

MOVING TO RICHLAND—II

WHEN the firm of Homer

Laughlin China, of Newell, West Virginia, introduced its Fiesta line, in 1936, the company's designers were not concerned with the hazards of radioactive glaze; they simply liked the brilliant red-orange that uranium produced. Fiesta was meant to appeal to modern taste, with bright, solid colors over stream-

lined forms. Homer Laughlin initially offered the pattern in blue, green, yellow, and ivory, but Fiesta Red was the focal point of the line, the favorite of designers and customers alike. Mango Red—as it was later known—always sold better than its companion colors, even though the difficulties of working with uranium or any red glaze added about twenty-five per cent to the cost.

The pigmenting properties of uranium were no new discovery. Once upon a time, Apaches and Comanches on the Colorado Plateau used to grind up carnotite, a uranium-bearing ore, to color their war paint. As early as the first century A.D., Roman artisans mixed uranium salts with sand to produce a yellowish-green glass for mosaic tesserae. Glass manufacturers in the early part of this century again used uranium, to create the fluorescent chartreuse of "canary" or "vaseline" glass. More than a hundred years before Fiesta, potters had learned that sodium uranate in ceramic glaze could yield yellow, orange, or black. In fact, before the development of the atomic bomb the only proven use for uranium was in the decorative arts.

In early 1986, fifty years after the introduction of Fiesta, Mango Red caught the eye of James L. Acord, Jr., a Seattle artist who designs and builds nuclear sculpture. Unlike the design-



ers at Homer Laughlin China, Acord was not particularly drawn to the color, although he liked it well enough. What really attracted him was the uranium content of the glaze. He had just finished carving the granite portion of a sculpture entitled "Monstrance for a Grey Horse," and he needed uranium to complete his plan for the piece. In this single work he wanted to demonstrate the integral relationship of stone and metal, reestablish the ancient link between art and advanced technology, and prove that sculpture could offer tangible solutions to the problems of society. Uranium, the most prominent of the trace elements contained in granite, suited each of these purposes perfectly. Thus far, however, Acord had had no luck in his efforts to obtain used nuclear warheads or spent reactor fuel. In some respects, the original Mango Red suited Acord's purposes almost better than spent fuel. According to gamma scans, the pre-Second World War orange glaze contains whole uranium, with all its isotopes present in their natural proportions. Then, in 1943, the United States government diverted all available uranium to military purposes; as the company put it, "Fiesta Red went to war." Material that would otherwise have gone to color cups and saucers orange went instead to fuel the Manhattan Project, Fat Man, and Little Boy. When Homer

Laughlin finally reintroduced Mango Red, in 1959, it looked the same, but the uranium in the glaze was now depleted, largely stripped of its U-235.

By the mid-nineteen-seventies, the Food and Drug Administration had grown sufficiently concerned about radioactivity in consumer products to sponsor a study on the possible dangers of uranium-

glazed ceramics. Tests revealed that the radiation coming off a plate dissipated within inches of the surface; the greatest potential hazard therefore came from direct contact with the glaze. In the absence of clinical studies, researchers used their radiological data to project the effects of long-term exposure. They posited the existence of a restaurant that used uranium tableware exclusively, and then calculated that a dishwasher in this establishment, working a full year of forty-hour weeks (with a two-week vacation), would receive an annual dose of 34.4 millirem, well under the maximum dose acceptable for the general public. The report, published in 1978, concluded that exposure to uranium glaze was not a serious hazard but one to be avoided nonetheless. The test results suggested that it would be inadvisable to use radioactive ceramics for storing sauerkraut and other acidic foods that might leach the glaze.

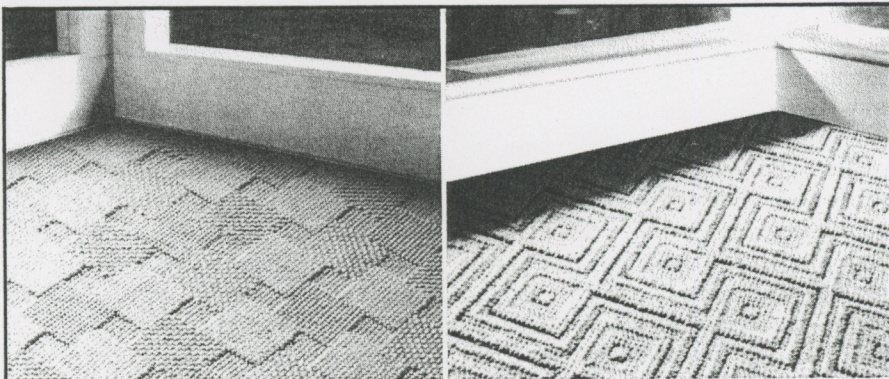
Homer Laughlin China eliminated Mango Red in 1972, and dropped the line entirely in 1973. (Fiesta was reintroduced in 1986, on the occasion of its fiftieth anniversary, but the favorite red was not restored.) The F.D.A. report noted with some alarm, however, that radioactive tableware was readily available in antique stores. ("Clearly, the problem is still with us today!") Indeed, no sooner had Fiesta

gone out of production than it became a collectible, and old sets began to emerge from attics and basements around the country. Interest was strong enough to inspire a history, "The Story of Fiesta," as well as six editions of "The Collectors Encyclopedia of Fiesta."

Fiesta aficionados were aware of the radioactivity of Mango Red. The editors of "The Collectors Encyclopedia" had commissioned their own radiological analysis to determine the safety of the glaze. According to their interpretation of this study, a person holding a "chop plate strapped to his chest for twenty-four hours" would receive the same exposure—twenty milliroentgens—as a radiation worker on an eight-hour shift. The encyclopedia repeated F.D.A. warnings about sauerkraut, but concluded, "Unless you've noticed your grandmother's nose glowing—we're all quite safe!"

The notoriety of Mango Red may have actually increased its value; certainly, every nuclear worker I talked to owned at least one piece. In any case, the resurgent market in Depression ware had a dramatic effect on Fiesta prices. Back in 1936, a service for eight—sixty-seven pieces, including something called a "nappy"—sold for twenty dollars; a companion set of flatware and glassware, including ashtrays and color-coordinated swizzle sticks, went for \$14.95. These days, a boutique might ask more for a single platter than Homer Laughlin charged for the complete service. But every consignment of pottery has a few cracked and broken pieces, and Acord persuaded several dealers to save the Fiesta scraps for him. He started stockpiling Fiesta shards at ten cents a pound.

At first, Acord planned to do nothing more than break up the plates, to make them fit more compactly in the core of his sculpture. But the process was crude and the results unappealing: there was too much earthenware in the mix. He then began to devise techniques to separate the glaze from the plates, and the uranium from the glaze. He pulverized shards in an alchemist's mortar, and then sluiced out the pottery dust with a water-flotation technique: immersed in water, the heavy particles of uranium sank to the bottom of a container, while the clay and silt remained in suspension, to be carried away in the flow. In other words, Acord panned for uranium. "I had the



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best luck with plastic salad containers from 7-Eleven," he told me. "Those corrugated ridges on the bottom of the tray were great for catching the glaze. The only trouble was, I hated salad."

To hold down the dust, Acord rigged up a rudimentary glove box—a clear-plastic tent with holes for his hands—and a dedicated vacuum cleaner to provide filtration. For further protection, he put on goggles and a bunny suit—the sanitary white overalls worn by nuclear workers. In time, he added a gas mask, but he started out using a stone carver's dust mask he had acquired while working as a granite carver in the monument industry in Barre, Vermont. "I was coming from the stone age into the nuclear age, so what did I know?" he says. "As is so often the case, I was into the ritual and the visual effects long before I had any understanding of what I was doing. At first, it was kind of a cargo-cult nuclear thing."

By the spring of 1987, Acord had reduced several table settings of dinnerware to a film-cannisterful of orange sand. He had documented the project with photographs and written logs, and now he wanted a detailed radiological analysis for his records. The Washington State Department of Social and Health Services' Office of Radiation Control, in downtown Seattle, was said to offer free gamma scans, so Acord made an appointment to take in a sample of Fiesta, a small chunk of granite, and some slides of his work. He hoped that by demonstrating his exacting standards and responsible procedures he might get permission to work with other nuclear materials. The officials listened politely to his presentation and then took a spot check of his samples with a Geiger counter. When the Fiesta glaze sent the needle off the top of the scale, they packed up the sample and told him to call back in a few days.

A week later, Acord met with Susan May, the nuclear-response officer in the Office of Radiation Control. Ms. May told him that her agency no longer accepted "walk-ins," so he would have to get his analysis done elsewhere. His Fiesta sample could not be returned, however, and before he processed any more uranium glaze she thought he ought to be aware of a few things. Ms. May then brought out the "Radiation Protection" volume of the

Washington State "Statutes and Rules, Including Fees" and drew Acord's attention to Chapters 402-19, 402-21, and 402-70 of the Washington Administrative Code, where the relevant regulations had been checked and underlined. She pointed out that possession of exempt material was limited to fifteen pounds at any one time and a total of a hundred and fifty pounds in a calendar year. Acord admitted to owning rather more Fiesta ware than that. If he divested himself of the excess, she said, he could continue working with Fiesta, under certain conditions. He would have to wear a personal dosimeter and file quarterly reports on his exposure to radiation. He would be allowed to break the plates into pieces, but if he chipped them or otherwise attempted to separate the glaze from the ceramic base, his action could be construed as mining and milling of radioactive source material, and that required a special license. The one-time application fee was \$27,000. The other fees—for licensing (\$165,000), inspection (\$90,000), and miscellaneous charges (\$10,885)—were all payable on an annual basis. "I always knew that sculpture was the most capital intensive of the arts," Acord commented later. "But that was a little beyond my means. I told her I'd have to think about that, and she just looked at me as if to say, 'Think all you like, you know, but there's nothing you can do about it.'"

"IS Fiesta ware really dangerous?" I asked Nancy Kirner one day over lunch at a Mexican restaurant in Bellevue, across Lake Washington from Seattle.

"Well, let me put it this way." She looked down at her burrito and smiled. "I'm glad this plate isn't orange. Yeah, you can get into trouble, if you—you know—live on top of a Fiesta-ware

plate. But still it's relatively safe. Normal people don't do that."

Mrs. Kirner, a health physicist, had been director of the Washington State Office of Radiation Control when Acord began his search for nuclear material, and it was she, in fact, who had steered him toward the use of Fiesta. She continued to advise him even after she left the state regulatory agency to work for EnviroSphere, a consulting company specializing in environmental engineering. In gratitude, Acord had given her a drawing of "Reliquary for Two Hands," another work in progress, which used granite and stainless steel to contain Fiesta ware. She accepted the drawing and hung it in her office, but she always identified it as a "long-term permanent loan," in order to disavow ownership. Her employer, it seemed, was sensitive about the legal and public-relations implications of any formal connection with Acord. Still, when we spoke on the phone she had sounded very willing to talk about Acord and his work.

Mrs. Kirner was often away on site visits, but we were able to arrange our lunch meeting for the day after she returned from a business trip, and the day before she was to leave on a three-hundred-mile bicycle trip with her husband and children. When I finally met her, I could understand why she had described the expedition as her ideal vacation. Her well-trimmed red-blond hair and simple linen suit suggested both physical fitness and businesslike efficiency, but the brisk look was softened by her bright eyes and warm smile. It was easy to imagine her leading the family through the entire journey without a stiff muscle or a whimper from the kids.

"You wouldn't say Acord's work is normal, I guess," I said, "but how hazardous could it be?"

Silence. Acord had warned me that Mrs. Kirner considers her answers carefully before she opens her mouth; she told him once that she always tried to envision how her remarks might look as a headline in the *Olympian*, a newspaper in the state capital. Finally, she said, "You know, in radiation protection there are three tenets that underlie all good programs. First, is this exposure necessary? And, second, if it's necessary, can it be done within safe limits? And, third, if it's necessary and can be done within safe limits—



well, can we further reduce the exposure to levels that are as low as is reasonably achievable? Within the framework of those three tenets, then, you keep bumping into the first one: Is this exposure really necessary? Is there any benefit? At first, I couldn't see any in Jim's work. I thought that it was a very odd and very frivolous use of radiation."

"But now you've changed your mind?"

Mrs. Kirner gave no immediate indication that she had heard my question. She took a bite of burrito, chewed slowly, and swallowed. Then she took a sip of water. Then she said, "See, I was raised Catholic. And so Jim's images of the reliquary and the monastic, the greater symbolic nature of spirituality—it really struck a chord with me, because I also feel as though you had to put something greater than just man's health and safety into a repository. It's got to operate in more than one dimension. You need some great symbol in order for man to keep the material safe into the future ages. I know, I might be strange in my endorsement of it—and on a technical level I just cannot agree with his wanting to put radioactive waste into his statues—but it does appear to be a legitimate use of his art to lend a spiritual context to radioactive-waste repositories." Mrs. Kirner's face colored slightly. "You know, I think of the monasteries and the monks, and the Bible as it was cherished through the Middle Ages. It was like a cult passed from generation to generation to keep the word alive. And if Jim's art can convey an urgency to be respectful of this material, then he has made a great contribution."

"If you felt that way, couldn't you have influenced the decision of the state?"

"The strong reaction from the state came after I left Radiation Control. So if you want to know about that I'm afraid you're going to have to ask Terry Frazee."

I HAD already made an appointment with Terry Frazee, Mrs. Kirner's successor at the Department of Social and Health Services, and the next day I drove down to talk to him at the radioactive-materials section, in Airdustrial Park, near Olympia. There was no receptionist at the door and, in fact, no one at all in the long corridors

of clerical cubicles which spread out on either side of the entrance. The regulators were out to lunch. I called out tentatively, reluctant to break the silence. "Be right with you," a voice answered from an office at the far end of the hall. Moments later, a man ambled out and introduced himself as Terry Frazee. Still slim and boyish in his early forties, he had sandy hair flopping down over his forehead and a thick mustache above an off-center grin. Dressed in running shoes, chinos, and a pastel-striped polo jersey, he appeared to be anything but the stuffed shirt I had expected to meet.

