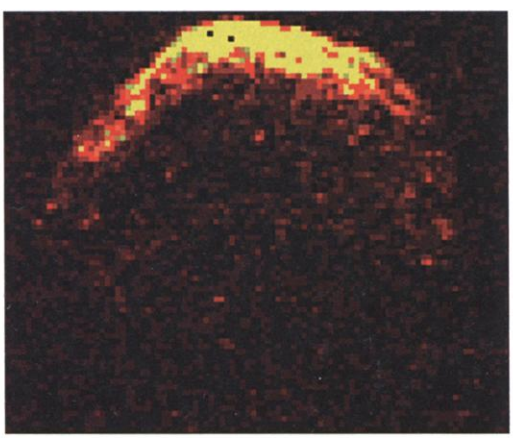
compromised, and eczema patients—groups at high risk of serious side effects from the current vaccines. Several companies, including Aventis, are already working on the next-generation, much more attenuated, vaccines.

–MARTIN ENSERINK

IMPACT HAZARD

Celestial Billiards Threaten Hit in 2880

The first master of gravity, Isaac Newton, saw the solar system as a clockwork machine whose workings depend solely on the mass of the machine's parts and thus their gravitational pull. Would that it were so. On page 132 of this issue, a team of researchers reports that the 1-kilometer asteroid 1950 DA has up to a 1-in-300 chance of clobbering Earth with a 10,000-megaton punch on 16 March 2880. For an event 878 years hence, that may seem like a relatively precise prediction. But if basic Newtonian mechanics were the only consideration, there would be little room for doubt. A pivotal uncertainty, it seems, is how the asteroid spins.



Destination Earth? The 1-kilometer asteroid 1950 DA—"imaged" here by radar—could be on a collision course with Earth, depending on an uncertain interaction with sunlight.

CREDITS: (LEFT TO RIGHT) J. D. GIORGINI *ET AL.*/JPL; JSC/NASA

As its temporary name implies, astronomers discovered 1950 DA 52 years ago, but they lost track of it when it faded from view before anyone determined its precise orbit. Unknowingly photographed in 1981, it was finally snared for good on New Year's Eve 2000 in an automatic telescopic search for threatening asteroids. Celestial mechanicist Jon D. Giorgini of the Jet Propulsion Laboratory in Pasadena, California, and 13 colleagues then calculated—based on telescopic and subsequent radar observations—that it had up to a 1-in-300 chance of gravitationally caroming off 15 close encounters with Earth and Mars to hit Earth in 2880. That probability is 1000 times greater than the well-determined impact probability of any other sizable known object. It's also 1.5 times the combined impact probability of all other asteroids.

But sources of potentially significant uncertainty remained, notwithstanding orbital observations spanning 51 years, high-precision radar data, and an orbit-stabilizing gravitational interaction between Earth and the asteroid. The tidal pull of the galaxy varies; the sun's gravity weakens as the sun blows off mass; its slightly squashed shape creates an irregular gravity field; estimates of planets' masses are uncertain; and sunlight exerts a gentle push. Combined, says Giorgini, these uncertainties could make 1950 DA cross Earth's orbit as much as a few days before or after the 20-minute window when a collision is possible in 2880.

But the killer uncertainty is the so-called Yarkovsky effect (*Science*, 13 August 1999, p. 1002). A century ago, the Russian engineer I. O. Yarkovsky recognized that the "afternoon" quadrant of an asteroid—the side most thoroughly heated by the sun—could act like a little rocket as it rotated into dusk and early evening, emitting thermal radiation that could push the asteroid into a different orbit. But astronomers know so little about 1950 DA—especially the direction of its spin axis—that celestial mechanicists can't tell what direction its Yarkovsky "rocket" points. The probability of impact could be higher than calculated—or it could be zero. Gauging the future path of an asteroid "is a lot like shooting billiards," says Giorgini. Given 1950 DA's 15 close planetary encounters before 2880, "we're trying to line up a 15-bank shot. We can do the first 12 really well. For the last three, we need to know more about the cue ball" and how much the Yarkovsky effect will influence its course.

