explosive growth of NIH's budget, which at more than $20 billion now dwarfs all other civilian science agencies.

Beginning in 1998, Congress responded to a lobbying campaign to double NIH's budget with the first in a string of major increases. Just how much credit the White House can take for the NIH gains, however, is in dispute. In a budgetmaking gambit to free up funds for other priorities, the White House typically asked for small increases for NIH each year, betting that Congress would up the request for this politically popular agency. As a result, NIH's growth "is a backhanded legacy for Clinton," says Steven Schier, a political scientist at Carleton College in Northfield, Minnesota.

But former NIH Director Harold Varmus goes further, saying that Clinton allowed him to speak freely about NIH's needs. "The White House tended to lowball us in budgets," he says, "but we were left unbridled to say what we really needed to say." Beyond budgets, Varmus says Clinton was willing to stand behind controversial policies—from lifting a ban on taxpayer-funded research using fetal tissue to this year's backing of rules allowing researchers to experiment with stem cells derived from human embryos.

NIH's success, however, also raised expectations in other disciplines. Gibbons spent much of his tenure touting how the Administration had protected basic research from the debt-reduction storm; new science adviser Neal Lane, appointed in February 1998, could turn his attention to the question of how to spend the newfound wealth. One answer, he has argued in a string of speeches, is to restore "balance" to the federal R&D portfolio by giving more money to the physical sciences, such as chemistry and physics, that have seen their budgets stagnate over the last decade.

So, while Gibbons touted the economic benefits of applied research to a somewhat skeptical Congress, Lane now emphasizes the long-term economic payoff of basic studies. By and large, federal lawmakers have been receptive to the idea, this year approving the most significant increases in years for NSF and for the basic science programs at the Departments of Energy and Defense.

The shift, says Harvard's Hart, represents the Clinton Administration's "tactical retreat to least common denominator politics" and a realization that the booming high-tech and pharmaceutical industries were ratcheting up their own R&D programs. Schier says it reflects "Clinton's masterful ability to reposition himself as political conditions shifted." But he warns that such flexibility "can produce a very variable policy record"—a view endorsed by critics of some Administration actions.

CUNY's Lubell, for instance, faults Clinton for failing to win Senate ratification last year of the 1996 Comprehensive Test Ban Treaty—an international nuclear nonproliferation pact supported by many physicists. The defeat, others say, resulted partly from the White House's failure to blunt claims by some scientists that current technologies would not allow adequate enforcement monitoring.

Similarly, some space scientists complain that Clinton allowed Al Gore and NASA Administrator Dan Goldin too much leeway in promoting the agency's "faster, cheaper, better" money-saving strategy, which may have contributed to the loss of several expensive Mars missions.

In addition, fusion fans blame the White House for not preventing Congress from backing out of ITER, a $10 billion international fusion energy project that had drawn cooperation from Japan and Europe. And engineers, mathematicians, and computer scientists funded by the Pentagon worry that post–Cold War research budget cuts—which drained up to 40% of the funds from their fields—went too far.

In an interview with *Science* (below), President Clinton defends the NASA strategy but concedes that the defense research budget needs a boost. And Administration officials note that, despite some flubs, they have achieved many of the R&D policy goals set back in 1993. Basic and applied research spending, for instance, are near all-time highs. Combined government and industry research investments have risen from 2.6% to nearly 3% of the country's gross domestic product, the Administration target set 8 years ago.

Similarly, the military's share of overall government R&D funding has fallen from 60% to 50%—another goal reached. And, in his only major science and technology speech—delivered last January at the California Institute of Technology in Pasadena—Clinton noted that his team's goal of wiring schools and universities to the Internet has been a huge hit.

Facts and figures aside, the speech also illustrated a different kind of presidential legacy: a personal embrace of science. Indeed, the man who once riled plant researchers by making a joke at their expense drew cheers when he proclaimed that "I've been spending a lot of time trying to get in touch with my inner nerd."

–DAVID MALAKOFF

AN INTERVIEW WITH THE PRESIDENT

"I'd Like to See America Used as a Global Lab"

THE OVAL OFFICE—As one of only three 20th-century presidents to walk away after serving two full terms, William Jefferson Clinton could understandably be expected to dwell on his achievements over the past 8 years. But when he met with *Science* magazine on 6 December for a broad-ranging interview, the nation's 42nd president was more than happy to look ahead—at how science and technology were likely to change our world, and how he might continue to interact with the scientific community after he leaves office in January.

