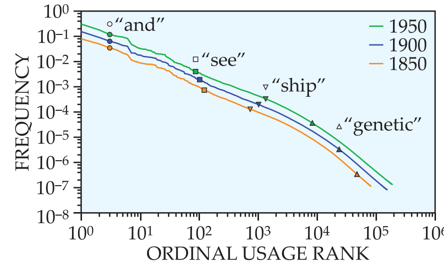
HOW BATS OPTIMIZE FORAGING

By the time a Japanese pipistrelle bat (shown here) has finished foraging for the night, it has eaten up to 20% of its body mass in bugs and flies. Such prodigious feeding is necessary because foraging itself is energy intensive. Some bats spend two-thirds of their daily energy budget on the activity. Efficient foraging is therefore paramount. Emyo Fujioka of Doshisha University in Kyoto, Japan, and his collaborators have set themselves a goal of determining how the Japanese pipistrelle maximizes its food intake.

Their principal tool is an array of 32 microphones positioned around a stream where local bats habitually forage. By analyzing the ultrasonic chirps emitted by the bats, the researchers can track not only the bats' flight paths but also the directions in which the bats aimed the chirps to echolocate their prey. What's more, because the chirps become more frequent the closer a bat gets to its prey, the researchers can determine when its targeting has been successful. One efficient feeding strategy that bats could conceivably adopt is to locate two targets that could be captured in quick succession. Fujioka and his collaborators developed a numerical model that embodied the strategy and compared it with their data. They found that when a bat identified two nearby targets, it adjusted its flight path to consume them one after the other, typically within 1 second. The tactic worked most often when the bat made an aerial turn of 0.6π–0.8π to line up the prey. (E. Fujioka et al., *Proc. Natl. Acad. Sci. USA* **113**, 4848, 2016.) —CD

FINE-TUNING OUR VIEW OF HOW LANGUAGE CHANGES

Language is dynamic. New words enter, words that have outlived their usefulness leave, and enduring words are used more or less often over time. But is the pace of those shifts constant? Or, for example, did English change more rapidly from 1850 to 1900 than it did from 1900 to 1950? Information theory can quantitatively address such questions with a function called the Jensen–Shannon divergence, D. Start with a database of representative words that shows how frequently each word is used in various years. Put in those usage probabilities word by word for the two years to be compared, and D yields a number that measures how much the language shifted. But, as Martin Gerlach, then a PhD student at the Max Planck Institute for the Physics of Complex Systems, and his colleagues have noted, D's overall language assessment is blind to a salient feature: As the figure shows, unusual words, such as "genetic," rise or fall in frequency more rapidly than do common words, such as "and." (Note that the blue and green curves are displaced for ease of visibility.) In part to address that deficiency, Gerlach and company generalized the Jensen–Shannon divergence to a one-parameter family D_α. When α is large, D_α is sensitive to changes in the commonly used sector of a language; small α homes in on less frequently used words. So what about the evolution of English over the period 1850–1950? With the help of the Google Ngram database, the researchers found that the rate of change depends on how you ask the question: The overall change as measured by D was greater in the period 1900–1950, but 1850–1900 saw faster shifts in common words. (M. Gerlach, F. Font-Clos, E. G. Altmann, *Phys. Rev. X* **6**, 021009, 2016.) —SKB



IRON ISOTOPE REVEALS EARTH'S CLOSE ENCOUNTERS WITH SUPERNOVAE

In 1999 researchers in Germany discovered traces of iron-60 in crust from the Pacific Ocean. Because only supernovae are known to create abundant amounts of ^{60}Fe, which has a half-life of 2.6 million years, Gunther Korschinek at the Technical University of Munich and colleagues concluded that dust from a relatively recent and nearby supernova had littered Earth's surface with the isotope. After only a smattering of supporting evidence over the past 17 years, a burst of ^{60}Fe research has now solidified the supernova interpretation and opened a new window for investigating how those close encounters affected Earth's past climate and life.

Anton Wallner at the Australian National University in Canberra and colleagues expand the ^{60}Fe record by using accelerator mass spectrometry to measure the isotope's prevalence in crusts (including the pictured sample) and sediment cores from the Pacific, Atlantic, and Indian Oceans. The distribution and concentrations of ^{60}Fe rule out a terrestrial or meteoritic origin; rather, the evidence points to multiple nearby (within about 325 light-years) supernova events over the past 10 million years. Meanwhile, after years of unsuccessful lobbying, Korschinek and colleagues finally got their hands on samples of Moon regolith. Sure enough, the scientists found traces of ^{60}Fe. The new studies present a consistent global and extraterrestrial record of past supernova activity that occurred uncomfortably close to home.

In a third chapter to the unfolding story of supernova archaeology, Dieter Breitschwerdt at the Technical University of Berlin and colleagues simulate the sequence of stellar explosions that could account for the Pacific deposits of ^{60}Fe. The researchers propose the demise of two nine-solar-mass stars between about 290 light-years and 325 light-years away; the more recent supernova would have occurred 1.5 million years ago, when early species of *Homo* were spreading over the planet. While recent supernovae didn't have drastic, mass extinction–inducing consequences, Wallner and colleagues note that some ^{60}Fe deposits correspond to a period of global cooling that eventually ushered in the Pleistocene epoch. (A. Wallner et al., *Nature* **532**, 69, 2016; L. Fimiani et al., *Phys. Rev. Lett.* **116**, 151104, 2016; D. Breitschwerdt et al., *Nature* **532**, 73, 2016.) —AG PT