germany (East and West) during the 1950's." I am indebted to Károly Balogh for reminding me that Gottwald was Ulbricht's Czech counterpart.

F. C. DYER
4509 Cumberland Avenue,
Chevy Chase, Maryland