The interview took place at one of the most dramatic junctures in U.S. history: a month after the election for Clinton's successor had ended in a virtual tie, with the result still in doubt. Yet, for all the sound and fury taking place outside the Oval Office, the atmosphere within was serene and the interview subject perhaps a bit wistful.

On the move. *Science* Editor Ellis Rubinstein meets President Clinton in the Oval Office.

CREDIT: RICK KOZAK

What emerged confirms a portrait many people have painted of Bill Clinton: a polymath who rarely resorts to the platitudes we have come to expect from politicians—especially on the topic of science. Perhaps it should come as no surprise that the man many thought was entirely ignorant of—and uninterested in—science when he entered the White House should leave the nation's capital with a rich and nuanced view of many

of the most important issues facing the scientific community.

The following is a transcript, edited for brevity and clarity, of a conversation between President Clinton and *Science* Editor Ellis Rubinstein.

***Science*:** Mr. President, how do you feel about the impact of science on society nowadays—on individuals and on government? Do you feel it is substantially greater than it was in your youth?

The President: Well, at a minimum, we are much more aware of the impact of science on our daily lives. Take the space program. If you go back and look at the rhetoric of President Kennedy, we had to get into space, and we didn't want the Russians to beat us. And then you look at the rhetoric around what we're saying about the space station today. We've got 16 nations working together, because it will give us some sense about what's happening to the environment on Earth, how to handle climate change, for example. Moreover, in a gravity-free environment one can address all kinds of biological issues—how proteins form, what happens to tissues, all these kinds of things. And a gravity-free environment will help us resolve remaining questions in materials science, an area that has been so pivotal to our growth in productivity and to our economic strength.

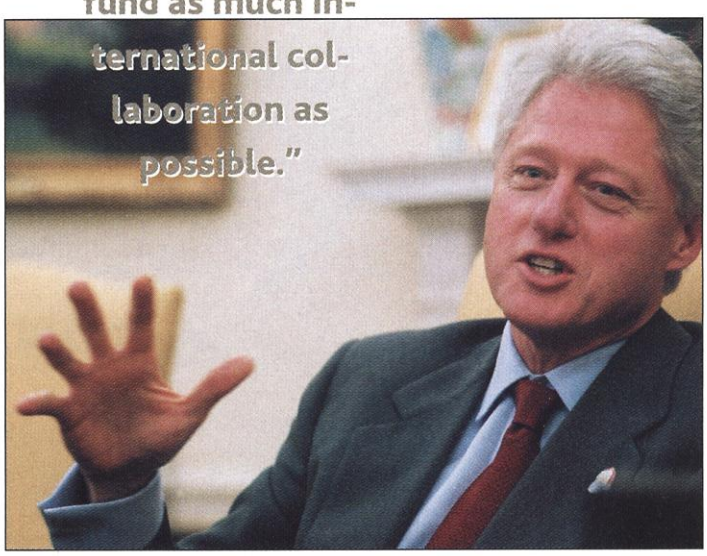
And, of course, most people didn't know there was any such thing as a human genome. Most people still don't know what nanotechnology is. But if you combine the sequencing of the human genome and the capacity to identify genetic variations that lead to various kinds of cancers with the potential of nanotechnology, it staggers the imagination. For example, assuming you have the right screening technologies, you're identifying cancers when there are only a few cells coagulated together in this mutinous way. This could raise the prospect of having a 100% cure and prevention rate for every kind of cancer, which is something that would have been just unimaginable before.

I could give you lots of other examples. Take climate change—the prospect that the sugarcane fields in Louisiana or the Florida Everglades could flood, or that agriculture could move north. And the globalization of society has made us more vulnerable to each other's epidemics and viruses. Science has become essential—indispensable—to dealing with national security. Consider the possibilities of bioterrorism, chemical warfare, and cyberterrorism!

So, for each of those reasons, I think the language of science—and the necessity of understanding at least the basic concepts of science—will become a much more pervasive part of the average citizen's life in the next 20 to 30 years than it ever has been.

***Science*:** During your first term, some people thought you weren't that familiar with scientific issues, maybe even uncomfortable with them. But at the "Informatics Meets Genomics" dinner that the First Lady organized, you were obviously enthusiastically involved in the discussion. And you gave a very good talk earlier this year at the American Association for the Advancement of Science [publisher of *Science*] on the genetic privacy rights of federal employees. Has there been a change in your own relationship to science?

"I would advise my successor to fund as much international collaboration as possible."



The President: I've always been interested in science issues. But I didn't have a lot of time to be consumed with them, except the one or two areas where Arkansas universities were doing important research when I was governor. One of the reasons that I asked Al Gore to be my vice president is that he's devoted so much more of his life to studying scientific issues and understanding them. And one of the reasons I thought—and still think—he would be a good president is that he does understand those things, and he cares about them.

