rologist George Reid of the National Oceanic and Atmospheric Administration in Boulder, who published a similar but less striking correlation in 1987 using sunspot number as a proxy, knows the story: "You can show these correlations endlessly and people either believe them or they don't."

Politics may predispose a few people to welcome the new findings, and that possibility worries many researchers. "The discouraging thing about this," says Eddy, "is that it resurrects the ghost of the Marshall Institute report." That document, which was highly regarded in the White House, cited disputed evidence that the sun's variations over decades or centuries have affected climate. It predicted that a fading of the sun in the next century might largely counteract any greenhouse warming (*Science*, 24 November 1989, p. 992).

Scientists' response was overwhelmingly negative when the Marshall report came out, and the new sun-climate correlation isn't changing anything. For one thing, the Danish result says nothing about what the sun will do in the future; the Marshall report's premise that it will dim remains as dubious as ever, Eddy emphasizes. And no matter what the sun does, says climate modeler James Hansen of NASA's Goddard Institute for Space Studies in New York City, the doubling of greenhouse gases that seems inevitable in the next century will overwhelm any effect solar variations might have. Real or not, the sun-climate connection won't resolve the greenhouse dilemma. ■ RICHARD A. KERR

GE Achieves Dial-an-Isotope Diamonds

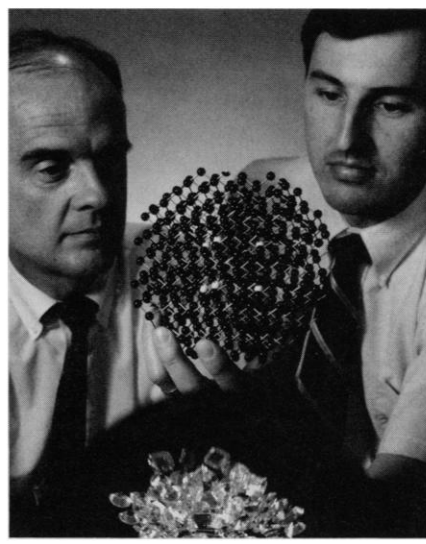
Last year, the General Electric Co. rented out the 21 Club in New York City to announce loudly that it had made synthetic diamonds that seemed better than perfect (*Science*, 6 July 1990, p. 28). The new specimens tantalized engineers with their ability to conduct heat at least 50% more efficiently and resist laser damage ten times better than any other diamond, natural or synthetic. The reason: the superdiamonds had but one carbon-13 atom for every 1000 carbon-12 atoms. The ratio in natural diamonds is about one in 100, and those extra carbon-13 atoms apparently prevent the stones from conducting heat as well as they might while making them more vulnerable to high-power lasers.

Still flushed with their success in making C-12 enriched diamonds, the same researchers have now turned the isotopic cards around, bumping up the carbon-13-to-12 ratio. Out come materials with more atoms per given volume than any other in the world.

The secret behind all these crystalline successes is isotopic control. The GE group now can make every kind of gem-quality diamond from the nearly pure C-12 variety to the nearly pure C-13. And the payoff is more than intriguing new properties, they say. "We now have a way to use diamond as a vehicle to study fundamental physics" in materials as their isotopic composition varies systematically, says William F. Banholzer, who led the effort with Thomas R. Anthony.

Take the distances between diamond's carbon atoms, which theorists had argued—based on quantum mechanical calculations and previous observations in other crystals—should decrease slightly with increasing carbon-13 abundance. In the 1 October *Physical Review B*, Banholzer and his GE colleagues, together with collaborators at the Ford Motor Company, report the first experimental confirmation of this isotope effect for diamond. As a diamond's composition changes from nearly all C-12 to all C-13, its atoms get about .015% closer together, according to x-ray measurements done at Ford. As a consequence, the C-13 diamonds contain slightly more atoms in a given volume than any known solid, Banholzer says. The researchers raise the possibility that the world-record atomic density of C-13 diamond will translate into increased hardness or some other physical improvement, though that remains to be seen.

The key to making these isotopically adjustable diamonds is to mix separate sources of carbon in the form of methane gas that has been enriched in either C-12 or C-13 by a supplier. The researchers then apply chemical vapor deposition (CVD) methods to deposit the chosen mixture of isotopes as thin mosaics of tiny diamond grains. These serve as feed stock for a hellish synthetic gem-making process, developed during the late 1960s by other GE scientists, that involves a 1000-ton press, 1500°C of heat, and as long as a week. In this slow and expensive heat-and-press treatment, the diamond "nutrient" dissolves into an underlying slug of molten metal, and then diffuses downward toward a tiny diamond seed at the bottom of the liquid metal, where the temperature is slightly lower than at the top. Since carbon is less soluble in cooler metal, it readily deposits onto the solid diamond seed, yielding gem-quality diamonds.



GE RESEARCH & DEVELOPMENT CENTER

Designer diamonds. *Anthony* (left) *and Banholzer make diamonds with isotopic ratios not found in nature.*

With its cost and slowness, the method isn't likely to become a practical way of making the super-premium diamonds, even if—like the C-12 diamonds—the high C-13 gems turn out to have technological advantages. But John Angus, a leader in CVD diamond research at Case Western Reserve University, thinks an alternative route for growing the gem-sized diamonds might develop from the vapor deposition methods now used for growing diamond films.

Even if he's wrong and no one comes up with a practical alternative for producing these aristocrats of stones, the GE group's achievement is bound to get more attention than Herb Strong's C-13-rich diamond, which glittered unnoticed 20 years ago. Strong is a retired member of the GE quartet that first made small synthetic diamonds in 1954. Back in 1971, he and his co-workers fed their high-pressure apparatus with an exotic starting material. "I got carbon-13 graphite from the Oak Ridge National Laboratory," Strong told *Science*. Out popped the world's first C-13 enriched diamond. Though Strong says he recorded the feat in his notebook, the team never published the result or studied their creation—they did it just for fun. That unique diamond ended up embellishing an award presented to Robert Wentorf—another member of the original GE quartet—for achievements as a glider pilot. ■ IVAN AMATO