On the way back to his office, Frazee stopped to show me a glass display case, his curiosity cabinet of low-level radiation. I could recognize decorative items of vaseline glass and Fiesta ware and a couple of recent pieces of Chinese cloisonné with the familiar orange color. Frazee pointed out various practical items such as an americium-cell smoke detector, a tritium-powered exit sign from a commercial airliner, an assortment of X-ray tubes containing cobalt. Perched on top of the cabinet were three Revigators, patented stoneware jugs that had once been primed with tiny amounts of radium, to infuse radon gas into drinking water. In a more optimistic era of health consciousness and nuclear awareness, just seventy years ago, the jugs were thought to produce the elixir of life. Down in a corner of the cabinet were a small Indian basket and a stack of coffee filters. "I have no idea what those are doing there," Terry said. "I guess someone just needed a place to put them."

"But all the others pose a threat to the environment?" I asked.

"Well, the ultimate hazard varies. I like to use a spectrum as an analogy, because it ranges everywhere from naturally occurring materials that are in relatively low concentrations or low quantities all the way up through really high concentrations of what's called unnatural material—that is, man-made. And in between that there's all levels of hazard. Now, some radiation has very weak energy. The tritium we were just talking about is stopped by the glass tube that surrounds the phosphor in the exit markers. I wouldn't call that a serious hazard. And tritium is an isotope of hydrogen, so if you break open that tube it'll exchange with any other hydrogen. I mean, very

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rapidly it just goes everywhere, and it's gone. In fact, in the human body you have lots of tritium anyway, because it's a natural by-product of cosmic radiation. Tritium, carbon 14, potassium 40, and a few others are being continuously produced in the upper atmosphere, so they're all over the place. There's nothing you can do about that."

Frazer had talked us into his office. He motioned to me to sit down and dropped into his own chair.

"And then, probably the high end of the spectrum," Frazer went on, "has to be the nuclear industry—the weapons industry and the nuclear-power industry as a spinoff from that. And associated with both of those are some rather high-level waste problems, waste being something that's going to stay with you the rest of—Well, there's a big potential, but by and large, day to day, millirem here, millirem there,

you get very small exposures to most citizens from the nuclear industry. Under normal operating conditions it's difficult to measure the exposure at the fence line of a reactor, because the levels are very, very low. And, you know, there's a limit to how much we can do away with exposure anyway, because there's usually a benefit of some sort. I mean, weapons or the power that's produced by the reactors—ah, those are desirable things that at least some in our society want to have."

"But materials on the low end of the spectrum, like Fiesta ware, are presumably safer to work with than high-level waste?"

"Safe?" Frazer replied. "Safe is the thing that catches you up, because we know what high exposure to radiation does. In the early days, the standard was, hey, if your skin starts reddening, then you've gone too far. We didn't know that Fiesta ware was a possible problem. We didn't know that it wasn't a good idea to be chugging radium-laden water. As we've gone on, we've got more information from the atomic-bomb survivors and from certain medical studies that were done that, let's say, backfired. Scientists have tracked those people, and then, years later, they've found, oops, hey, there's something else happening here. So now there's a little graph that you can draw.

And we know that if you have x amount of exposure you'll have y effect. And if you have twice that exposure, then you have about—well, round numbers—twice the effect. O.K., so that's at high exposures. At low exposures, it gets to the point where there aren't good scientific studies to validate what happens to the line. So the presumption is that it continues to be linear right down to zero. That means that for something like a cancer if you have a little teeny bit of exposure you have a little teeny bitty risk of devel-



oping a cancer. And it's, like, at that point, you know, *who cares* what the exact number is." Frazer paused and stroked his mustache. "It's like splitting hairs; it's like splitting atoms of split hairs. But if you really get back and look at it from a distance, from the professional point of view, you say 'Big deal.' I mean, we know almost down to a gnat's eyebrow what the risk of radiation exposure is, and when you relate that to the risk of smoking a cigarette, the risk of driving your car, the risk of climbing a mountain—some people just really get off on that—most people are comfortable with those odds." Frazer noticed my rising eyebrows. "O.K., sure, there is definitely harm—hazard—involved with radiation. It's bad. I won't downgrade that. But relative to other things, when you compare it with the rest of the real world, you say, Hey, radiation isn't all *that* bad."

"Then why were you so hard on Acord?"

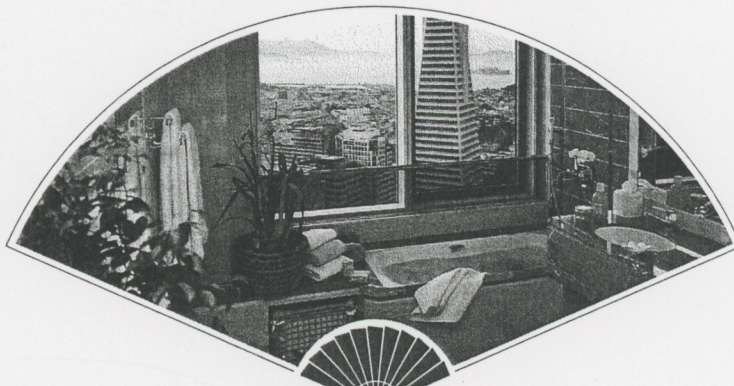
"Well, you know, as we've come to grips with what to do about high exposures in the nuclear industry and medical uses, you start wondering, Wait a minute, how come we're not doing more for the low end or the middle ground? So with Mr. Acord, you know, originally we thought, My gosh, what's he doing? He's out there deliberately doing something with Fiesta ware, which we knew to be radioactive." Frazer gave a sheepish shrug. "We're regulators. Our job is to make sure that nobody's getting more than his fair share, although, frankly, we weren't really worried about it from the practical health standpoint. A lot of our initial concern had more to do with the legality of it, the regulations. Being regulators, you know, we think every-

thing has got to be tied down someplace. So it was like, Whoa! I mean, either he's in a loophole or we're missing something. He doesn't fit into any known category. He's just not there. We consulted with the N.R.C. and they didn't know what to do with him, either, and so we're both madly fumbling through the regulations trying to figure out an out. The people in our Seattle office were getting this message from him that he grinds this stuff up and he processes it and, Oh, God, uranium! Is he a uranium mill? So that was the tie-in. He's doing, apparently, what a uranium mill does, and therefore you pull out the uranium-milling chapter and, I mean, it goes wild with all sorts of requirements. And it came to a fee of two hundred and eighty-five thousand dollars, whatever."

BY this time, Acord was living (as he is today) with Margaret Morrissey, a painter, collagist, and fabric designer who had moved to Seattle in 1983, from Peoria via Oakland and the California College of Arts and Crafts. They seem at first an unlikely couple. Margaret, slim and shy, with wide eyes, a long oval face, and a halo of dark-gold hair, has the look (and, perhaps, the heart) of a Renaissance saint. Her art is light in line, strong in color, and ephemeral in material—the very antithesis of Acord's work. She is also vehemently opposed to nuclear power in any form; she admires Acord's art, but she fears what stands behind it.

They met in early 1986, just before Acord began working with Fiesta ware. Margaret and some friends stopped in late one night at a studio Acord shared with two other sculptors in Fremont, an arts-and-industry neighborhood near the Ship Canal in Seattle. Acord was doing the lettering on a grave marker he had designed, and he had just cracked the stone, a mortifying—and expensive—experience. Nevertheless, Margaret was impressed: "He was cutting names in stone, and I was working as a sign painter, so there was an immediate bond there. We could talk about lettering." They could also talk about birds. Margaret loved to paint them, and she sometimes incorporated feathers into her work. Unlike Acord, who did studies of roadkill and other found corpses, she preferred to draw from life, but when she was

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studying at Humboldt State, in Northern California, she had often sketched stuffed specimens she borrowed from the ornithology collection of the campus museum. In all, she and Acord discovered, they had more in common than it first appeared. They continued to disagree about nuclear art, but Margaret soon became what he calls "my reality check."

"He seemed to take every argument personally," Margaret recalled recently, "but— Well, he was extremely sensitive about a lot of things at that time. He acted as if the whole world were making life difficult for him. Back then, I guess, he had more to prove to the world, and to himself. And maybe that was a way of gearing up psychologically for the battles that he ended up fighting."

The battles came on all fronts, and in the beginning Acord's victories were few. In compliance with state regulations, he divided his stock of Fiesta into fourteen-pound lots, sealed each lot in a plastic garbage bag labelled with radiation-warning stickers, and distributed the bags among his friends; still, he couldn't resist setting up a secret laboratory in one friend's basement, where he continued his experiments with the glaze. Following Susan May's suggestion, he obtained a thermoluminescent dosimeter designed specifically for the high neutron flux of a reactor accident; unfortunately, he stored the badge for weeks in a drawer full of Fiesta, where it absorbed enough radiation to alarm the lab that prepared his quarterly analysis. It took him eight months to send a fifty-gram sample of Fiesta glaze to U.S. Testing, a private laboratory on the Hanford nuclear reservation: the Postal Service and U.P.S. both refused to accept the

package, although it was shielded and double-walled, and the Department of Transportation denied him permission to carry the material overland. The University of Washington finally allowed him to ship the glaze under its radioactive-materials license, but he still had to fill out what amounted to an environmental-impact statement detailing the nature of the contents and the construction of the packaging. His one unmitigated success was a two-week introduction to radiation safety at the university—his first brush with

formal education since he was seventeen. He enjoyed himself so much that he later took a course in Radiation Detection and an Introduction to Nuclear Systems at a branch of Washington State University.

With Nancy Kirner's help, Acord outlined his new safety procedures in long letters to the Office of Radiation Control, the Department of Energy, and the Nuclear Regulatory Commission. In response, Terry Frazee offered a deal: Acord could be licensed as a manufacturer of exempt material for only \$1,320 a year, with the provision that anyone who bought his sculpture would also be required to obtain a license, to transport and install the work. After considering the implications of this plan for future sales and exhibits, Acord turned down the deal and continued to push for complete exemption.

Bureaucrats and health physicists were not the only people who opposed Acord's ideas. A downtown gallery agreed to show "Reliquary for Two Hands," an empty repository for Fiesta, but when customers protested the piece was permanently "rotated" into the storeroom. At an antinuclear exhibit called "Hanfordgate," members of the environmental organization Heart of America Northwest accused Acord of being a tool of the nuclear industry. They grew angrier when he invited five Hanford workers, who had been

picketing the show, to join the discussion. He still professes surprise that "the addition of the word 'nuclear,' even when joined to 'art,' provoked an intensity of debate more akin to medieval theology than to art or science."

Closer to home, the situation was even worse. Acord's fellow-tenants in Fremont got worried when he began to wear his radiation-detection badge around the studio. Their anxiety increased when, shortly after his interview at Radiation Control, a police car started parking across the street from the studio; no one ever connected the surveillance directly to Acord's activities, but it seemed like a bad omen. Finally, the landlord remembered that the Fremont district had declared itself a nuclear-free zone, and Acord was asked to pack up his things and go.

Margaret Morrissey has suggested



that Acord's eviction might have had less to do with nuclear politics than with what she calls "boys' stuff." When I asked her what she meant by that, she said, "Well, stone's pretty macho stuff. It doesn't have to be, but there's sort of a competitiveness of skill. You can hear it in the shoptalk, when they start sparring a little bit. 'How do you do this?' 'Well, how do *you* do this?' You know, boys' stuff."

Peter Bevis, another Fremont sculptor, amplified Margaret's account: "Some of these guys just crash into a piece and call it done, like calf-roping at a rodeo—you just do it and put your hands in the air and that's it. But Jim is so, let's say, meticulous. He's a perfectionist. So there was a very basic difference there in their approaches to technique, and the situation just bubbled and boiled until Jim was asked to leave. Jim felt he got run out of Fremont on a rail, you know, but some people would say he helped lay the track."

Acord admits that both Margaret and Bevis may be right. "I have often been accused of making a fetish of technique—sometimes to my face, with the guy getting red around the collar as he says it. But it's not something I cling to for its own sake. I mean, mastery of technique frees you to create sculpture, and I thought, Well, these guys are sculptors, they ought to know this stuff. So I'd tell 'em. Yeah, I guess you could say I was a pain in the ass in those days, but I've always tried not to be judgmental. After all, sculpture is a large enough plot of ground for us all to be wrong. But still, there are times when I think, Jeez, you know, why am I out here all alone?"

WITH no place to carve granite, no money to cast metal, and no license to work with Fiesta, Acord turned to drawing again, with a vengeance. Without the opportunity (or the burden) of actually executing his designs, he let his imagination explore all the possibilities of his new material. His palette lightened, dominated by bright orange, and his line grew quicker and more fluid. Acord showed me months of ideas one night when he took me through his sketchbooks. I had asked him to explain the design of something called, depending on his mood, the Mark I Studio Reactor or the Fiesta Home Reactor, but a lot more came out.