But what happened is, after I got here, I began to try to imagine what our responsibilities in basic research ought to be, and how I might make a stronger case to Congress. Are we going to save the space program or not? What are the national security issues of the 21st century, and how much will science play a role in them? For example, we were all shocked at that sarin gas attack in the Tokyo subway. And then, of course, I had to deal with these global problems: the fact that one-quarter of all the people who die in the world today die from AIDS, TB, and malaria. What are the implications of the breakdown of public health systems all over the world?

So, the more I learned, the more I saw these things related one to the other, and the more I began to study and read so I could get myself comfortable with what I thought my responsibilities were.

***Science*:** How would you assess your record with regard to science?

The President: Well, I think we did do a great deal of good with basic research. There was enormous support in the Congress, among the Republicans as well as the Democrats, for more funding for the National Institutes of Health [NIH] and all related health research. I think there were some politics in that, because it's easier to sell that to voters back home because we all want to live forever. But I think a lot of it was genuine. I think the commitment of men like John Porter, the retiring Republican congressman from Illinois, was deep and genuine.

But our Administration kept fighting for overall increases. We got the biggest increase in history for the National Science Foundation this year. So, I think we got research back on the national agenda, and big. And, you know, we had some unlikely allies. Newt Gingrich, even after he left the Congress, has continued to speak out for it [*Science*, 17 November, p. 1303]. So I think that was quite important.

***Science*:** What are some of the particular areas that deserved funding increases?

The President: I think that research and funding for the climate change–related areas and the development of alternative energy sources and energy conservation technologies are profoundly important. We have to be able to create wealth with smaller and smaller amounts of greenhouse gas emissions. If India and China grow wealthy the same way we did—and they will not give up the right to become wealthy—we're not going to whip this climate change problem. So I think that's important.

The other new area that I'm glad we con-

CREDIT: RICK KOZAK

tinue to support is the sequencing of the genome and all of the genome research. We identified a couple of the genetic variants that lead to breast cancer and other conditions. And I think that 10, 20 years from now, the work we've done in nanotechnology will look very big. I think that the potential of this is just breathtaking.

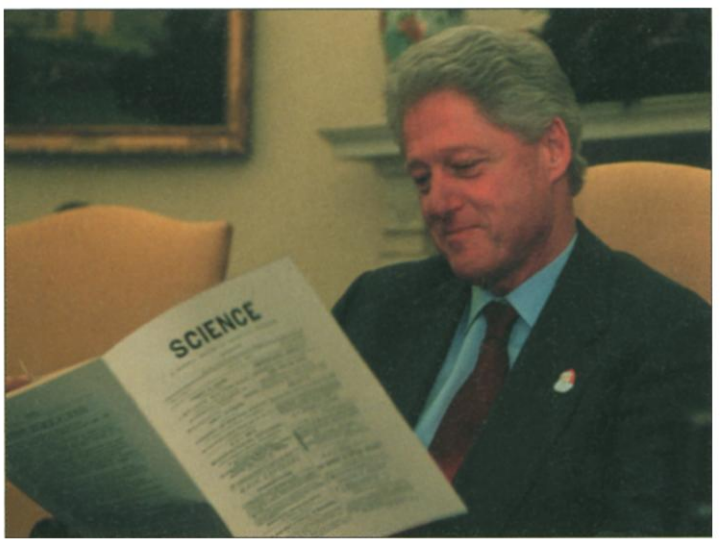
***Science*:** You began this discussion by expressing great enthusiasm for U.S. initiatives in space. Why, then, does NASA continue to get sort of a flat budget?

The President: Well, first of all, I think that NASA, when I took office, needed to show that it knew how to economize and could be managed better. I think NASA Administrator Dan Goldin has done that. I think NASA has proved that it can do more with less.

***Science*:** But NASA has also had some disasters.

The President: They've had some disasters, but look, they're out there fooling around with Mars. You're going to have some disasters. You know, if you want something with a 100% success rate, you've got to be involved in something aside from space exploration. I think the important thing is that, from my point of view, NASA people responded in an honest, upfront way to their difficulties with the two Mars probes that didn't work so well—the lander mission and the climate orbiter.

So I would like to see their budget increase now, because I think they have proved, after years and years of flat budgets, that they have squeezed a lot of blood out of this turnip.



A good read. Clinton, holding the first issue of *Science*, says he has tried to keep up with scientific developments while in office.

