key court victories (*Science*, 10 March, p. 1729). The Pope verdict "suggests a revitalized FSB and a danger to all researchers," says Paul Josephson, a Russian historian at Colby College in Waterville, Maine.

Pope's release would ease tensions—but only a bit. U.S. officials are on tenterhooks after Russia threatened last month to resume arms sales to Iran after a 5-year hiatus on new contracts. "The worst-case scenario," says one observer, "is that all the technology cooperation programs are halted." Others have a more hopeful attitude. "I continue to be an optimist," says Lev Sandakhchiev, director-general of the State Research Center of Virology and Biotechnology "VECTOR" in Novosibirsk, Russia, a former bioweapons lab. "Russia and the U.S.A. are bound to have good relations."

–RICHARD STONE

ECOLOGY/PALEONTOLOGY

Colorado River Clams Provide Benchmark

When naturalist Aldo Leopold explored the Colorado River delta in 1922, he found a "milk-and-honey wilderness." But 27 years later, he wrote that "I am told the green lagoons now raise cantaloupes." Conservationists have long contended, largely in impressionistic terms, that 70 years of American dam building and water diversion have destroyed the biological richness of the delta, a key nursery of marine life at the end of the Southwest's great watercourse. Now researchers have confirmed those suspicions, using an important ecological player as a quantitative marker.

Washed up. Despite the periodic accumulation of shells (above), the Colorado River now supports 95% fewer clams than in decades past.

CREDITS: (TOP TO BOTTOM) IRIDIUM; KARL FLESSA

"Basically, we've used clam shells to quantify what things were like before the dams and found they were vastly different," says Karl Flessa, a geoscientist at the University of Arizona in Tucson who led the four-university team's work, which is reported in the December issue of *Geology*. The work, says Sally Walker, an invertebrate paleontologist at the University of Georgia, Athens, "shows paleontology can be extremely useful for solving environmental questions by establishing an ecosystem's long-term past before humans altered it. That's powerful."

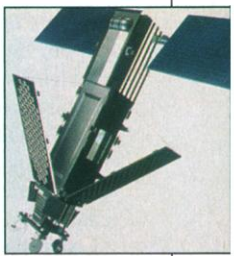
Flessa and his colleagues in Virginia and Mexico studied clams in the delta because, unlike other animals that decay and are lost to the geological record, clams leave behind hard shells to tell of past abundance. Clams furthermore stand as a "proxy" for "the whole marine ecosystem and its health," says Flessa, who notes that numerous fish, mammals, and migratory shorebirds depend directly on them for food. Flessa and his colleagues hoped that an analysis of the vast islands of gleaming white shells, using paleontological, geochemical, and geochronological methods, would allow them to estimate the delta's biological productivity both before and after the river's water was diverted.

To do so, the researchers carried out a series of simple mathematical calculations. First, they used satellite images, trenches excavated in shell-rich beaches, and field measurements of ridge density to estimate that the remains of some 2 trillion clams lay entombed in great shell ridges and islands in the delta. Then they dated 125 shells by analyzing changes in their amino acids and calibrating the results with radiocarbon dating. Virtually all those 2 trillion shells accumulated over the 1000 years from A.D. 950 to 1950, they found. Finally, they used stable isotope profiles recorded in shells to calculate the population turnover rate, which allowed them to calculate that 6 billion mollusk bivalves flourished at any given time in the area. From that number, they calculated an average density of 50 clams per square meter over the last millennium. In contrast, earlier this year seven sample areas yielded estimates of just three individuals per square meter.