He opened one pad and started flip-

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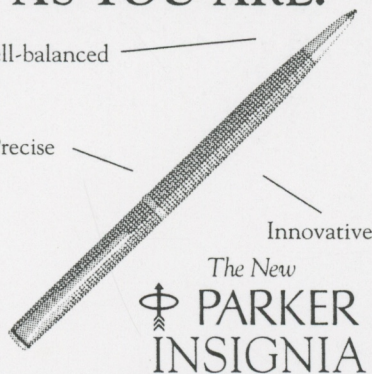
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ping through the pages. "Here's one," he said. "Right. This is a soup spoon with a smoke-detector alpha source to keep your soup warm as you bring it to your lips." He turned the page. "Then, of course, there's radioactive jewelry on a lead blouse. This is almost apocryphal," he said, although he meant apocalyptic; Acord, an autodidact with a hearing problem, is notorious among his acquaintances for his difficulties with spelling and pronunciation. "It's the kind of jewelry people might wear should we fail in carefully using radioactive materials on this planet and cast ourselves back into the darkness. It might then be appropriate for the survivors, if there were any, to keep a certain aura of personal radiation. Individual isotope tags might replace the Social Security number. After all, the world would be a very hot place and we would be evolving at a high rate of speed."

Next page. "For those who are really into the new age, we have here underwear with Fiesta-ware inserts; the woman's, of course, comes with two buttons directly over the ovaries, and the man's comes with a radioactive codpiece. I'd have a series of attractively designed leather straps, perhaps, holding it in place. It depends on what part of town I'm exhibiting it in."

The following drawing showed a triangular wedge of granite, about three feet high and thirteen inches on each side, with a winged titanium golf tee, about four feet long, embedded in the top. "Ah, the Arthead Project," Acord said. "I'm looking for peaceful uses for our ICBM fleet, and these sculptures could replace existing warheads. See, after disarmament many of the rules of the game would remain the same—only the consequences would be greatly reduced. A first strike would be possible with artheads, like a warning shot. Or as a peace offering. Or they could be launched in response to a nuclear disaster, for instance. Just the thing for something like Chernobyl, say. You get the alert, calculate the trajectory, and fire."

The next sketch looked like a tiny fireworks display. "When you reach the target, the nose cone blows apart and the artheads come out like a handful of darts. The parachutes open and

ten artheads float down and form a perfect warning circle at ten thousand metres, one hundred thousand metres—whatever the death-exclusion zone would be. We're talking twenty-eight minutes to any point on the Earth, and an even faster response could be gained by pre-positioning artheads in space. Actually, with trained sculptors standing by around the clock, given two hours' warning you could send whatever message you wanted to send, so maybe this will be a commercial delivery system in the end. And the beauty of it is, is it can all be done with surplus equipment." Acord took a sip of coffee. "Let's see, say we had a thousand MX missiles, ten warheads to a missile. That would be ten thousand of these sculptures—a big job, paying work, you know, with the cost overruns and the kickbacks. This is the one that will put me over the top. In any event, it would make a nice gallery piece until the D.O.D. contract came in."



"This sounds like the beginning of a cultural-industrial complex," I suggested.

"Exactly. Take a look at this." Acord riffled past sketches from a recent working trip to Alaska—detailed studies of salmon heads and welding tools in surreal combination, triptychs of dripping water spiralling off the keel of a drydocked trawler—until he found what he was looking for. "Here it is. The Fiesta X-Ray Laser. This is my own Star Wars project, the Strategic Art Initiative." The drawing showed a stack of Mango Red plates behind an electron gun pointed at a large gilded radar dish. "This puts me in direct competition with Edward Teller, but my design has a significant advantage in that it wouldn't be classified as a nuclear weapon. This is an answer. We can satisfy the extreme right wing, the weapons dealers, the Pentagon—everyone—and still stay within the confines of Kennedy's agreement with Khrushchev, about no nuclear weapons in space."

The reactor studies, five or six in all, finally turned up in a different sketchbook. All the designs called for transparent tanks filled with Fiesta suspended from intricate mechanisms of pulleys and gears. Each one showed

a different combination of pumps, valves, gauges, thick slabs of leaded glass, and elaborate emergency devices. Rube Goldberg meets Enrico Fermi.

On the back of one of the drawings Acord had drafted a brochure with "important sales points for the Patent Atomic Plasma Fiesta Reactor." He lit another cigarette while I read.

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In theory, Acord explained, the thing would actually work. The Fiesta Home Reactor is based on the design of the Canadian Deuterium Uranium Reactor, known as the CANDU, which also uses whole uranium. Instead of enriching the fuel by boosting the percentage of U-235, the CANDU enriches the moderator—the bath in which the fuel rods sit—by replacing plain water with "heavy water." What makes the water "heavy" is deuterium, a naturally occurring isotope of hydrogen with one extra neutron. Exposed to radioactive source material, mostly U-238 in this case, the deuterium releases its extra neutron, causing the chain reaction.

Deuterium exists in all water—in the ocean or out of the tap—in a concentration of about one part per six thousand (0.015 per cent). The percentage can be increased by boiling water in a huge tower, condensing the steam, and cycling the water back to another boiler, in a continuous cascade of distillation. With each run through the system, more H_2O precipitates off, while the heavier isotope remains. Acord points out that this is precisely the principle of the alchemical pelican, a recirculating alembic so named be-

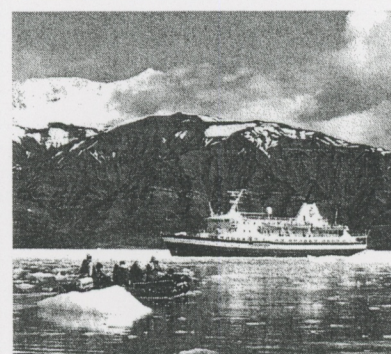
cause its condenser and feeder, leading back to the flask, looked like the head and bill of the bird tucked back in its breast. The Home Reactor will collect deuterium in just this way, using cold-water aquarium pumps in place of two-hundred-foot heated stills.

It would take millions of years for the process to accumulate enough deuterium to begin a reaction. "It's more of a conversation piece, really, but something your great-great-grandchildren could look forward to, perhaps. The thing I'd worry about would be some maniac coming in and dumping a gallon of deuterium, and having it go critical during an opening." Acord sat up a little straighter and cleared his throat. "Safety is important, you know. One of the reasons I hope to be accepted as a licensee by the Nuclear Regulatory Commission is my proven track record of safety, contributing to the general good. In the event that one of my tabletop studio reactors *did* go critical, however, we could mark the affected area with artheads. Slingshot-size."

I asked if one could keep fish in the tank, too.

"You could." He paused to consider the implications. "That would be a sure test for when it went critical: all the fish would be poached and float to the surface. A fish dinner. But that's why I've got these neon lights on top. As soon as the neutron flux hits them, they'll go on—even if they're not plugged in." Acord's eyes lit up at the idea. "Oh, and there's one thing I forgot to put in the drawing. I thought about plumbing it in the bottom so you could tap off a little water into one of those Mr. Coffee machines. When the neutron flux got to the level of criticality, a little valve would open and the water would go through the filter. So you'd have heat, light, and coffee. Which is all any studio needs."

EVEN without studio space, there was one area where Acord could make practical progress on "Monstrance." He wanted the stainless-steel cannisters to be inscribed with warnings, in words and symbols, and to accomplish that he would have to use both electroplating and electrochemical machining, a high-precision acid-etching process. As it happened, these were the last items on a list that Acord had drawn up years before; they would fill in what he called "a straight flush



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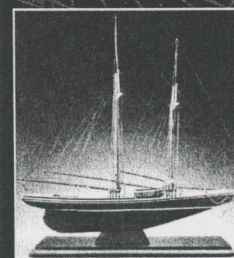
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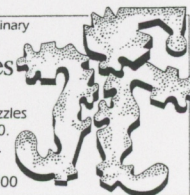
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in a sculpture C.V." From visiting shops and reading up on the procedures, however, he had learned more than he thought he wanted to know. By the time he heard of an opening in a plating shop, he was, for once, reluctant to get hands-on experience. But he went to the job interview anyway. "I'd kind of decided—well, you know, this list was a great idea, but I'm over forty, and electroplating sounds like it sucks," he explained to me. "It pays pretty good, but it's a helluva way to earn a living, I'll tell you that." Copperplating, for example, requires successive immersion in baths of cyanide and sulfuric acid. In combination, these chemicals release the lethal fumes used in gas chambers, and Acord was only mildly reassured to learn that plated parts receive a thorough rinse between baths. Even in the best of circumstances, the chemicals are highly toxic, and in the plating process they are heated to nearly the boiling point and charged with thousands of volts of electricity. "It looked like there were some real heavy-metal effects going on in the nervous systems in that shop," Acord commented. "We might be seeing something close to the alchemical experiments with mercury run awry, I think. Truly. In any event, everybody that worked there was, like, bald and deformed. And, of course, like so many factories, there were these quartz-halogen lights that make people look sort of green. And there I was, they were offering me this job." Needing money as much as experience, he signed on as the shop mechanic.

The work was worse than he had feared. The shop did a lot of cadmium-plating for companies in Japan, largely because the Japanese had outlawed the process, on account of its inherent toxicity and potential pollution. "I suppose the company I work for underbid

South Korea," Acord wrote to me at the time. His letter went on to suggest that the atmosphere at work was as unsavory as it was unhealthy: "One of the fellows took a big 'black-out' hit off his crack pipe sitting in his car in the parking lot at lunchtime (4 A.M. on graveyard). When he passed out, he dropped the pipe and the gas torch he was using. He escaped with minor burns but his 1971 Chev Impala burned to the ground. Why do I have to be a witness to all this stuff?"

Working graveyard, Acord at least had time to play and to learn. He tapped into the plant's power supply and ran a pigtail of wire back to an obscure corner of the shop floor, where he had a pair of carboys loaded with Fiesta ware, one batch soaking in sulfuric acid, the other in nitric. Together, the electricity and the acid leached the glaze from the pottery, leaving Acord with a set of faded plates and forty gallons of toxic, radioactive liquid. Later, he concentrated some of this pregnant liquor by slow-cooking it in a beaker over an electric hot plate. After a couple of months, he had about a tablespoonful of dark-yellow, molasses-like sludge, capable of pin-

ning the meter on his Geiger counter.

Hellish atmosphere notwithstanding, Acord's experience in the plating shop proved to be an epiphany. "Sometimes I think, you know, I've really been blessed, because, again, it was just what I needed. After all this work with stone and metal, with the fabric and alignment of elemental substances—this job finally got me right onto the atomic plane. I was taking an atom at a time off cakes of metal and putting the atoms on pieces of wire. That's an atomic process. And this got me to thinking again about Leucippus and Democritus, the two atomists. They were trying to figure out how we respond visually to an object across a distance. Do we reach out with our eyes somehow, or does the image come to us? And, of course, the atomists believed that the images we receive are composed of streams of atoms, actual material substance. If you take that one more step, this means that sculpture does not just exist as a mass within the void, because the light coming off the sculpture, the radiation coming off it, spreads out to fill the void. And I thought, you know, the atomists had perceived something of extraordinary

significance, almost on a religious level. It was like the reason for a Trinity, the unity of all things. The unity of both the mass and the void is the radiation that passes through it. What my mass-and-void theory needed was a Holy Ghost, and I found the Holy Ghost in the electroplating shop. Just typical of the way these things work. Yeah."

UNDER Chapter 402-21, Section 030, Paragraph 1 (d) of the Statutes and Rules of the Washington Administrative Code, possession of exempt radioactive material, including ceramic tableware, is permissible for "educational purposes." Acord therefore gave himself a part-time job



"Summer is behind us; winter is ahead. I guess we're on course."

as a lecturer. He already had some experience: since his sculpture was usually physically inaccessible to anyone who wanted to see it, he often gave informal slide presentations of his work. Now, however, the stakes were somewhat higher, since he was trying to demonstrate his competence (in all senses of the word) to work with nuclear material. He practiced his craft by delivering philosophical statements to elected officials at public hearings, occasional lessons in art history to small groups of bureaucrats, and technical lectures on radiation physics to his friends.

Initially, Acord's lectures were somewhat less animated than his sculptures. His stilted delivery resulted in part from an excess of caution and in part from a genuine desire to act like an engineer. Still, one lecture led to another. Nancy Kirner brought him to Envisphere to talk, and then arranged for him to appear on a program with Terry Frazee at the annual meeting of the Cascade chapter of the Health Physics Society. Someone in the audience there invited him to speak at the University of Washington, and on it went. "Monstrance for a Grey Horse" was well on the way to becoming a performance piece.

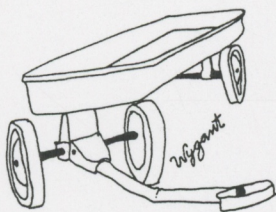
Acord's lectures and letters gradually gained him the grudging trust of a few nuclear workers, and consultation, correspondence, and frequent rereadings of the regulations enabled him to work out a compromise on his use of Fiesta ware. Finally, in the fall of 1988, the regional director of the Nuclear Regulatory Commission confirmed in writing that the fifteen-pound limit on uranium glaze referred to source material, not ceramics, so Acord could legally own hundreds of pounds of pottery. Furthermore, another regulation allowed the glaze to be twenty per cent by weight of the finished product, and "Monstrance" would weigh well over a ton. Acord was thus free to resume work on his sculpture.

In some ways, it wasn't much of a victory. Terry Frazee explained, "Basically, we were just looking for an easy way out, and fortunately we found one, so we didn't have to charge him two hundred and eighty-five thousand dollars. I mean, that was ridiculous. Nor did we have to deal with him as a licensee, either, because, look, he's

on the low end of the spectrum, and as a taxpayer of this state I think that I want to see my tax dollar going to the big problems, you know, not messing around with some poor entrepreneur. So at this point we've satisfied ourselves that he's taken enough courses, he's educated himself enough that we're pretty sure he's not gonna do something real strange, like eat it." Frazee shrugged. "And if he screws up anything, it's probably himself that's gonna get the exposure." In short, Acord had simply regained the exempt status that should have been his in the first place. But the letter from the N.R.C. was the first official acknowledgment of the legitimacy of his work. He had his foot in the door of the nuclear club.

