PHYSICS

Horsefeathers

Scientific prefixes borrow a page from the Marx brothers

IF YOU WANT TO SWEEP THE SCIENCE CATEGORY ON *Jeopardy*, here's a hot tip: make the acquaintance of *zetta, yotta, zepto* and *yocto*.

They are not fundamental particles, Aztec gods or missing Marx brothers. They are prefixes—benchmarks on the scientific scale of quantities—denoting, respectively, a billion trillions, a trillion trillions, a billionth of a trillionth, and a trillionth of a trillionth. Nobody has found much practical use for them yet (even the most remote galaxies in the universe are no more than a few hundreds of yottameters away). But they are there if you need them, courtesy of a 1991 decision by the Conférence Générale des Poids et Mesures, the international body that meets every four years to govern the realm of scientific units.

They are also darned peculiar words.

"They're sort of Latin," says Barry N. Taylor, a physicist at the National Institute of Standards and Technology in Gaithersburg, Maryland, and a member of the CGPM's advisory committee on units. When the committee coined the new prefixes, "sort of" Latin was exactly what it had in mind. *Zetta* and *zepto* are supposed to suggest the number seven, *yotta* and *yocto* to carry overtones of eight.

The laid-back approach to etymology evident in the prefixes dates back to 1974 and a bad alphanumeric pun. The prefix for a trillion, *tera* (from *teras*, Greek for monster), is one letter shy of the unrelated prefix *tetra* ("four"); coincidentally, one trillion just happens to be one thousand to the fourth power. In a dadaistic leap of logic, the advisory committee knocked a letter out of *penta* ("five") to produce *peta*, which the conference duly adopted as the prefix for a quadrillion.

By similar reasoning, the committee later derived *zepto, yocto* and their siblings from the Latin *septem* and *octo*. Even so, why did the committee have to monkey with their Latin roots? Whence the *y*? Why the *z*? What was wrong with the status quo ante? Simple, Taylor says: it would have caused problems with abbreviations. Lowercase *s* already stood for the fundamental unit of time, the second, and *o* was apt to be mistaken for a zero. As a compromise, the committee changed the initial letters but kept the initial sounds more or less intact.

No neologisms will be on the agenda when the CGPM reconvenes in February 1995, so the following roster of prefixes should remain current for at least another four years:

10^{24} yotta (Y), from Greek or Latin *octo*, "eight"
10^{21} zetta (Z), from Latin *septem*, "seven"
10^{18} exa (E), from Greek *hex*, "six"
10^{15} peta (P), from Greek *pente*, "five"
10^{12} tera (T), from Greek *teras*, "monster"
10^{9} giga (G), from Greek *gigas*, "giant"
10^{6} mega (M), from Greek *megas*, "large"
10^{3} kilo (k), from Greek *chilioi*, "thousand"
10^{2} hecto (h), from Greek *hekaton*, "hundred"
10^{1} deka or deca (da), from Greek *deka*, "ten"
10^{-1} deci (d), from Latin *decimus*, "tenth"
10^{-2} centi (c), from Latin *centum*, "hundred"
10^{-3} milli (m), from Latin *mille*, "thousand"
10^{-6} micro (μ), from Latin *micro-* (Greek *mikros*), "small"
10^{-9} nano (n), from Latin *nanus* (Greek *nanos*), "dwarf"
10^{-12} pico (p), from Spanish *pico*, "a bit," or Italian *piccolo*, "small"
10^{-15} femto (f), from Danish-Norwegian *femten*, "fifteen"
10^{-18} atto (a), from Danish-Norwegian *atten*, "eighteen"
10^{-21} zepto (z), from Latin *septem*, "seven"
10^{-24} yocto (y), from Greek or Latin *octo*, "eight"

—Robert J. Coontz Jr.

thesize organic molecules from the carbon dioxide in the air and the energy derived from the sulfuric acid reaction. Thus instead of depending on sunlight for energy, the ecosystem of Movile Cave relies on chemical energy. The bacteria grow along with fungi into white mats, which gently ride the surface of the lake, kept afloat by methane-gas bubbles, or cling to the rock walls in the air bells. All other life within the cave depends on the microbial mats.

After millions of years in the dark and toxic environment, the creatures of Movile Cave have lost both pigmentation and sight. Some retain empty eye sockets, but they have developed elongate legs and antennae to feel their way about in the dark. Many also have novel ways of warding off the destructive properties of hydrogen sulfide and sulfuric acid. The water scorpion, for instance, is covered with a thick layer of sulfur-loving bacteria, which biologists think protects the scorpion from the toxicity of hydrogen sulfide.

Biologists divide the life of Movile Cave into two groups: the aquatic animals and the terrestrial animals; the latter make their homes on the limestone walls around air bells. In each region are plant eaters, which peacefully graze on the microbial mats, and meat eaters, which prey on the plant eaters and on one another. The aquatic community lives just below the water surface—no more than two inches down—and includes a variety of swimming flatworms, roundworms, microscopic roundworms and snails, as well as isopods, insects and shrimplike crustaceans, none of which grow longer than half an inch. Three meat-eating species also live in the water: a flatworm with a triangular head, which feeds on the crustaceans; a reddish brown blind leech, colored by the hemoglobin in its blood, which eats the flatworms; and the water scorpion, which eats virtually anything.

On the walls are spiders, pseudoscorpions, millipedes, beetles and more isopods. Many of the smaller animals feed on the wall and floating mats. The top predator of the terrestrial environment is a centipede, which feeds on the mat eaters.

Because of the isolation of the cave, the microorganisms and animals have little similarity to the aboveground ecology of Romania. Many of them—particularly the terrestrial creatures—are relics of a period when the climate was tropical, more than five million years ago. The Movile Cave spider, *Lascona cristiani*, for instance, is most closely related to spiders living on the Canary Islands and in northern Africa.

To study the ecosystem further without damaging it, investigators will pump water out of the cave to a laboratory above ground. There they will recreate the cave environment while leaving the subterranean world undisturbed.

—Robert Zimmerman
and Wendy Marston

Gut Reaction

A remedy for oil spills may live inside the stomach of a whale

IT TAKES GUTS TO BREAK DOWN AN organic molecule. That's the object lesson emerging from the laboratory of the veterinary scientist Morrie Craig of Oregon State University. In the past five years Craig and a team of veterinary scientists have shown that certain bacteria in a sheep's stomach neutralize the poisons in plants such as the tansy ragwort. Craig's work has already piqued the interest of ranchers, whose cattle lack the sheep's resistance to tansy ragwort. Now a new phase of Craig's research is making waves among environmentalists and oil companies: whales, he has discovered, carry bac-

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