Michal Kowalewski, a geobiologist at Virginia Polytechnic Institute and State University in Blacksburg and one of the project's leaders, believes that the productivity of the delta system has fallen at least 95% since the 1930s, when Hoover Dam was built. "That's a big drop, but in fact our calculations are so conservative it's probably much worse than that—maybe 10 times worse," Kowalewski says. He blames reduced fresh water and nutrient flows to the delta. About 90% of the river, or about 13.5 million acre-feet of water a year, is now diverted to support the fields and booming

ScienceScope

Back From the Dead Radio astronomers may have to cope with some unwanted static after all. The U.S. Defense Department last week announced that it will spend $72 million over the next 2 years to revive the bankrupt Iridium satellite phone network, which produces signals that interfere with radio telescopes (*Science*, 24 March, p. 2135). Last March, some astronomers quietly celebrated after Iridium and parent company Motorola announced that they would scrap the 70-spacecraft constellation after losing nearly $7 billion. Now, the Pentagon says it wants the moribund system reenergized next year for emergency communications. Says one sky watcher: "It's like a bad roommate moving back in—you just learn to live with it."



Take Your Pick The presidents of the American Physical Society (APS), the American Chemical Society, and the American Mathematical Society are offering the next U.S. president a list of recommended candidates for top science policy jobs. The names for two dozen key executive posts and four R&D–related advisory boards could go to the president-elect as early as this week.

For White House science adviser, sources say the trio favors mathematician Phillip Griffiths, director of the Institute for Advanced Study in Princeton, New Jersey; engineer and MIT president Charles Vest; or chemist Tom Meyer of Los Alamos National Laboratory in New Mexico. For defense secretary, they recommend retired aerospace executive Norm Augustine, while they hope current NASA chief Dan Goldin will stay. The groups plan to forward only the names of those candidates who express interest.

APS is coordinating the effort and has even hired Christine Niedermeier, a former congressional staffer, to direct transition-related work. The effort "could be a rallying point" for the R&D community and "a valuable service" to the president-elect, Niedermeier told *Science*, while declining to confirm specific names.

No life scientists made the cut for science adviser. "Our parochialism is showing," acknowledges one person involved in the effort. Others say biology groups were invited to join but could not respond in time. Meanwhile, other groups, including the American Association for the Advancement of Science (which publishes *Science*) and the National Academy of Sciences, may also assemble wish lists in coming weeks.

CHEMICAL PHYSICS

Magnetic Wires Promise Giant Step for Memory

The race to cram ever more data onto computer hard drives could soon be veering onto more interesting terrain. So far the track has been level: Hard drives store bits of data in tiny beams of magnetic material lying side by side on a flat disk. By continually shrinking those beams and improving the devices that read and record magnetic traces in them, computer engineers have boosted storage capacity nearly 100-fold over the past decade. In theory, they could pack in even more bits by standing the beams upright. But the leading technology for making dense arrays of magnetic posts requires chemicals corrosive to other disk materials and is limited to making posts of just one size. Now, a better way to make such an array may be at hand.

On page 2126, researchers at the University of Massachusetts, Amherst, IBM's T. J. Watson Research Center in Yorktown Heights, New York, and the Los Alamos National Laboratory in New Mexico describe a potentially cheap and simple method of creating porous plastic templates. By filling the pores with magnetic materials, they can make magnetic posts so small and close together that 10^{12} of them fit in a square centimeter. If each post could be addressed individually—a feat beyond the capability of today's read-write heads and likely a major challenge—disk drives would be able to store a terabit of data per square centimeter, a 300-fold improvement over current models.

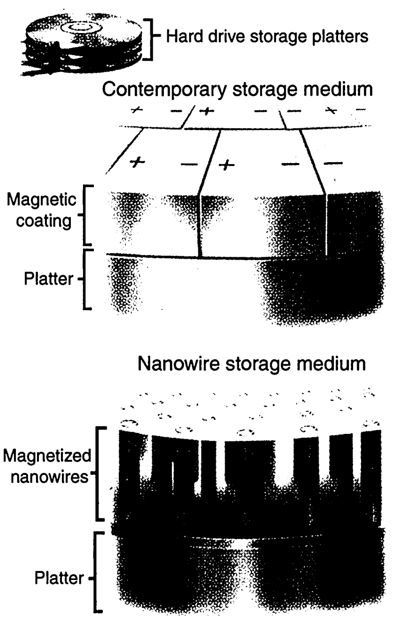
"I think it's going to be important," says Ivan Schuller, a physicist at the University of California, San Diego, who studies the properties of ultrasmall magnetic structures. And magnetic storage may be just part of the story, says Tom Russell, who led the University of Massachusetts portion of the team. By tweaking the recipe for the template's chemical precursors, he points out, one can create films with pores of different sizes. That may open the door for nanowire templates and arrays that serve as novel porous membranes for chemical separations or as tiny crucibles for controlling chemical reactions.

