The technique known as fragmentation is discussed with regard to its current and future role in probing the structure of the nucleus. A curator at the Institute of the History of Medicine discusses a common misquotation of the Hippocratic Oath. In reference to the "Biological Invaders" special issue, a reader comments, "We are focusing a lot of attention on the invasions of species within very small scales of time...." It is suggested that there is reason for the public to perceive that "scientists have an active anti-religion agenda." And an assessment of the spread of engineered tobacco mosaic virus is questioned.

Radioactive Nuclear Beams

In his News Focus article (1 Oct., p. 28), Andrew Watson describes the current effort to create facilities that will produce slow nuclear beams by postacceleration of rare isotopes. The article, however, may leave the impression that the other main technique for exploring nuclear structure, based on fast direct beams from heavy-ion fragmentation, will be superseded because of "poor beam intensity." This is definitely not the case.

The greatest scientific perspective in research with radioactive beams lies in the exploration of exotic nuclear species at the limits of stability of the nucleus. Experience from the last couple of years suggests that, for this purpose, the high-energy beams from the fragmentation of heavy ions are superior to beams produced from isotope separation online (ISOL) combined with passage of sorted radioactive nuclei through a small accelerator. As a rough measure, in a study based on nuclear reactions, the same amount of information can be obtained with a fragmentation beam that is a factor of 100,000 weaker than an ISOL beam of the same isotope. Because the production rates are comparable, this implies that direct fragmentation beams will reach several mass numbers farther away from stability, to rare species produced with very small probabilities. This pioneering exploration is already in progress at existing fragment separators at major heavy-ion laboratories: the Large National Accelerator for Heavy Ions (GANIL) in Caen, France; the Center for Heavy-Ion Research (GSI) in Darmstadt, Germany; the National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University; and the Institute of Physical and Chemical Research (RIKEN) in Tokyo, Japan. An upgrade now in progress here at the NSCL will by 2001 increase our beam intensity by about a factor of 1000 over the current value. Any plan for the future must have even more powerful fragmentation beams as a major, if not the main, component.

For a future heavy-ion machine representing the ultimate in modern technology, the "second-generation" radioactive-beam facility referred to in Watson's article, the fragmentation beams are expected to have at least the same intensity as those based on the ISOL technique.

P. Gregers Hansen
National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, MI 48824, USA

Quoting the Hippocratic Oath

One of the most reiterated and erroneous myths of medical history appears in the review by Julio Licinio of Howard I. Kushner's book *A Cursing Brain? The Histories of Tourette Syndrome* (Harvard University Press, Cambridge, MA, 1999) (*Science*'s Compass, 1 Oct., p. 56). In the final column of this otherwise enjoyable review, Licinio parenthetically equates the Hippocratic Oath with the quote "first do no harm." This may seem a bit of a quibble, but for the past 20 years I have fielded queries from physicians and lay researchers for the exact citation in the Hippocratic Oath of that quote. They are amazed when they can't find it in the Oath or another of the Hippocratic works, because they have seen it cited as such in reputable books and magazines. Neither those words nor that sentiment appears in any known version of the Hippocratic Oath. In Ludwig Edelstein's translation of the Greek version, the Oath does say, "I will keep them [the sick] from harm and injustice" (*1*, p. 3).

"First do no harm" is a most worthwhile rule, and I do not mean to belittle it. However, the closest Hippocrates (or any of the unknown authors of the Hippocratic corpus) came to expressing it is in the work *Epidemics,* book I, where it is stated, "As to diseases, make a habit of two things—to help, or at least to do no harm."

Christine A. Ruggere
Institute of the History of Medicine, Johns Hopkins University, Baltimore, MD 21205, USA

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Invaders Today, Natives Tomorrow?