By the time Acord got clearance to work with Fiesta, his mind had turned to other things. He continued to use orange dinnerware in his work, but he had begun to set his sights much higher. In January, 1988, he had given three lectures in Richland, which borders on the site of the Hanford nuclear reservation, and the experience had profoundly altered his plans. The Richland Public Library, Acord discovered, had excellent holdings in metallurgy, radiation, and nuclear physics. More important, he was entranced by the castings in zirconium, titanium, and stainless steel displayed in the Visitors' Center at the Fast Flux Test Facility, the nation's most advanced fixed nuclear reactor. "I immediately recognized that here was a level of knowledge and skill and sensitivity to material higher than anything I had ever seen before. And it was, in fact, exactly what I had always dreamed of using in my own sculpture."

Each of Acord's lectures drew a bigger crowd than the one before, as technicians and health physicists returned and brought their friends. In the scientists and engineers who came to talk to him after his lectures Acord thought he had found some true soul mates. "I told stories about my foundry work to the metallurgists at Hanford, and they just *beamed*. God, it was like they just discovered I was related to them or something, you know. And the things they talked about! They kept apologizing because they couldn't tell me everything—there's a real cult of secrecy in the D.O.E.—but you could



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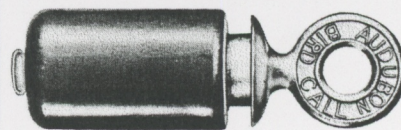
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The way these days she dresses with more attention to go out to pass the afternoon alone, shopping or just taking walks, she says, than when they go together to a restaurant or party: it's such a subtle thing, how even speak of it, how imagine he'd be able to explain it to her? The way she looks for such long moments in the mirror as she gets ready, putting on her makeup; the way she looks so deeply at herself, gazes at her eyes, her mouth, down along her breasts: what is he to say, that she's looking at herself in ways he's never seen before, more *carnally*? She would tell him he was mad, or say something else he doesn't want no matter what to hear. The way she puts her jacket on with a flourish, the way she gaily smiles going out the door, the door, the way the door clicks shut, the way its latch clicks shut behind her so emphatically. What is he to think? What is he to say, to whom? The mirror, jacket, latch, the awful door? He can't touch the door, he's afraid he'll break the frightening covenant he's made with it. He can't look into the mirror, either, that dark, malicious void: who knows what he might see?

—C. K. WILLIAMS

tell they were just bursting with pride over their work. I mean, these guys are making zero-tolerance titanium castings in huge vacuum chambers, you know, with every molecule magnetically aligned, with huge horseshoe magnets humming. They're having a great time. I'd be happy to eat lunch in their lunchroom for a couple of months, and that's a fact."

Richland enchanted Acord, in much the same way that Barre, Vermont, had enchanted him during an earlier phase of his career. Instead of quarries and stone sheds and toolmakers, the Hanford reservation offered reactors and waste-storage tanks and zirconium extruders, but the basic attraction—material and technology—was the same. Richland resembled Barre in other respects as well. The local economy had suffered under President Carter, with the cancellation of the breeder-reactor program, and it had never quite recovered under Reagan. Jobs had been cut on the reservation and a lot of people had left town. The state and several contractors, including Westinghouse and Battelle, were looking for ways to diversify the economy; thus far, the only success had been a small machine shop making titanium golf clubs. Employment prospects weren't great, but housing prices were ridiculously low. It looked as though Acord might for once be able to afford both a studio and a place to live.

He was looking for a place with more space and comfort than he was used to, because he knew that he would soon have to make room for his father. Jim had had problems with his parents since childhood; the older Acords had never accepted his rebellious behavior, and they had never forgiven him for choosing art over a career in academia, veterinary medicine, or the military.

After his mother's death, in 1984, however, Acord had been able to get back in contact with his father, and now he heard that the old man's health was failing. Mr. Acord had probably suffered a few slight strokes, the doctors said, and he was beginning to show signs of Alzheimer's disease. He was also legally blind, but he insisted on continuing to drive his beloved Karmann Ghia even after his license was suspended. When Acord got news of two auto accidents in quick succession, he flew down to Florida to be with his father through cataract surgery. The visit convinced him that the old man could no longer live on his own. A small, quiet town like Richland might provide the perfect environment for his father, safer certainly than a city like Seattle.

Margaret Morrissey was not enthusiastic about living near Hanford. She was concerned not only about the physical effects of radiation but about the psychological impact as well. "When it comes to nuclear power, no one can be trusted," she told me. "The people that are drawn to it in the first place are sort of mesmerized by the power and the magic, and once it's got you that way you don't think about the reality of the substance anymore. I think Jim will have to be really careful about that, because—well, I sense that there's something in him that wants to experiment with the danger. One of the things that I love most about him is that he's not afraid to stare into the abyss. But I'm afraid he'll be transfixed by the beauty, and end up being swallowed whole. I'm not sure that he'll be able to pull himself out."

Despite her concerns, Margaret wanted to stay with Acord, and she liked the desert. The climate suited her, and the birds and wildflowers

delighted her. She, too, saw a chance to set up her own studio, and to have a garden in the back yard. So Margaret and Jim put down a bid on a duplex they thought they could afford. Unfortunately, as self-employed artists, with irregular income from part-time jobs, they were considered poor credit risks. They tried to improve their chances for a mortgage by getting married, but it didn't work. In the end, however, a desperate seller agreed to carry the note on their purchase, and they started their move to Richland in January, 1989.

"WHAT about the glass eyes?" I asked, peering into a jewel box. A dozen blue and brown irises stared back at odd angles.

"Nah," said Acord, "I'll get them on the next trip."

We were cleaning out the basement of a friend's house on Capitol Hill, in Seattle, where Acord had carried out his experiments with Fiesta. He had just had a show at the 9-1-1 Gallery entitled "Moving to Richland," which had included "Monstrance for a Grey Horse," "Reliquary for Two Hands," the Fiesta Home Reactor, and drawings of other projected works, as well as documentation of his regulatory fight. On the final evening of the show, two days earlier, Acord had recited excerpts from his essay "Shape: Mass and Void," illustrated with slides and videotapes of his work intercut with shots of reactor operations at Hanford, and accompanied by electronic music specially composed for the show. Now he was going to take me to visit his new home town. Before we left Seattle, however, he wanted to load up the car with some odds and ends from the friend's basement.

A couple of hours later, we finished

packing the station wagon and wedged ourselves into the front seat. "Sometimes I think the show should be called 'Commuting to Richland,'" Acord said as he pulled away from the house.

The ride up to Snoqualmie Pass was like a trip into Acord's past. All along the way there were turnoffs to old cabins he had lived in, old jobs he had held, mountains he had climbed as a beginner and as an expert. Then, as we came over the pass, the craggy Cascades turned into gentler, smoother slopes, which finally gave way to the broad expanse of the Yakima Valley. The land became dry, almost a desert, but huge, spidery sprinklers made the steppes bloom. Fields full of wheat, hay, cattle, cherries, and grapes lined both sides of the road. As we approached Hanford, power lines pointed the way. Long rows of hundred-foot towers, strung together by cable as thick as fire hose, stretched out to the horizon. With each bend in the road, it seemed, a new line joined the procession. They came from all directions—carrying power *in*, not out. Hanford is an important relay on the Northwest power grid, drawing current from surrounding dams and conventional power plants, and then sending it on, along with the power generated by the Washington Public Power Supply System. But the systems on the reservation use a lot of electricity, and some observers wonder whether Hanford is a net producer or consumer of power.

Just inside the reservation, we crossed the Vernita bridge and stopped at a rest area. A sign on the road a few miles back had promised "free coffee," and we decided to give it a try. Then, in the rest area, another sign on the water tap warned us:

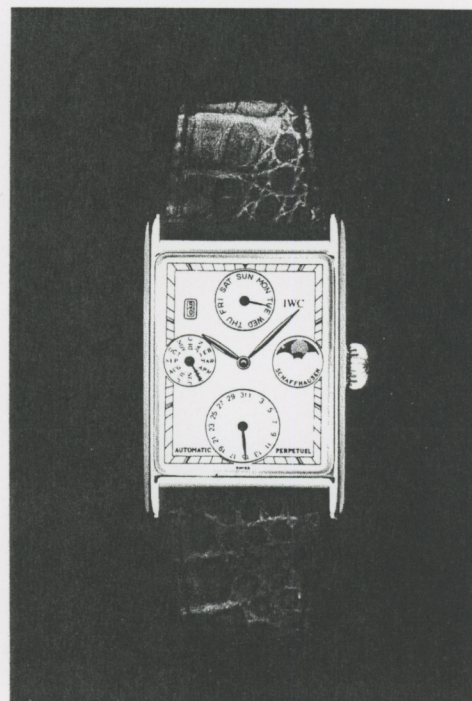
WATER UNFIT
FOR DRINKING

NO TOME
EL AGUA

We were still well upstream of the reactors, so the contamination was probably not nuclear but chemical, or even organic. Nevertheless, the sign was disconcerting. The coffee wasn't very good, either.

As we pulled out of the rest area, the sky overhead was a transparent blue, but closer to the ground there was a dusty haze. Out of the haze rose a dark, indistinct structure flanked by two tall water towers whose silver vessels flashed in the raking light of

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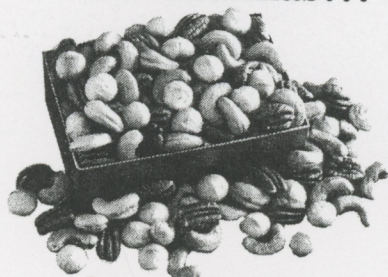
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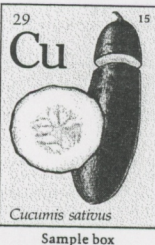
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the sunset. It was the 100B, America's first production reactor, used in the Manhattan Project and recently declared a Mechanical Engineering Landmark.

"Spectre of Albion!" Acord crowed. "Warlike Fiend! In clouds of blood and ruin rolled, I here reclaim thee as my own, My Selfhood! Satan armed in gold."

"Beg pardon?"

"Blake," Acord replied. "'Jerusalem.' I mean, the first time I saw that reactor I thought of some of William Blake's images. You know, it was like some dark new world, still cloaked in shadow, not fully born. I don't quite have the lines right. Something like

Lo, the gates of the new Jerusalem
The city of Albion
America, thou art the gate to the new world."

"Well, it reminds me more of that old Tom Lehrer song," I said, looking out over the plains.

Acord cocked his head at me. "*What sound layer is it on?*" I'm not sure I know that expression."

"Tom Lehrer," I said. "The comic singer."

"The atomic singer?"

"You know, *satiric*." I recited:

Along the trail you'll find me lopin'
Where the spaces are wide open
In the land of the old A.E.C.

(Yahoo!)

Where the scenery's attractive
And the air is radioactive
Oh, the Wild West is where I want to be.

"Yeah, that too," Acord said.

STARTING with the 100B, the Department of Energy's Hanford Site spells out the history of atomic energy in this country and, like some Broddingnagian Ouija board, foretells its future. Spread out over five hundred and sixty square miles (an area about half the size of Rhode Island), the Hanford Site includes twelve reactors in fixed installations and an unknown number of portable mini-reactors in development for use in submarines and space vehicles. Nine of the twelve were built to produce plutonium and enriched uranium for the Manhattan Project or, later, for the Department of Defense: C, K-West and K-East, N, D and DR, H, and F all line up behind B in a fifteen-mile stretch of the Columbia River. Eight of these are permanently shut down, some of them too contaminated to enter. Until re-

OCTOBER 21, 1991

cently, the ninth, N-Reactor, one of the nation's last plutonium producers, stood by on "wet layup," ready to go again if needed; however, in August it, too, was shut down.

The road turns south where the river swings north, so most of these reactors were out of sight from our car, but Acord kept his gaze fixed in their direction, following the road out of the corner of his eye. We got a good look at PUREX, the Plutonium Uranium Extraction plant, a mammoth building a quarter of a mile long. PUREX was on standby; rumor had it that after undergoing "safety modifications" it had been contaminated within weeks of restarting operation. Closer to Richland, we came upon the three newest reactors on the reservation. Two are owned by the Washington Public Power Supply System, known in the region as Supply System and elsewhere in Washington as Woops. W.P.P.S.S., which defaulted on its bonds in 1983, seems to summarize the current state of the civilian reactor industry: one of its two Hanford reactors is in operation (most of the time); the second stands unfinished; and a third, which was never more than fifteen per cent completed, was dismantled and sold to foreign interests. Finally, we passed the last new reactor—the Fast Flux Test Facility, which is a harbinger of future nuclear design.

The past lives on (and on) at Hanford in myriad forms of nuclear waste. No one has yet figured out what to do with the very first contaminated material, produced by the Manhattan Project back in 1943. Most of it is still stored in underground tanks, which are gradually eroding while their contents remain as hot as ever, both thermally and radioactively. The tanks sometimes "burp," when heat-created hydrogen bubbles rise to the surface—or, as some claim, when enough plutonium collects in one spot to cause a criticality incident. In recent years, the D.O.E. has grudgingly given in to public pressure to remedy this situation, and it now appears that for some time to come the biggest budgets in Hanford will be dedicated to cleanup. As one state representative used to tell his constituents, the future offers many "waste opportunities."

According to the Environmental Protection Agency, Hanford is home to some thirteen hundred contaminated sites. Margaret Morrissey once

overheard two engineers in a diner chuckling over all the contaminated sites that even the E.P.A. didn't know about. In a bit of Hanford hyperbole—of a sort never presented to the press—the men commented that the tumbleweeds rolling over these sites got “so hot they hummed,” meaning that their radiation level was high enough to make the clicks on a Geiger counter come in a constant stream. Until recently, however, the first item on the E.P.A. cleanup list was a patch of spilled antifreeze in the bus barn.