***Science*:** A second area where physical science and math have lost support in your Administration is Defense Department research, which has been cut by 40%, despite the fact that the DOD used to support a lot of our research infrastructure—math and Internet development, for example. Some people wonder how you could have permitted this.

The President: First of all, I think a lot of the research is going to have dual benefits running back the other way. For many years, defense research had a lot of nondefense implications. I think a lot of the civilian research is going to have a lot of defense implications now, because if you think about the kinds of restructuring that the Defense Department is going to have to do, an enormous amount of it will have to do with information technology and weapon systems and troop deployments and intelligence-gathering. And I also think that a lot of what they will have to do in the fields of chemical and biological warfare will be driven in no small measure by nondefense research.

Now, I think the Defense Department, frankly, had to make some very tough calls. In this last election, the vice president said that he would put some more money back into the defense budget, and we began to turn the defense budget around a couple of years ago because we thought we had basically reached the limits of the post–Cold War peace dividend. So I think that's something the next Administration will have to look at. We had limited dollars, and we tried to put it into quality of life, into training, into the basic things that would make the force available to meet the challenges of the moment. And maybe, you know, it does need some more money.

***Science*:** Perhaps we can turn to international matters. Many have noted that while the United States is admired for its power and success, it is increasingly resented. What advice would you give your successor about how science might be used internationally to try to deal with the kinds of feelings that our European and Asian allies might have?

The President: I think I would advise my successor to fund as much international collaboration as possible. For example, the work that we did through the NIH with the Human Genome Project involved several other countries. And when we announced the sequencing, we not only invited the U.S.'s J. Craig Venter to the White House, but we held the press conference jointly with British Prime Minister Tony Blair, and with the ambassadors of the other countries involved in the project.

To give you another example that I think is profoundly important and somewhat controversial, the 16-nation collaboration developing the international space station has been very, very important. I've spent a lot of time, as you know, on this space station, and I've observed what the Canadians have done and what the Japanese contribution is. And the Russians got criticized for not being able to come up with their contribution, but the price of oil collapsed, and they were killed by this horrible financial crisis. And now I think they're getting back on their feet, and I think they'll pay their way.

When I took office, there weren't all that many people who resented us, because they thought our economy was a basket case. Then, when we had a great deal of success, we bent over backward not to lord it over anybody. But we did have some inevitable conflicts—our desire to end the ethnic cleansing in Bosnia and Kosovo, things of that kind. We were criticized when we acted on this, and we were criticized when we didn't go in quickly enough in Rwanda. Now, part of this is inevitable. But I think we do have to try to wear our power lightly, and also with some humility, because there's always a chance we could be wrong, number one, and number two, nothing lasts forever.

***Science*:** Are you aware of the brain drain that the rest of the world is experiencing?

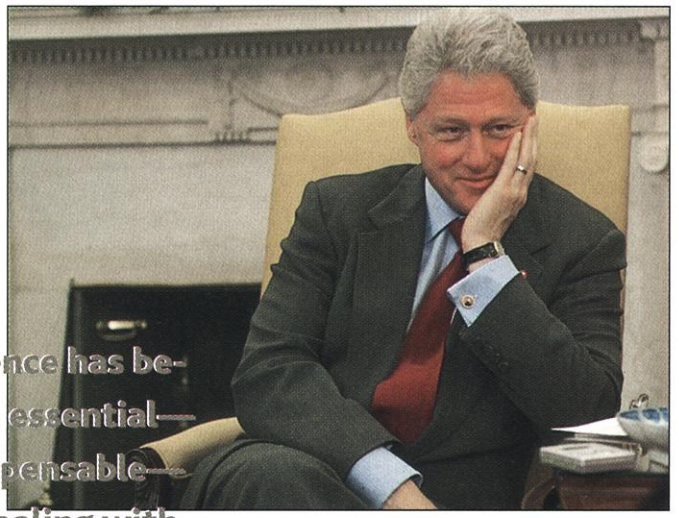
The President: There might be a way for my successor to institutionalize a little offset there. I do worry about this. Just take the information technology area. There are 700 companies today, in Silicon Valley, that are headed by Indians—700! It is just stunning. Now a lot of the Indians are also active back home. But I think there needs to be a way for us to try to share both the scientific and the economic benefits of our enormous infrastructure with the rest of the world. I'd like to see America used, in that sense, as sort of a global lab, with the ability to send our folks back out, and to send their people who come here back out, and to finance educational and research exchanges and even operational exchanges.

***Science*:** When national leaders get together, is science discussed?

The President: Yes. I talk to Tony Blair about such issues a lot. And, of course, we're dealing with them in more contentious areas, too. Within Europe, there's mad cow disease.