No one in the planetary science community is panicking. "The work is done about as well as it can be," says planetary dynamicist William Bottke of the Southwest Research Institute (SRI) in Boulder, Colorado, but "it's a long time away, and the probability is small."

Small, but the biggest around, notes Bottke's SRI colleague, asteroid specialist Clark Chapman: "It looks to me [like] there's a good chance that for the next 30 years this will be the one to watch." If the threat continues to grow, one solution could be as low-tech as dusting 1950 DA with soot or powdered chalk to power up or throttle back the Yarkovsky effect (as well as sunlight pressure) and steer the asteroid away from Earth. Or just plastic-wrap it in reflective Mylar by sending a sunlight-driven solar sail on a collision course with the asteroid. Such tinkering with his clockworks would stun Newton.

–RICHARD A. KERR

ScienceScope

Privacy Rule Revised Biomedical research groups are welcoming revisions to a patient confidentiality rule that they feared would paralyze research. On 21 March, the Department of Health and Human Services (HHS) proposed several changes to the so-called Privacy Rule, which goes into effect in April 2003.

Most important for researchers, HHS this month is seeking suggestions on what data should be stripped from records so that they can be shared with scientists. HHS had planned to remove so many identifiers—such as zip codes and birth dates—that the records would have been useless, say researchers (*Science*, 7 December 2001, p. 2070). HHS also wants to simplify patient consent forms for sharing data.

Jennifer Kulynych of the Association of American Medical Colleges says that although her group still has concerns, "we're very encouraged."

Tough Task A Nobel Prize–studded panel held its first meeting this week to tackle NASA's troubled life and materials sciences program. Led by Columbia University neurobiologist Rae Silver, the task force was put together by NASA Administrator Sean O'Keefe to study how to maximize scientific returns aboard the shrinking space station.

The 20-member panel boasts two Nobel Prize winners, but scientists close to the station program are skeptical that it will have an impact. Money woes, they note, will severely restrict station science for the foreseeable future. But Silver says O'Keefe gave the panel free rein to propose the best science, regardless of budget. Its final report is due in June.

Imported Embryos French research minister Roger-Gérard Schwartzenberg has jumped the gun on proposed changes in France's bioethics laws that would authorize human embryo research. Last week, Schwartzenberg announced that he intends to allow French scientists to import embryonic stem cell lines from other countries where such research is permitted, such as Australia and the United Kingdom. The new bioethics law has already passed a first reading in the National Assembly, but Schwartzenberg acted after noting that the lengthy parliamentary process meant that scientists "risk having to wait" until 2003 to get cells.

for early stages of protein misfolding in Alzheimer's disease.

What this all means is yet to be determined. In people, as opposed to the test tube, "this doesn't happen to every protein," says Jeffery Kelly, a chemist at the Scripps Research Institute in La Jolla, California. No one knows what qualities, if any, are unique to the 20 proteins known to form amyloid fibrils in humans, or whether most proteins have evolved properties to prevent certain kinds of misfolding.

A small but growing cohort of scientists suspects that if this style of misfolding is a generic property of proteins, it's likely to play a still-hidden but useful role in normal biology. "My view is that there are some cases where these kinds of transitions are beneficial," says Susan Lindquist, a molecular biologist and director of the Whitehead Institute for Biomedical Research in Cambridge, Massachusetts. Her work suggests that this applies to yeast, sometimes moderating gene expression in helpful ways; other researchers are examining whether this is also true in other organisms, including humans.

–JENNIFER COUZIN

Early bird? Blue tits use information from past years to synchronize their nesting with peak insect abundance.

CREDIT: DAVE WATTS

ANIMAL BEHAVIOR

Last Year's Food Guides This Year's Brood

Timing is everything for some breeding birds. They must hatch their young in time to exploit a brief springtime abundance of food. Seasonal cues such as day length help birds calibrate their breeding. But now a study on page 136 shows that some birds adjust their efforts according to lessons they learned the previous year. The finding implies that such birds might be able to accommodate some environmental changes spurred by global warming, but scientists caution that such adjustments may be limited.