Models of colonizing species and episodes from the annals of population biology tell us that colonists, including exotic species or potential "biological invaders" ("Biological Invaders," 17 Sept., p. 1834), are most vulnerable to local extinctions early in an invasion. Once a colonizing species gains considerable momentum in staking its evolutionary claim on a habitat or ecosystem, it becomes all but invincible. Therefore, it seems to me that it makes little sense to attempt to control well-established biological invaders (foreign colonists) with equally exotic control agents. Only in the earliest stages of a biological invader's population growth cycle would eradication be possible, but unfortunately this is the most cryptic phase of the colonizing strategy, making detection of a potential problem extremely difficult in many cases.

I advocate the notion that the entire planet is, and has been, one mammoth mixed-bag of countless colonizing episodes, both in geological and in contemporary time. We are focusing a lot of attention on the invasions of species within very small scales of time, but Earth's intermingling of organisms from different continents and seas has been occurring for millions of years. Doesn't it therefore follow that in cases today where biological invaders have strong footholds, that they are best left alone? Isn't it possible that at some point these populations will be naturally controlled by new interrelationships with local species and climate? In other words, at some point biological invaders have the potential of becoming new or quasi-native species.

The Snake River Valley in Oregon where Eurasian cheatgrass and medusahead rye have a strong foothold.

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Allen M. Young
Milwaukee Public Museum, 800 West Wells Street, Milwaukee, WI 53233–1478, USA. E-mail: young@mpm.edu

Investigations of biological invaders may be more complicated than it would first appear. For many potentially noxious pests,

we do not have adequate information about their native distribution. For example, concern was raised in the 1980s when *Bursaphelenchus xylophilus*, a parasitic nematode that severely damages native pines in Japan, was found to be responsible for the rapid death of mature pine trees in the midwestern United States (*1*). Concern lessened, however, when it was determined that it was primarily exotic, non-native pines that were dying and that the nematode was probably a North American native species.

Similarly, the soybean cyst nematode, *Heterodera glycines*, was first observed in North America in North Carolina in 1954. Records suggested that the nematode was introduced with shipments of tulips from Japan (*2*). In spite of quarantines, the nematode spread to every soybean-producing state and, in 1997, it was estimated to have reduced U.S. soybean production by 218 million bushels (*3*). Its rapid spread has led some researchers to suggest that the nematode may have been endemic to North America, existing on related weed hosts, and that its distribution expanded with increased soybean production. Another theory has implicated importation of soil from Japan in the late 1800s to obtain *Bradyrhizobium japonicum* for soybean root nodulation. Biotic surveys and inventories of native organisms are critical for the proper identification of biological invaders.

Thomas O. Powers
Department of Plant Pathology, University of Nebraska, Lincoln, NE 68583–0722, USA. Web address: ianrwww.unl.edu/ianr/plntpath/nematode/wormhome.htm

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Silent Scientists

In their Editorial "Fending off furtive strategies" (*Science*'s Compass, 17 Sept., p. 1847), R. Brooks Hanson and Floyd E. Bloom offer an argument against the Kansas State Board of Education decision to eliminate evolution and cosmology from their curriculum requirements. They encourage political leaders who care about education to speak out on this issue. In addition, they assert that, "Science is not an attack on people's beliefs...." This is true, but the public has ample reason to think that most scientists believe otherwise.

From Thomas H. Huxley in the 1800s to John Maddox (former editor of *Nature*) and T. V. Rajan (*1*) today, many prominent scientists have asserted that evolution and cosmology render religion obsolete because they explain the origin of human beings by purely naturalistic processes. Many philosophers who work in this area and a substantial number of scientists who hold religious beliefs clearly disagree with this position. Yet individual scientists and organizations of scientists have been silent on this matter and have let the assertions of anti-religion scientists stand unopposed. Therefore, it is not unreasonable for the public to perceive that scientists are largely united in the view that evolution and cosmology render religion obsolete. On the basis of this perception, it is also not unreasonable for some people to object to having this world view presented to their children. However, the typical response of scientists to laws or policies that reflect this public concern has been to ridicule those who support such laws or policies. This only serves to reinforce the perception that scientists have an active anti-religion agenda and thus to increase the activism of opponents of evolution.

On the basis of my experience as a biology professor at a religiously affiliated college in the South, I suggest that it is possi-