Currently, laboratories make the most densely packed arrays of tiny, parallel magnetic wires by chemically pitting a thin block of aluminum with tightly packed holes and then filling the holes with a magnetic material such as cobalt or iron. The trouble, Russell says, is that creating the holes requires caustic reactions that can wreak havoc on other components in computer circuitry.

To overcome that problem, Russell and his colleagues turned to two-part plastic molecules called copolymers. A copolymer molecule contains two portions sewn together in the middle, like a strand of spaghetti that is egg-flavored at one end and spinach-flavored at the other. When large numbers of copolymers are mixed together in solution, similar ends quickly crowd together. Researchers have long used this self-segregating property to make thin plastic films in which the copolymer halves arrange themselves into various patterns, including arrays of cylinders of one polymer component standing upright within the other. Those cylinders can then be hollowed out and filled with other materials to make things such as tiny magnetic posts. But such well-ordered films tend to be too thin to mold useful magnetic posts. And in thicker films the cylinders point in random directions.

Russell's team set out to orient those cylinders in thick films. Starting with two-part polymers made from standard plastic precursors, polystyrene and polymethylmethacrylate (PMMA), they deposited a thick layer over a surface. The polymers self-segregated into randomly oriented PMMA cylinders in a polystyrene matrix. The researchers then simply exposed the film to an electric field oriented perpendicular to the surface. Because the lowest energy state for each cylinder is to follow the path of the lines of the external field, the cylinders stood at attention like an army of tiny soldiers.

To hollow out those cylinders, the researchers exposed their film to ultraviolet



Raw bits. Nanowires cast in plastic molds might lead to computer drives packed with 300 times as many magnetic domains capable of storing information.

ILLUSTRATION: CAMERON SLAYDEN

ScienceScope

Thinking Strategically Canadian researchers will soon get a chance to share their visions of a "strategic investment." The new Canadian Institutes of Health Research last week launched plans to give each of its 13 newly appointed scientific directors (for a list, see sciencenow.sciencemag.org/cgi/content/full/2000/1206/4) $3.5 million annually to spend on strategic research. That has triggered a debate on exactly what to fund.

Genetics institute director Roderick McInnes, for instance, says the focus should be on cutting-edge science, while Jeff Reading, head of the Aboriginal People's Health institute, wants to emphasize research addressing social needs, such as reducing suicide among aboriginal teens. Infection and Immunity director Bhagirath Singh envisions using the money as leverage to attract research partners from industry and academe.

The directors agree that canvassing the science community for their ideas will be essential. "The biggest fear that scientists have is that some director is going to propose his pet project ... and that's it," says Cancer institute director Philip Branton. The spending plans are due 1 April.

Mehr, Bitte Germany's top basic research organizations are bemoaning a "disappointing" science budget for 2001. Research leaders said this week that planned increases won't be enough to sustain some innovative programs—or keep pace with other leading nations.

At the Max Planck Society, the nation's premier basic research agency, spending will rise 3% next year, to about $800 million, says president Hubert Markl. That's well short of the requested 5.2% budget hike, so the society may scale back new "international research schools" and other efforts to promote interdisciplinary partnerships, he says.

Markl and Ernst Ludwig Winnacker, head of the DFG basic-research granting agency—which will also get a 3% increase to about $1 billion—warn that Germany is falling behind the United States. To keep pace, both men vowed to push for more "substantial" raises in the 2002 budget. Markl is aiming for at least 5% more, while Winnacker hopes for as much as a 10% boost.

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