As oak trees leaf out in European woodlands each spring, caterpillars hatch and devour fresh young foliage before the trees pump too many noxious tannins into the leaves. The 2-week burst of caterpillars provides blue tits, small birds akin to chickadees, the food they need to satisfy a nest full of clamoring little mouths.

Birds likely use a host of cues to sense that spring is in the air, such as temperature, young leaves, or hatching caterpillars. But some researchers have suggested that birds breeding too late or too early one year might learn from their mistake and adjust their timing the next. Indeed, a few studies have suggested that past experience can guide other reproductive decisions. For example, collared flycatchers adjust their clutch size, and great tits decide whether to stick with the same mate, based on past breeding success. Now, Fabrizio Grieco, Arie J. van Noordwijk, and Marcel E. Visser of the Center for Terrestrial Ecology in Heteren, the Netherlands, provide the first experimental evidence that experience can influence reproductive timing.

The group monitored pairs of blue tits as they bred in nest boxes for two consecutive years. In the first year, the team supplied half the pairs with caterpillars and mealworms as they tended their broods. The researchers took advantage of the birds' tendency to nest later than the natural caterpillar peak during their first year of breeding, due to inexperience, unfamiliarity with their territories, and the challenges of finding a mate. Thus, most unfed control birds bred late in the first year, then advanced their breeding to match the caterpillar peak in the second. But the pairs given food did not move up their breeding time in the second year. In fact, they delayed it, apparently because the first year's supplemental feeding led them to expect that food abundance would peak later.

The results show that timing reproduction "is more complex than we previously thought," says ornithologist Ruedi Nager of the University of Glasgow, U.K. Although past experience may be only one among many cues, others say, it is probably important for a species that returns to the same territory year after year and would benefit from learning the idiosyncrasies of its real estate.

But in another way, the blue tit seems to be an unlikely candidate for long-term

ScienceScope

Interim Quartet Health and Human Services Secretary Tommy Thompson last week appointed a four-member team heavy on bioterrorism expertise to temporarily lead the U.S. Centers for Disease Control and Prevention (CDC) in Atlanta. The quartet succeeds Jeffrey Koplan, who will become a vice president at Atlanta's Emory University (*Science*, 1 March, p. 1624).

CDC deputy director David Fleming leads the new crew, with James Hughes and Julie Gerberding, the director and acting deputy director of CDC's National Center for Infectious Diseases, fronting bioterrorism efforts. The fourth member is bioterrorism guru Michael Osterholm of the University of Minnesota, Twin Cities, who will be Thompson's "representative" to CDC until a new chief is found.

Agency watchers say Osterholm's slot is designed to give Thompson greater control over CDC, which was criticized for its handling of the anthrax crisis. Margaret Hamburg, a bioterrorism expert at the Nuclear Threat Initiative in Washington, D.C., says the pick "reflects Thompson's desire to have someone he knows and trusts on the team."

Pick Six The National Science Foundation (NSF) has chosen six new Science and Technology Centers (STCs) for its long-running and once-controversial experiment in large, collaborative research. The new centers—which will be formally unveiled this summer—could receive up to $40 million each over 10 years to explore everything from space weather to new cancer-detection technologies.

Then–NSF director Erich Bloch started the STC program in 1987 as an attempt to move the agency beyond its traditional emphasis on small grants to single investigators. Many scientists feared that the centers would focus on applied science and drain support for basic research, but outside reviewers have since endorsed the concept.

The six new centers, chosen from 143 applications, will join five existing centers created in 2000 (23 others have finished their runs). Another competition is scheduled to begin later this year. All the new centers have multiple partners—the University of California, Berkeley, for example, is involved in four new STCs. The winners are now negotiating their budgets and marching orders with NSF. (For a list, see sciencenow.sciencemag.org/feature/data/stc.shtml.)

Contributors: Jocelyn Kaiser, Andrew Lawler, Michael Balter, Martin Enserink, Jeffrey Mervis