As one of the nation's few active dump sites, Hanford stores not only its own waste but exotic radioactive material from all over the country. By the time a nuclear submarine is retired, for example, the hull is so radioactive that the center third must be chopped out and barged two hundred and fifty miles up the Columbia River for burial at Hanford. In 1990, the reservation received a consignment of eight hundred and twenty-eight beagle carcasses, along with more than seventeen tons of their urine and feces—relics of a twenty-five-year experiment in radiation at several universities along the West Coast.

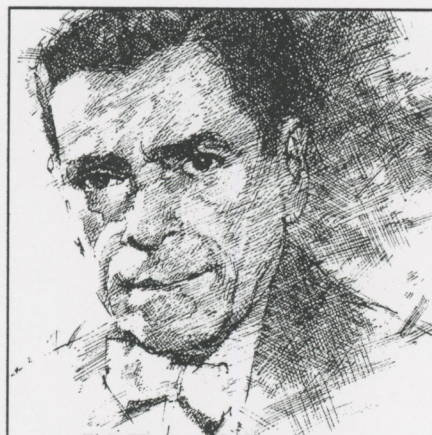
Hanford does not need to import its radioactive excrement, however. Coyotes on the reservation, contaminated by eating rabbits that have licked salt from contaminated sodium deposits, leave spoor that can make a Geiger counter scream. The D.O.E. has sent out teams to comb the arid hills for coyote droppings, which they vacuum up and take to the lab for analysis. “And then they have to dispose of the waste *again*,” Acord points out. “Well, I could help them there. In fact, I've been considering the possibility of building a reactor specifically designed to exploit this unique product: I could isolate the fissile material and extract methane from the manure to power a nuclear-biomass plant that would take advantage of the best features of fossil fuel and atomic energy.”

ON the eve of the Second World War, Hanford, Richland, and a third town, White Bluffs, were lonely farming communities on the west bank of the Columbia River, with a total population under a thousand. In 1943, these villages became the first targets of the Manhattan Project: their remoteness offered secrecy and security, their proximity to Grand Coulee prom-

ised unlimited supplies of electricity, and the abundant waters of the Columbia would provide a pure coolant for the plutonium-production reactors. The Army Corps of Engineers therefore dispossessed the citizens, razed their houses and schools, and left their orchards to wither (though not before the engineers enjoyed the peach harvest that summer). At Hanford, the Army set up a trailer camp and tent city to shelter the fifty-five thousand workers (and several Nobel Prize winners) needed to build the nuclear facilities. At Richland, the engineers laid out a more permanent town, for reactor operators and support staff.

The Hanford construction camp was in many ways a classic frontier settlement. A writer in the *Tri-City Herald* later recalled, “Here thirsty men and women downed more beer in eight hours than the people of Seattle (eight times as many) downed in any one 24 hour period. Here bets were placed on the roll of the dice, or on which of two flies would move first.” Richland, on the other hand, was meant from the beginning to be more middle-class. Over the next five years, the government commissioned nearly five thousand family homes in a variety of styles. For convenience, the different models were identified by letters: roomy, two-story A duplexes; long, low B's; and boxy, single-family F's, among others—an alphabet city to go along with the alphabet reactors. Richland and similar settlements at Oak Ridge and Los Alamos became the prototypes for Levittown and other planned communities developed after the war.

Atomic City today looks like the small-town America of Ronald Reagan's imagination, with leafy streets, well-mown lawns, and driveways graced with Chevys and Fords (including occasional cherry restorations of Bel Airs and Fairlanes from the fifties). The houses, like the cars, were designed to last only five years, but most have survived quite well. The original planners avoided cookie-cutter uniformity by introducing small differences in orientation, siting, and landscaping. Over time, individual owners have given the houses themselves a personal look, with the addition of decks, carports, and new façades of stone, false brick, or aluminum siding. During the day, the residential neighborhoods show a diversity of style which has taken decades to develop. At night, however,



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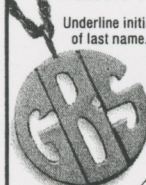
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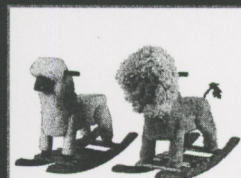
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the houses seem to revert to their primordial shapes; if you're going visiting, you'd better have the exact address.

The Acords live on a street named after an otherwise forgotten officer in the Army Corps of Engineers. When we pulled up at dusk, Margaret, in a sunbonnet, was tending her flower beds. She would have liked to grow vegetables, but she was a little worried about the soil, so her garden was an exaltation of larkspurs and columbines, daisies and poppies, fading irises and surging sunflowers. Mr. Acord ("the Ancient One") walked slowly out to greet us, and his dog, Sugi, offered us a stick to throw. It was a scene worthy of Norman Rockwell or David Lynch.

The Acords' house, a B duplex, was probably built in 1944—"the same year I was," Acord likes to point out. Inside, the décor seemed

to come from about the same era. Margaret, doing her shopping in local thrift stores, had come home with items that might have been the height of retro fashion in a larger town—straw hats, chintz curtains (and a mangle to press them), and chenille bedspreads in lime and salmon. Her husband, meanwhile, had set up an office in the basement and furnished it from auctions of D.O.E. castoffs—a desk and chair marked "Property of U.S. Government," file cabinets with "Classified" stickers still intact, and a telephone with office numbers and security reminders glued to its side. As he showed me around, we had to pick our way through stacks of half-unpacked boxes—tools here, desiccated birds there, books everywhere. Boas, Boswell, Burroughs, and Frost peeked out from one carton, and Marcus Aurelius, Nietzsche, Plato, and the comic-book character Dr. Strange from another. The place was in barely contained chaos, but that night, as his father sat dozing in front of a baseball game and Margaret thumbed through a catalogue of fabric dyes, Acord had never seemed so settled.

The next day, he took me to see the sights. The Tri-Cities telephone book (including the neighboring towns of Pasco and Kennewick) lists about a dozen small businesses that call themselves "Atomic," and we tried to vis-

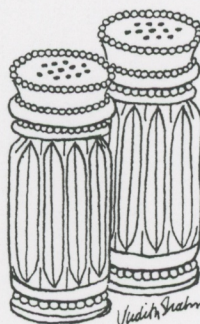
it them all. Sometimes the names sounded unintentionally ominous—Atomic Foods, say, and Atomic Health Center. In other instances, the designation seemed more encouraging—Atomic Body Shop & Towing Service, and Atomic Plumbing & Mechanical. Atomic Laundry promised to do a very thorough job of cleaning. Atomic Gas offered just what Acord needed to revive his old truck, though he might hesitate to buy a used car from Atomic Auto Sales, conveniently situated on Terminal Drive. I hoped that Atomic Lanes

might do something for my bowling average, but when Acord and I went to try it out we found that the place had been closed because of unsafe conditions. (Structural, not radioactive; the lanes later reopened, after extensive renovation.)

Next, we went by the Hanford Science Center, where we picked up some

Atomic Marbles and Simulated Fast Breeder Fuel Pellets. The marbles were toasted to the color of root beer by exposure to cobalt 60, a gamma-radiation source that, the paper envelope explained, was "used for developing the peaceful atom." The Fuel Pellets were tiny cylinders smaller than a pencil eraser. According to an attached card, each pellet represented the energy equivalent of three tons of coal, twelve barrels of oil, five hundred gallons of gasoline, or seventy-five thousand cubic feet of natural gas. The Science Center attendant suggested that they would make good souvenirs for the kids.

All in all, it seemed that Richland had few nuclear skeptics besides Jim and Margaret (and Margaret isn't sure about Jim). Everywhere we went, bumper stickers urged us to "KNOW NUKES," and to "BE A NUCLEAR FAMILY, RADIATE LOVE." The youth group at Christ the King Parish was raising funds by selling T-shirts in fluorescent chartreuse, with "WE GLOW FOR GOD" inscribed around the radiation symbol. A sign in front of Richland High School announced, "HOME OF THE BOMBERS." Indeed, the unofficial team motto is "Nuke 'em till they glow," and their logo is a mushroom cloud; the mascot wears a flight suit, helmet, and oxygen mask, and football players are rewarded for good plays with helmet



stickers bearing a silhouette that looks like Little Boy, the Hiroshima bomb.

"I HOPE you don't mind a few G-forces, gentlemen," Wanda Munn said as we climbed into her car, an Acura Integra. "Most people expect me to be a little old lady in tennis shoes, but I'm an aggressive driver." Despite her warning, Ms. Munn drove quite demurely, but no one would have mistaken her for a little old lady. With her steel-gray hair and gold-buttoned white safari suit, she had the look of a Coast Guard commander on dress parade. In reality, she is a senior engineer for Westinghouse-Hanford, the prime D.O.E. contractor at Hanford, and she has been working at the Fast Flux Test Facility since 1977, when the reactor was still under construction. Now she was taking us for a tour of F.F.T.F., which her husband calls—only half in jest—"her shrine."

Ms. Munn likes to project the image of a Dragon Lady, to the point of tacking the title to her office door. She cherishes a reputation for outspokenness, claiming to say openly what others in the industry will only whisper among themselves. Her private mission is to inform the public of the truth, as she sees it, about nuclear energy. She was one of the picketers at the "Hanfordgate" show in Seattle, the only one to accept with enthusiasm Acord's invitation to debate with the arts community. Another time, she appeared (wearing her personalized hard hat) on a Seattle television program about nuclear waste. "How can you call spent fuel waste?" she demanded. "It's not waste. It's a national treasure." Ms. Munn had been an admirer of Acord's work ever since the "Hanfordgate" show, and he had seized on the occasion of my visit to take her up on an offer to show us around F.F.T.F.

"The entire concept of nuclear waste in this country is completely skewed," Ms. Munn told us in the car. "Much of so-called nuclear waste is really just spent fuel; it's fuel that's been run through a reactor one time. To store it, when we are energy poor and getting poorer, is absolutely criminal. If you reprocess that fuel in a breeder reactor, you will take the uranium and the plutonium out of it, to be reused as fuel in other kinds of reactors. You will separate the useful isotopes, of which there are many, and then you're

left with very high-level slurry. With the alchemy that these reactors are designed to perform, you can take part of that material, bombard it with neutrons, and turn it into something else again. We can reduce the number of radioactive materials to the point where you have to store what's left for about six hundred years. The idea that you need to put it in a deep repository for two hundred and fifty thousand years is balderdash."

She allowed that some steps in the process were still experimental, and some theoretical, but the real obstacles, she insisted, were political, not technical. Many aspects of the technology had been successfully tested right here at the Fast Flux Test Facility, which was built as the prototype for a fast breeder planned for Clinch River, Tennessee. Thanks to the public's "incredible, abysmal lack of understanding of the world around us," however, neither F.F.T.F. nor Clinch River had ever been permitted to complete its mission and reprocess spent fuel.

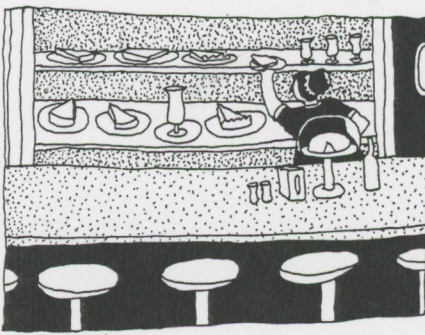
Fearing the proliferation of plutonium, Jimmy Carter announced plans to cancel the breeder program just two months after he took office, in 1977. The Reagan Administration followed the same policy, and finally, in 1983, the Great Communicator was able to persuade Congress to stop restoring funds for the project. Clinch River was halted in mid-construction, but F.F.T.F. survived the cuts. The reactor was already up and running, and it had proven itself to be a valuable laboratory for testing materials under extreme conditions. "We want to create the harshest possible environment for anything that we put in there," Wanda Munn explained as she led us in through the Visitors' Center. "We want to make sure that they get more neutrons, more heat, more everything than they would ever get in a commer-

cial plant. If a material can withstand the neutron flux in this core, it will do fine in any other reactor." Indeed, results from experiments carried out in F.F.T.F. have been incorporated into designs for a variety of advanced reactors, including tiny, high-powered generators for use in outer space.

Before going on to the reactor, Ms. Munn wanted us to see a model of the Materials Open Test Assembly, her favorite feature of F.F.T.F. (and Acord's, too). The MOTA is a slim, forty-foot torpedo of stainless steel, designed to be inserted directly into the reactor core. The frame is honey-combed with fifty-six cannisters that carry small samples of such things as ceramics, oxides, and metal alloys. The purpose is to test the structural limits of these materials by cooking them in the reactor—some until they disintegrate or swell beyond recognition. Acord was originally drawn to the MOTA for its material, form, and workmanship, but Ms. Munn loved it for what it could do.

From the beginning, scientists at F.F.T.F. had realized that the reactor could not only destroy materials but create new ones. With all the fissioning of atoms that goes on in any reactor, trace amounts of every natural element (as well as thousands of isotopes) will eventually be produced. The scientists at F.F.T.F. have refined the process to the point where they can rearrange atomic particles in almost any way they choose; they have, in fact, achieved the alchemical goal of transforming elements at will. They can even fabricate gold if they want to, though it would hardly be economically feasible.

Recently, the operators of F.F.T.F. have been thinking more and more in economic terms. In an era of budget-cutting, F.F.T.F.'s future funding is in jeopardy (the Secretary of Energy, James Watkins, has already declared his intention to phase out the program), so Westinghouse executives have begun searching for other sources of revenue. They have marketed data from their experiments to reactor designers in other countries, and they have in effect rented out space in the MOTA. Scientists and engineers envision an atomic atelier, custom-crafting isotopes for medical and commercial applications. They are particularly proud of their success in making (and selling) small amounts of gadolinium 153, an isotope used in the detection of



d. chaf can Borg

osteoporosis. Gadolinium sells by the curie, a unit of measure based on the number of disintegrations per second—about thirty-seven billion—in a gram of radium; a gram of gadolinium puts out four thousand curies, and each curie sells for five thousand dollars. At twenty million dollars a gram, gadolinium is still cheap compared to cadmium 109 at fifty million dollars a gram, or phosphorus 33 at three *billion*. At those prices it's not surprising that they have not yet sold very much, but then perhaps it's just the recession. In any event, it will be some time before F.F.T.F. turns a profit. Meanwhile, Acord would like to be part of the diversification program.