CREDIT: RICK KOZAK

What do they do about genetically modified organisms? How do you balance political pressures with scientific reality? How do you define scientific reality? Does the European Union need the equivalent of the Food and Drug Administration?



"Science has become essential—indispensable—to dealing with national security."

***Science*:** Let's pursue science literacy. I know you and Mrs. Clinton have been very interested in education. I don't know to what degree you're familiar with the state of science education and if you have some feelings about this. The latest report just came out about U.S. schoolchildren in math and science [*Science*, 8 December, p. 1866]. The 8th graders ranked in the middle of 38 countries in both subjects. So, I was wondering about your thoughts on the status of science education in particular.

The President: Well, I think there are basically two issues. One is, in a country as big and diverse as ours, how do you get more kids to take math and science courses at more advanced levels? And secondly, if you could do that, how would you have enough qualified teachers to do it?

I noticed that California passed a really sweeping initiative last year to try to give bonuses to people who will enroll as teachers. I think that, in the future, there will be more alternative certification mechanisms, and people will be paid more.

I also think that, at the advanced levels of science and math, a lot of high school systems are operating the way colleges do now—bringing people in to teach one course.

We are going to have a critical mass of people out there in America who know the things that all of our kids now need to know, but virtually 100% of them are making a lot more money than they can make teaching school.

A friend's daughter made $30 to $40 million in her late 20s or early 30s in a software enterprise. She's now just cashed out and spends all of her time teaching inner-city schools. But you're either going to have to find tons of people like that, or you're going to have to find ways to finance the education of young people to do this work for 4 or 5 years. Or you're going to have to have—in the junior and senior high schools—people who have this knowledge and yet who come in and teach a single course, just like someone who comes into a college classroom and teaches one course.

***Science*:** In your speech last January at Caltech, you referred to releasing "your inner nerd." Do you think you'll do anything related to science after you leave office?

The President: Oh, I certainly hope so. I'm very interested in continuing to work in the climate-change area in particular, and doing what I can to convince the political systems of other countries that they have to participate in this and that there are economically beneficial ways to do the right thing for the global environment. And in order to do that, we have to continue basic research into alternative fuels and alternative technologies. There is no way to solve this over the long run unless we can get more growth out of fewer greenhouse gases.

The other thing that I'm particularly personally interested in is the breakdown of public health systems in so many countries, and how it disables them from dealing with things like the AIDS epidemic and other problems. So I expect those are two areas that I'll be involved in for a long time to come.

A fuller version of this interview is available online, at www.sciencemag.org/cgi/content/full/290/5500/2236.

CREDIT: RICK KOZAK

MEETING GEOLOGICAL SOCIETY OF AMERICA

Geologists Pursue Solar System's Oldest Relics

RENO, NEVADA—Last month, the Geological Society of America held their annual meeting here. Offerings included claims for the oldest known examples in a class: the oldest scrap of ocean crust, the oldest sample of Earth, and the oldest trace of life—which happens to come from Mars.

Oldest Bit of Earth Hints at an Ocean

It's not much to look at, this quarter-of-a-millimeter speck of zirconium silicate. But according to extraordinarily sensitive microprobe analyses, it is the oldest bit of Earth known. The zircon's mere existence shows that the planet was separating out lighter continental crust at its surface 4.4 billion years ago, just 100 million years after Earth had formed—when it was barely a toddler, in human terms. More surprising, its isotopic composition implies that liquid water—perhaps an ocean of it—was around shortly after a planetary rime of rock had solidified and while huge rocks were pummeling Earth, regularly vaporizing both water and rock.

At the meeting, isotope geochemists William Peck, now at Colgate University, John Valley of the University of Wisconsin, Madison, and their colleagues presented their analyses of the new zircon they found among many younger ones in a sample from the Jack Hills of Western Australia. Others had discovered the previous record holder, a 4.2-billion-year-old zircon, in the same sample. "It's just a fantastic find," says geochemist Allan Treiman of the Lunar and Planetary Institute in Houston. "It pushes back the ages of continents and oceans on Earth. At least intermittently, Earth seems to have been a fairly familiar place that now and again gets hammered."

The find was made possible by the zircon's tenacity and by exquisite analytical sensitivity. Zircons form in abundance in silica-rich crustal rocks such as granite, and their durable structure lets them easily outlive granite's other minerals while preserving their original chemical and isotopic composition. The oldest granite known—much altered over the years—is just 4.0 billion years old. The zircons in the Jack Hills sample—a conglomeration of