As Ms. Munn led us across a parking lot between the Visitors' Center and the security station, we passed two officers from the Hanford Patrol—a woman in a Smokey-the-Bear hat and a man in starched, box-pleated camouflage fatigues and spit-shined combat boots. The woman's dress was accessorized with a 9-mm. Beretta service automatic strapped to her hip; the man's outfit included an Uzi slung over his shoulder and three extra magazines clipped to the sling. It was hard to tell what they were looking at from behind their mirrored aviator glasses, but Acord was watching *them* closely as they climbed into their pickup truck and pulled away. A former marksman himself, he had noticed that the trucks carry, propped between the seats, a 12-gauge semi-automatic shotgun with magazine and an airborne assault M-16 with flash suppressor. "Better armed than your average SWAT team," he said.

Inside the station, a stern-looking woman in a blue uniform and a black eye patch asked if she could help us. We had submitted our names, birth dates, and Social Security numbers the day before, and we had presented that information again, along with our driver's licenses, when we picked up our visitors' badges (each with its own identification number and a radiation-detection chip) at the entrance to the reservation. Now we went through the whole routine once more. The woman studied our I.D. photos, scanned our faces, and looked back at the pictures; then she called up our files on her



computer. Apparently, our records were still clean, because she asked us to sign in. We moved on to the exit at the back of the building where a guard—who had been watching us the whole time—looked at our badges, scanned our faces, checked his computer, and waved us on out.

The reactor shimmered in front of us: three cubical cooling towers surrounding a sparkling white dome like squat minarets around a mosque designed by Richard Rogers, one of the architects of Beaubourg. The towers poured out transparent waves of heat that rippled the sky and speckled the sidewalk with stripes of refracted light. We seemed to be walking on the bottom of a clear pool of water, but as we drew closer the mirage dissolved into reality. Above the entrance, a band of red letters crawled across an electric sign: "The Reactor is now in Mode 1... Reload 2 days ahead of schedule... TOTAL... Quality... is our Goal."

"Hurray!" Wanda Munn cheered, raising both fists in the air. "We're at full power."

Inside the entry hall, the building looked less like a temple of technology than a high school in suburbia. Beside the door was a trophy case, celebrating the accomplishments of the F.F.T.F. softball team. Posters of rabbits and coyotes hung from the walls, promoting a Hanford ecological project called Arid Lands. To complete the effect,

the walls themselves were painted institutional green. According to Ms. Munn, the color had been scientifically selected to instill a sense of calm alertness in the viewer. For me, however, it stirred up memories of hospital emergency rooms and cheap apartment buildings on the Upper West Side.

As we approached the control room, Ms. Munn waved to an operator on the other side of a plate-glass window and then turned to us. "When they buzz us, be ready to move right in. This door can't be open for more than forty-five seconds or it sets off an alarm and they send down the Mod Squad," she said, referring to the Hanford Patrol.

The control room was covered from floor to ceiling with an array of lights, dials, switches, and other instruments. Among other things, the instruments monitored the status of each of 15,841 fuel pins in the reactor core, and also indicated the flow, pressure, and temperature of the coolant at every stage of its progress through the system. In the center of the room was a long, angular console, with computer screens and more measuring devices. On the console was a large bright-red mushroom-shaped protrusion—"the SCRAM button," Ms. Munn called it—used to shut down the reactor in the event of an accident. Like the emergency brake on a subway car, the button seemed to say, "Try me. See what happens."

The color scheme appeared to have

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the desired effect. Three or four operators moved about the room, calmly and alertly reading dials and making notes on their clipboards. Everything looked to be quiet and controlled, and strangely familiar. "It's like the beginning of 'China Syndrome,'" I muttered to Acord. He didn't hear me, but Ms. Munn did.

"Beautifully done," she said, without the slightest hint of sarcasm. "Beautifully done, absolutely beautifully done. 'Silkwood.' Wonderful show. And, of course, that's the real problem here, I believe. The public learns about nuclear technology from some of the best fiction writers, some of the best dramatists, and some of the best producers alive in the world today. Everyone has seen 'The Incredible Hulk'—everyone. Sooner or later, everyone has seen what happened to poor Dr. What's-His-Face: he got super-irradiated, and ever after, whenever he lost his temper, he turned green and split his clothes. All right, people think. There you go, we *know* what radiation does. But the public has no basis at all for evaluating the risk. They've been told that any amount of radiation is dangerous and that the risk is enormous. Neither of those statements is true, of course, but truth does not enter into public perception.

"I agree that radiation is not a phenomenon to be treated casually," she continued as she shepherded us out of the control room. "But then I don't feel that childbirth is a phenomenon to be treated casually, either. Radiation is necessary for all living things; as a matter of fact, it's beneficial. We've never been healthier, our life expectancy has never been longer, our food supply has never been safer. And yet we're subjected to Meryl Streep scrubbing her vegetables in Tide on the television set. Thank You. Ted. Turner."

Ms. Munn cut her media analysis short when we walked through a tall, tornado-hardened door into the operating side of the reactor. Heading toward the entrance to the containment dome, we followed a path marked by yellow-and-black tape. ("Just like my Fiesta reactor," Acord said.) The corridor opened out on one side to reveal a broad bank of shiny stainless-steel pipes, each two and a half feet in diameter,

stretching into the gloom as far as the eye could see. Ms. Munn told us that they carried the reactor's coolant, liquid sodium. Thinner piping climbed the walls and spread across the ceiling in a network as complicated as capillaries, as intricate as a microchip. Ms. Munn led us back among the pipes, ducking and climbing around the plumbing like an explorer through underbrush. She showed us elaborate traps to divert sodium for testing, and enormous shock absorbers—"seismic snubbers"—designed to stabilize the pipes during an earthquake.

"The welds," Acord said, running his hands along the curve of a huge cast cornerpiece. "Feel the welds." They felt good: clean, smooth, and only the slightest bit warm, even though the sodium rushing along inside was heated to over six hundred degrees. "And look at the polish. The guys who did this were really into their work. You can tell."

We had to go through an air lock before we could enter the containment dome. The pressure inside is lowered to minimize any radiation leak in the event that containment is breached. While waiting in the lock for the pressure to stabilize, I noticed that the familiar radiation warning, three wedges inscribed in a circle, was here adorned with an outer ring of letters proclaiming "Fissile ... Fissile ... Fissile." We weren't looking at a model anymore. Posted next to the warning

sign was a list of emergency signals. A "Howler" ("Ah-oo-gah! Ah-oo-gah!") signified a high-gamma-radiation alarm, and upon hearing it we were to "Run do not walk 300 feet from containment." A "Gong! Gong!" signified a fire alarm, and we were to leave by the nearest and safest normal exit. If we heard a "Telephone

Bell Steady Ringing," we were to "Answer promptly, and listen carefully."

"I hope there's an alarm," Ms. Munn said. "It's usually over nothing at all, and I want you to see how quickly we handle it."

The air lock opened, and we stepped into a vast, vaulted space. The dome rose a hundred and twenty feet above us, yet the atmosphere felt stiflingly close, and heavily charged. It was not the result of radiation but the combined



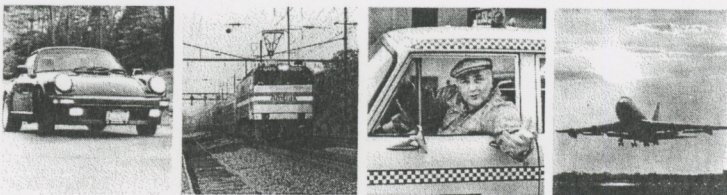
J. Oliver

as the effects of negative pressurization, filtration, and the low roar of fans and sodium pumps. The noise of the equipment was difficult to hear precisely but loud enough to muffle any single sound.

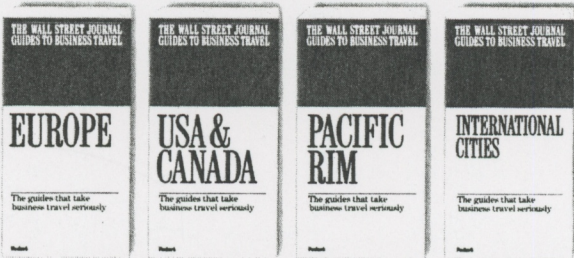
"My next studio!" Acord shouted almost inaudibly. He stood transfixed, tracing cables and catwalks with his eyes, and, in his imagination, filling the open floor with small mountains of granite. He gazed with special longing at a two-hundred-and-fifty-ton crane that spanned the entire dome, each end resting on a motorized car that circled the perimeter on a narrow-gauge railroad. "I want that crane," he said. "But in the meantime I guess I could make do with this." He patted the tire of a twenty-foot-high, seventy-five-ton crane, painted bright orange. Ten feet up, a silver sticker the size of a postage stamp identified the equipment as "Property of U.S. Government." Acord said, "Who knows? Maybe this'll turn up at auction someday."

Before descending to the head of the reactor core, we ran our shoes under an electric buffer to brush away any dust. Wanda Munn scrambled down the steep yellow steps like an able seaman, with Acord close behind. "You two are lucky," she called from below. "This is one of the few places in the world where you can get this close to an operating reactor. Most commercial reactors have a high enough radiation field that they don't like the public generally to go in there." That seemed like a very sensible policy; I hesitated at the top step. "We're very well shielded here," she went on. "You won't be exposed to much more radiation than you were in the parking lot."

We ended up on a narrow catwalk "Gong!" surrounding the reactor head. Here we and we were in the heart of the beast, and it nearest felt—well, *small*; smaller, seemingly, exit. If than the boiler of a good-sized skyscraper. The thicket of tubes sprouting were to from the head was the densest that we n care—had seen—we had to crouch as we circled the catwalk—but by then we i," Ms. had seen plenty of pipes. The vessel nothing (mercifully) gave no sign of the cataclysmic energy inside, and so seemed all out of proportion to the soaring stepped dome and miles of massive pipes that ne dome surrounded it: the banality of power. et above Finally, after emerging from the stiflingly reactor head, we descended another set was not of stairs to the Interim Examination combined and Maintenance Cell, an argon-filled



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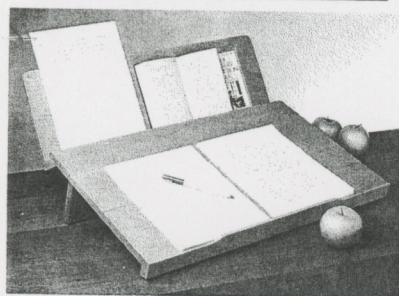


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HANDMADE IN EGYPT

shaft extending seventy feet below ground, where the cannisters from the Materials Open Test Assembly were dismantled and their contents studied by remote control. The workstations were deserted that day. Large pneumatic levers, to operate robotic arms, hung down in front of heavily shielded windows. Inside, the arms were at rest, pincers poised above a jumble of exotic tools. The MOTA dangled in the middle of the shaft like a flayed carcass in some space-age butcher shop.

The windows, six-foot-thick sandwiches of mineral oil layered between six plates of leaded glass, distorted depth perception, warped lines, and gave a yellowish cast to everything in the shaft. Acord rocked slowly back and forth, clearly enjoying the shifting perspective and the multiple reflections. He was registering ideas on colors, textures, materials, and form to incorporate into his sculpture, but he was also contemplating a more fundamental relationship between his art and nuclear technology. "You know, it was my first sight of the MOTA, more than anything, that brought me to Richland," he said. "I thought that the materials and fabrication technologies used in the MOTA were eminently appropriate for sculpture—and I was right. But I had missed the whole point. The nuclear age is not about advances in metallurgy. The nuclear age is about process—that's what's new. The actual transmutation of elements, the release of the fundamental energies of the universe—this has changed everything, and it ought to change art as much as it has changed science or politics. Look at it this way: neutrons are the chisels of the nuclear age."

HALF an hour later, Acord and I were sitting by ourselves in the Sandbar at the Hanford House. Of the dozen or so patrons, we were the only ones without security badges. We each ordered a Nuclear Ice Tea (gin, vodka, and rum, both 80 proof and 151 proof), and Acord began drawing feverishly in his sketchbook. "I want to get some of those images down before I forget them."

When the drinks came, Acord lit a cigarette, took a sip, and sat back with a contented grin. "You know, I was actually weak in the knees before we were a third of the way through the tour. Especially when we finally went through the air lock into the contain-

ment barrier. I've seen dozens of photographs of it, read about it for years, you know, but it was like, take your breath away, light-headedness, tiny spots before your eyes. I mean, I almost fainted. The last time I felt that way was at the Cloisters, on my way to Barre, Vermont. And the time before that was when I saw the 'Treasures of Early Irish Art' show in San Francisco. For me, the guys who built F.F.T.F. are right up there with the Master of the Ardagh Chalice."

I asked Acord about some arithmetical calculations I had seen written on the girders, back among the cooling pipes.

"It's an old pipe-fitters' practice," he said. "You know, they work out how long a piece needs to be, then they cut it and weld it up."

I showed him one I had copied off a wall among the cooling pipes:

$$\begin{array}{r} 3.1 \\ 7 \overline{) 28} \\ \underline{21} \\ 7 \end{array}$$

"It could be a joke, I suppose," he said. "Or—who knows?—maybe this guy was working with some cosmic mathematical system that we can't begin to comprehend. Besides, it doesn't always help to get the calculations right." Acord tapped the ash off his cigarette. "You know, welders and pipe fitters sometimes do better when they ignore the plans. They've got a lot of experience, and sometimes they just *know* that some part of the design won't work. So they improvise some adjustments, 'just in case the longhairs were wrong.' Bend this pipe just so, move that valve over there. And it does seem to work—at least, for a while. But then when something breaks down, the engineers have to go and get the old-timers who did the original installation, because nothing is where it's supposed to be." Acord let out a smoky sigh. "The human element."

THE day before I left Richland, I went on a picnic along the Columbia River with the two James Acords, senior and junior, and the family dog. Approaching the entrance to Columbia Park, we passed a shack with "ATOMIC DUCKS" painted in large letters along one side; it was the scuba-diving unit of the Lower Columbia Basin Search and Rescue Council. Then, just inside the park, we were

met by a reception line of real atomic ducks, begging for handouts. They waddled up to us on deformed feet, stretching and flapping their stubby wings. Some had bald spots, and others had piebald feathers in colors that to my eye seemed unusual. Many of them had warts on their heads, a few of which had swollen into nasty black tumors. Strangest of all were their bills. On one, the upper and lower beaks went off to the sides at opposite angles, like an avian bow tie, or perhaps a propeller. On another, the beaks twisted around each other, corkscrew fashion. "People around here will tell you that this kind of thing is the result of pesticides and fertilizer running into the Columbia River," Acord, Jr., said. "May be, but it makes you wonder."

After watching the ducks, we settled down at a picnic table some distance from the bank. Acord ate his sandwich quickly and then went off to give the dog some much needed exercise and obedience training, leaving me to talk with his father. Mr. Acord was still in the early stages of Alzheimer's. The disease would consume his mind and his son's energy for the next two years, but that afternoon he was in high spirits, full of reflections on the past.

Mr. Acord spoke slowly, as though each word had physical weight and he had the strength to carry only one at a time. He was happiest talking about his mother's family, and he took me through five generations, speaking so clearly of ancestors on both sides of the Civil War that I could almost believe he'd been there with them. Memories of Jim's childhood did not come as easily, and some were too painful to discuss. He still regretted that his son had not gone to West Point, but he was certain that Jim had made the right choice in marrying Margaret, and he was relieved to be living with them. Though Mr. Acord recognized that there was something special about Jim's art, he preferred to talk about his son's accomplishments in other fields. "If you ever get with him, and you've got a little beer bash going, ask him to play 'Tequila' on the clarinet," he said. "He'll blow your hat off. Yeah, he sort of specialized on that one piece of music, but it's well worth your twenty-five cents' admission. You tell him the old man said so."

Mr. Acord's gaze shifted over my shoulder to a point somewhere in the distance. "Here's one for you," he said.

"I learned this from Sara Teasdale, I think.

Spend all you have for loveliness
For one white singing hour of
peace."

He stopped and looked at me. "That's ass backward. There's another line in there, which I'll give you at no charge, on the house. Excuse me for just a few minutes." Mr. Acord closed his eyes and let his shoulders sag. I waited, and then began to pack away the remains of our lunch.

Mr. Acord was still in his reverie several minutes later, when Jim returned with the dog. "Looks like it's time we were heading back," he said to me, and then, to his father, "Everything all right, Dad?"

Mr. Acord's eyes popped open, and he started to recite:

And children's faces looking up
Holding wonder like a cup.
Spend all you have for loveliness.

He stopped again. "Spend all you have for loveliness..."

"Buy it and never count the cost," his son chipped in, and then they went on together:

For one white singing hour of peace
Count many a year of strife well lost.

"I HAVE no idea where that came from," Acord told me the next day. "I heard my father say that one line, and the rest came into my brain like a freight train—or an alpha particle. I was completely non-pulsed."

We were driving back to Seattle so that I could catch a plane. Acord kept his eyes fixed on the reservation, and when we passed W.P.P.S.S. he gave a deep sigh. "Eventually, they will pull all that spent fuel out of those swimming pools," he said. "They're gonna have to. And they have sediment ponds dug where radioactive waters were set up to cool, so they're permanently radioactive. And they have this huge contaminated cluster of buildings, stretching over probably hundreds of acres. No one should go in this giant site for thousands and thousands of years. It has to be shielded from the biosphere in perpetuity. No one knows what to do—it's never been successfully done. And I keep thinking of the stupa"—the dome-shaped structure used for Buddhist shrines. "Make it a sacred site, encourage people to bury their dead there, do something so that it becomes a sculpture park, a sacred



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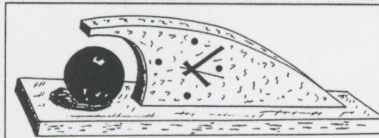
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place. People would in fact preserve it and be careful with it. And there would be an oral tradition attached to it that would be passed on and might well outlive any historical documentation."

Acord recognizes that if the oral tradition should be broken, the myth forgotten, or skepticism set in, other precautions may be necessary. To that end, he has been working on a series of deterrents. First come warning markers, encoded in words, symbols, and numbers, which should be made well enough to survive but not be so valuable or beautiful that they might themselves become objects of desire. "We'll have to create art repellent to every taste throughout time," Acord said. "Now, *there's* a challenge to look forward to." Beyond that would come a series of barricades of increasing security, then booby traps of growing severity, starting with tear gas. The idea would be to discourage the curious. The one thing Acord could not guard against, however, was someone possessed of the same terminal curiosity as Acord himself.

"Think you'll ever get the chance to do all that?" I asked.

"Well," Acord said, "someone's got to. I can't help but say this—it sounds like the beggar standing out in front of the rich man's house calling him brother, you know—but I feel that art and science will have to grow closer together again, to the benefit of both. I think that part of the struggle that art is having right now is that artists have cut themselves off from much of what they could learn out there—from the metallurgists or the computer experts, for instance. Without that cross-fertilization, art falls behind. On the other hand, I believe that applied science and engineering have been too easily dominated by the constraints of the marketplace and the dictates of politics. They use these new materials in ways that very narrowly—and, of course, very skillfully—fulfill demands of a wholly mechanical nature. But the spirituality has been left out. Now, that's not to say that swords haven't been made for a very long time. But when a man makes weapons he loses something of himself—it's that old alchemical feeling that the purity in the heart of the manipulator is as important as keeping your crucible clean. And when we build up a whole technology that makes only swords, never

a plow, never a statue, then something is lost from that process, too. And when that happens, I can't help but feel that sculpture is failing its job to civilization. There's just something about it that makes it harder for me to get to sleep at night."

FROM January to May of 1990, Acord drove a forklift on the graveyard shift at Tater Boy, a potato-processing plant. There was nothing to learn on that job except, perhaps, a few words of Spanish and the varieties of frozen French fries (e.g., cajun, curly, matchstick, batter-dipped). Still, the work suited Acord's purposes. He had chosen not to seek skilled employment on the reservation, because he thought it better to be identified as an artist than as a worker. He also wanted to avoid getting a security clearance; it might take him longer to learn things that way, but he needed to feel free to use whatever he saw without fear of violating some oath of secrecy.

Acord knew that he could never incorporate nuclear processes into his art without the active collaboration of the scientific community. Therefore, he decided that instead of confronting the establishment—any establishment—as he had done all his life, this time he would infiltrate. He joined the public library, two local arts organizations, the East Benton County Historical Society, the Audubon Society, Camerata Musica (as a subscriber, not a singer), Christ the King Parish, the American Nuclear Society, the B-Reactor Museum Association, and Alcoholics Anonymous. "I'd heard that some of the Hanford workers had drinking problems, you know, and it seemed like a good way to meet people. God, they told some great stories! But then, the next week, they took everyone with a Q-clearance out of my group, which made it a lot less interesting." The meetings have had no noticeable effect on Acord's drinking (which is only occasionally immoderate these days in any case), but he continues to attend as often as he can. "After all, I have an image to maintain."

In his determination to fit in, Acord cut his hair and started to dress like an engineer. He bought a silver-gray suit in Seattle for a hundred dollars and a chocolate-brown shirt at the Richland Goodwill for ninety-nine cents ("and worth it"). He thought that both went well with his favorite tie, which was

orange and silver. The Goodwill also yielded a five-dollar pair of snappy brown-and-white wing tips. (Later, walking through an airport metal detector, he learned that the shoes had steel-capped toes, a discovery that delighted him. "They must have belonged to some engineer in the Manhattan Project—a part of history.") Modern engineers at Hanford found Acord's outfit rather quaint. They didn't sense any parody, even with a calculator and a Geiger counter hooked on his belt and a plastic penholder stuffed in his breast pocket; these were, after all, legitimate accoutrements of his trade as well as theirs. Acord had managed to show respect for local form while setting himself apart as an artist.

The multiple lives took their toll. Many days, he'd knock off at the potato factory at dawn, change from his thermal overalls to his business suit in the cab of his truck, and drive to a breakfast meeting of one organization or another. He'd get home just as Margaret was leaving for work, and spend the day drawing, writing letters, and tending to his father. Usually, he found time for a nap in the evening, but when there were special events—public hearings, sessions on waste cleanup, conferences on Hanford diversification—he might keep going around the clock for two or three days. On more than one occasion, as Margaret set out in the morning, she found him draped over the steering wheel of his truck, sound asleep.

Mr. Acord's Alzheimer's grew steadily worse, and in his mind he travelled back to more active years. He went to sea again, and he once more drove in sports-car rallies. He visited old friends, some long dead and some who had never existed. When he started acting on his fantasies, wandering out at three in the morning to explore the neighborhood, his son had to quit the potato factory and stay home all night. Soon the old man required almost constant care, and, as medical expenses mounted, the paperwork for Medicare alone became a full-time job. In a letter Acord described life with his father as "a Beckett play in which I never get to play Lucky." Meanwhile, Margaret held down three jobs to pay the bills (almost), and looked after the Ancient One when Acord had to be away. Then, one night this past January, Mr. Acord got out of bed and fell

to the floor. The next morning he was taken to the emergency room, and that afternoon he fell into a coma. He was discharged two weeks later, when he regained consciousness, but his strength was gone. For the next six days, the son stayed by the father's bed while the old man lay with his eyes closed, breathing softly. At last, Acord was able to talk through all their old problems, finally forgiving his father, and believing that he, too, was forgiven. After all their years of strife, they had finally found their hour of peace. In between the one-sided dialogues, Acord read aloud to his father, a former merchant seaman, from John McPhee's "Looking for a Ship." "There were stories in there that Dad had told me when I was a kid," Acord told me later. "Some of them *exactly* the same. And here I was, I was giving them back to him." Five pages from the end, Mr. Acord opened his eyes, raised his son's hand to his cheek, and died.

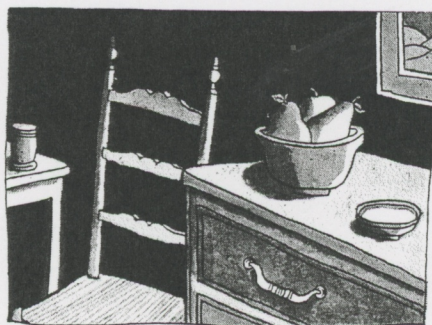
THE strategy of integration was beginning to work. Acord had volunteered his services as a lecturer or consultant on nuclear art to any interested organization, and several groups had accepted the offer. He was invited to speak to the Boy Scouts, Kiwanis, Rotary (three branches), the American Welding Society (twice), the American Nuclear Society, and the Westinghouse Managers' Association. After a talk at the American Nuclear Society, he was asked to become a member of its Public Information Committee. What he was proudest of, however, was a talk he gave at Battelle laboratories, where he was featured in a lecture series that had also included Glenn Seaborg, the Nobel Prize-winning chemist who once chaired the Atomic Energy Commission.

Acord impressed audiences with his knowledge of nuclear physics, amused them with his artistic twists on reactor technology, and touched them with his

sincere admiration for their work. The engineers and scientists had always looked on their creations as objects of beauty, but no outsider—certainly no artist—had ever shared that view. At first, such listeners were less enthusiastic about his desire to create new art in F.F.T.F. itself. Some took the project to be just another inside joke, and one suggested that if his career in art didn't work out he should consider becoming a standup comic. Eventually, however, they came to realize that he was dead earnest.

With the help of Wanda Munn, Acord formed the Fine Art Use of F.F.T.F. Technical Advisory Committee, or FAF-TAC, to assist him in developing the scientific aspects of his proposal. In addition to Ms. Munn, the committee includes Robert Schenter, a nuclear physicist; Gerald Woodcock, a senior project-control analyst; and William Schuck, an engineer. All four FAF-TAC members work for Westinghouse-Hanford and serve on the Public Information Committee of the American Nuclear Society. Their initial goal may well have been to use Acord as a public-relations tool, a voice for the nuclear industry in the arts community, but over time they have demonstrated their commitment to the project itself.

Acord gets along particularly well with Bob Schenter. As the Chief Scientist for Isotope Production at F.F.T.F., Schenter knows as much about transmutation as anyone in the world, and in his dealings with Acord he has been as generous with his knowledge as security restrictions will allow. And he has discovered that he, too, has much to learn from his eager acolyte. "Being in contact with Jim tells me to not just go the straight and narrow, but to broaden out and try new things," he told me. "Because we need new ideas, we need new ways and new imaginations to solve some of our problems. And just discussing some of these ideas and concepts helps me to be a better, more creative scientist, and also to be a more creative person." Indeed, Schenter has openly expressed his enthusiasm for the Fine Art Use of F.F.T.F. among his colleagues in Richland and across the country, and he has invited Acord to collaborate with him in a series of joint lectures on F.F.T.F. diversification. Meanwhile, Acord's influence has already made itself felt in Schenter's own



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work. For a recent colloquium at Hanford (which he called "Bone Cancer Pain Relief: How F.F.T.F. Will Put Drug Dealers Out of Business"), Schenter prepared a set of handouts that mixed different typefaces and graphics in a style that reminded Acord of "punk fanzines." The back page carried a grainy photograph of Albert Einstein, and two Einstein quotations: "Great Spirits have always encountered violent opposition from mediocre minds," and "Imagination is more important than knowledge."

Schenter has access to a supply of isotopes from F.F.T.F. which he contributes to various research projects at Hanford or sells to radiology laboratories and other facilities. Since some of the isotopes have no immediate purpose or market value, Schenter saw no reason he shouldn't offer Acord a sample. Together, they pondered the properties of each possible choice, and finally settled on ruthenium 100. A member of the platinum family, ruthenium is a natural element, but it can also be produced by irradiating technetium 99. Another form of technetium was once a naturally occurring radioactive element, but it had a half-life of only 2.6 million years (compared to 4.5 billion for uranium), and had therefore almost completely disappeared within a few million years of the formation of the earth. The element had represented a puzzling hole in the periodic table until 1937, when it turned up in the cyclotron at Berkeley.

Acord would have preferred radioactive material, of course, but the atomic stability of ruthenium had certain advantages: it might calm Margaret's fears slightly, and it would permit him to exhibit his sculpture wherever he chose. Ruthenium was, in any case, a big step up from Fiesta ware: it had been created in the core of F.F.T.F., and it was a transmutation of the first humanly produced element. Ideally, Acord would have liked to take possession of his own technetium, plan the irradiation campaign, and then use the resulting ruthenium in his art. "I've made it clear that I don't want any leftovers," he told me. "I want to show that sculpture can come in—*should* come in—through the front door." That may yet happen, but Bob Schenter has pointed out that the process (both nuclear and bureaucratic) could take years, and by then F.F.T.F. might well be shut down. Whatever

the final result, Schenter's sample will give Acord something to experiment with.

Acord isn't sure what he will do with a few milligrams of ruthenium, but since the metal has properties similar to gold he thinks he will try to spread a thin coating directly on granite. His friends at the American Welding Society have volunteered the use of their plasma flame sprayer, and a Hanford engineer has suggested that he try electro-spark deposition or an even more advanced technology called sputtering. Any one of these processes, which are modern equivalents of the medieval technique known as flame gilding, will enable Acord to bond metal to stone a few atoms at a time, and ten milligrams (about the size of a pinhead) can be stretched to cover an area about two feet square.

Two months ago, Acord received a letter from the Assistant Manager for Operations at the D.O.E.'s Richland office confirming the release and laying out the guidelines for taking possession of the ruthenium. No license will be required, since the material will not be released until the radioactivity falls "below the level of regulatory concern." Acord will, however, be required to pay for the cost of processing the paperwork. The price has not yet been determined, but Acord expects to be charged a fee of several thousand dollars.

"It's a good deal, whatever it costs," he told me. "Of course, my truck needs a valve job, and Margaret's car needs a new transmission, and the check for the house payment just bounced. Oh, yeah, and Margaret's bicycle has two flat tires. But we'll figure it out somehow; I'm too close to stop now."

ACORD's ruthenium period had scarcely begun when events took a startling turn. Wanda Munn and Bob Schenter had been busy all spring helping to prepare for the F.F.T.F. Internationalization Symposium, in May, a conference intended to stir up interest (and foreign investment) in the reactor. Organizers were expecting about two hundred participants, representing the major nuclear laboratories in the United States, France, Germany, Japan, the Soviet Union, and other countries. The program included small panels and working groups to deal with various nuclear arcana, and several plenary sessions to be addressed

by such luminaries as Booth Gardner, Governor of Washington, and the state's two United States senators, Slade Gorton and Brock Adams. Acord had been hinting to Munn and Schenter that he would like to attend the symposium. Instead, they put him on the program, as the final speaker at the main banquet on May 29th.

"I went away a real believer," reported Alan Waltar, the manager of Nuclear Applications at F.F.T.F. and the author of "Fast Breeder Reactors," a revered text in the industry in both the West and the Soviet Union. "At the front end, you know, there was a little bit of murmuring and tinkling glasses and that sort of thing. Nobody'd ever heard of this guy, and they weren't all that interested. And then, all of a sudden, about a third of the way into the talk, a hush came down. I looked around and noticed that all the eyes were focussed on



Acord, and, really, you could have heard a pin drop. You know, unfortunately, a lot of people perceive the nuclear industry as a 'cold-prickly' instead of a 'warm-fuzzy,' but Jim basically had people eating out of his hand. I had never heard this kind of story before, and I found it, quite frankly, very refreshing, very imaginative. That was the reaction I heard from other people, too, particularly the French delegation. They kept saying, 'Hey, that was great!' And it was."

As soon as Acord switched off his final pair of slides (showing F.F.T.F. nestled next to Stonehenge), the entire crowd, or so it seemed, came forward and pressed around the podium. "Suddenly, my pockets were filled with other people's business cards," Acord recalls. (Over the next two days, he collected a hundred and sixty cards, and also invitations to speak at Oak Ridge, Los Alamos, and Lawrence-Livermore.) "The Germans, I remember, seemed particularly excited. They were shaking my hand and telling me how much they'd enjoyed it. Of course, I was just overwhelmed and exhausted by this time, so I couldn't really focus on what they were telling me. But they did say, 'How would you like some depleted uranium to make sculpture with?' I said, 'Sure, well, that would be great.' I mean, what else do you say at a time like that? I couldn't

picture if it was a paper bag full of powder, or what. I had no idea what they were talking about."

The leader of the German group was Dr. Werner Koop, Kraftwerksdirektor of the SNR-300, a fast breeder reactor about fifty per cent more powerful than F.F.T.F. The SNR-300 was completed in the late eighties, but a change in government policy prevented its operation. Nevertheless, Dr. Koop was still a figure to be reckoned with. In order to stay abreast of new developments in breeder technology, he was trying to strike a deal with Westinghouse-Hanford: in exchange for operations data and test results, the Germans would sell their surplus fuel to F.F.T.F. As it happens, the German reactor and the American reactor are so similar that fuel assemblies from the SNR-300 will fit the core of F.F.T.F. with only minor modifications. The deal was important to Westinghouse-Hanford because the current supply of fuel at F.F.T.F. could run out by 1995, so everyone wanted to please Dr. Koop. And Dr. Koop wanted to help Acord.

At a dinner the next night, Dr. Koop summoned Acord to join his party; the Beggar had been not only permitted to enter the Rich Man's house but invited to sit at the head table. Dr. Koop still did not explain his offer; he was saving that for a breakfast meeting the following morning, he said. That night, he wanted to get to know Acord better. Throughout the meal, the two discussed German architecture and the wood carvings of Tilman Riemenschneider, much to the bewilderment of the other engineers at the table.

When Acord arrived at breakfast the next morning, he found an impressive cast of characters. Dr. Koop had brought officials from Westinghouse-Hanford, Interatom (a European fuel-processing company), and Advanced Nuclear Fuels (its American equivalent). He had also invited a regulatory specialist, "so there would be no problems." After they had eaten, Dr. Koop signalled to an aide to set a drawing case up on an easel. He showed a series of photographs of the mothballed SNR-300: the exterior, the containment dome, the core, the equipment. Finally, there was a picture of a breeder-

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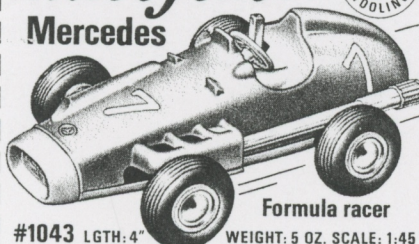


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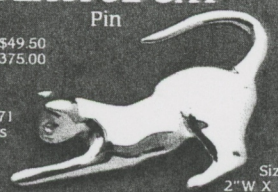
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blanket assembly, designed to convert spent fuel into plutonium in the reactor core. Dr. Koop apologized for having only one photograph, and then explained that this was the depleted uranium he wanted to give Acord.

The photograph showed a hexagonal bundle of stainless-steel tubes five metres long. Inside the stainless steel, Dr. Koop said, were eighty-two kilos of depleted uranium in a fired-ceramic oxide form. The tubing alone was worth thousands of dollars, and the cost of fabricating the uranium brought the total value close to a hundred thousand. "But if you don't have a reactor to put it in," Alan Waltar noted, "all of a sudden it becomes waste again." For Dr. Koop, the breeder assemblies had become a worthless burden. For Acord, they were priceless. "And, the thing looked just like a MOTA."

Dr. Koop wanted to know how many assemblies Mr. Acord thought he would need. Oh, at least three, Acord guessed. "Ah, for composition," Dr. Koop said, pleased at his own insight. Would he be cutting them up?

Acord paused. The regulatory specialist turned green. "Perhaps," Acord said at last. "But they are so beautiful as they are that I might not want to change them." The Americans breathed a sigh of relief, and Dr. Koop's chest puffed with pride.

Dr. Koop said that his company, SBK, a division of Siemens, would assume the cost of shipping the assemblies, and he delegated James Edgar, the Safeguards Specialist at Advanced Nuclear Fuels (another subsidiary of Siemens), to take care of matters on the receiving end. Edgar later told me that he and his colleagues planned to cooperate in every way possible. As was their policy with other fuels that they handled, though, they would never assume ownership of the material. They would simply receive the shipment, clear it through customs, and turn it over to Acord. All that Acord had to do was prove that he was licensed to possess spent fuel.

Acord immediately got in touch with Nancy Kirner, and she agreed to help—unofficially, as usual. It was her considered opinion that Acord's general license would not cover two hundred and fifty kilos of depleted uranium. Together, she and Acord calculated that under normal circumstances the new license would cost under five thou-

sand dollars—a lot less than the state had wanted to charge him for working with Fiesta ware, but still more than he could afford. "But we're working on that," he told me at the beginning of July. On September 20th, he received a letter from the Germans informing him that plans were proceeding apace, and that he could expect delivery sometime in the spring of 1992.

"MONSTRANCE FOR A GREY HORSE" remains unfinished. Acord has completed a model for the helmet, but the titanium casting is still tens of thousands of dollars away. In the spring of 1989, he cored the column of the sculpture to make room for a double-walled cannister of radioactive material; the containers are still in the design stage, however, and the contents are still open to negotiation. That summer, back in Barre, Acord bought the first of two granite slabs to use for the base; two years later, he has just finished carving this block. There is still one more slab to go before the stonework is finally done. Acord maintains that there is nothing he would rather do than cut stone, but right now he finds he has more pressing matters to attend to. In any event, since the sculpture is designed to last thirty thousand years, it hardly matters if he takes another decade or so to complete the work.

Margaret is concerned. She thinks he spends too much time on his interviews and lectures and committee meetings, and too little time on drawing and sculpture; she would rather see him cut names on a gravestone than write letters on his computer. "On the other hand," she said to me this summer, "sometimes I think that the muses have been fooling with him, and maybe words are his medium after all, and not stone and metal." Nevertheless, she is afraid that Jim is being exploited by people in the nuclear industry, as an apologist and showpiece to mask the inherent evil in the technology. She knows that he has turned the situation to his own advantage, to get access to the "magic metal," but she is still not happy about it. One night, after watching a video of "Silkwood," they had a fierce argument. "You're not the guy I married anymore," Margaret told him. "You're losing your soul, and it doesn't make any difference that you're giving it away instead of selling it."

If Acord is putting his soul at risk,

he is doing so, in his view, for the sake of us all. His understanding of nuclear technology has indeed changed, scientifically and philosophically, since he moved to Richland, but his goal remains the same. When he talks about a stupa or a cloister, he is not speaking in metaphors; he truly intends to build a nuclear temple. He has already done it once, however briefly: the "Moving to Richland" show was more like a storefront church than a cathedral, but the rudiments of the new iconography and ritual were in place. Acord's radiation suit and gas mask were his cassock and alb. The Fiesta Home Reactor was an altar of sorts, exposing the residue of a nuclear process much as the glass casket in the Milan Cathedral exposes the holy bones of San Carlo Borromeo. The "Monstrance" and the "Reliquary" were there, and as the fuguelike music throbbed Acord intoned his new liturgy. He had been over the mountain, and he had come back with a message, the same message that continues to guide his work. "We're all in this together," he said. "It's our nuclear age, like it or not. The age of stone lasted several hundred thousand years. The age of bronze lasted five thousand years. The age of iron lasted two thousand years. And we're fifty years into the nuclear age. If we're going to get to any further ages, then we'll have to get through this one. Together. In Renaissance times and in ancient Greek and Roman times, art and science were often in the same head. I think there's a wonderful balance that comes from that. Art answers questions in ways that are as valid as the answers of science. They're like the sun and the moon—they both give off a necessary illumination." —PHILIP SCHUYLER

(This is the second part of a two-part article.)

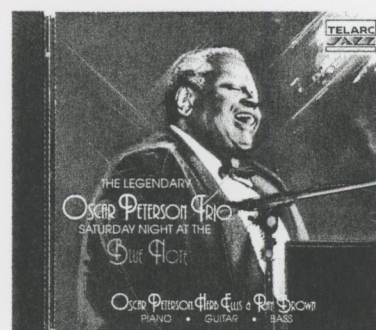
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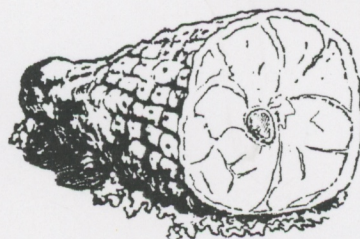
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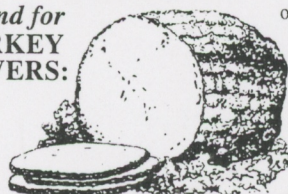
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